West Liberty Foods
Spiral Controller Program Description
J/N 0619   S/N 064S

This manual describes the functions of the RMF Freezers Spiral Freezer Control Panel.

I. SYSTEM OVERVIEW

1. Overview

The components controlled by this system include:

- Spiral Freezer Belt
- Four (4) Evaporators with four (4) Fan Motors.
- Baffle Fan

Additional status is given for spiral operating temperature and alarm conditions. The spiral system controls allow for automatic and manual operation of the evaporator units and belt drives.

2. Universal Parameters for Every Screen

Every screen contains a general alarm and emergency stop indication. The general alarm and emergency stop will appear using the text “SYSTEM ALARM” and “E-STOP”.

When an alarm occurs the F15 can be pressed to silence the alarm horn. The F15 silence key is available on most all screens. When any alarm occurs, it needs to be acknowledged before you can continue. To view the current alarm, press the F8 key to navigate to the alarm display. On most screens, the F7 key will reset the alarm condition once it has cleared. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.** The alarm can now be reset and cleared from the control system by pressing the “Alarm Reset” function key F7. The rest of the “F” keys will change depending on which screen is displayed.

The Main Menu screen can be accessed from any other screen by pressing the F16 key. Certain screens have shortcuts to other screens, but the user can always press F16 to reach the main menu for access to the other screens.

The function of each of the “F” keys is displayed at the bottom of the screen. Its position corresponds to the “F” key below it. To go to a screen or access control functions, press the corresponding “F” key on the Panel View keypad.

3. Example: Alarm Condition

If the spiral cage has an alarm “Evap 2 Fan 4 Fail”, the banner will be displayed on the screen explaining the alarm. Below is an example of a typical alarm banner.

9:48:12 AM 3/17/2007 Evap 2 Fan 4 Fail

Figure 1

Press the Function key “K12” to close the banner. Next, the user can silence the alarm horn using the “Alarm Silence” function key F15. Next, the user is needs to reset the alarm by pressing the “F7” function key. **<u>Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.</u>** If the user accesses the alarm screen by pressing the “Alarm Screen” F8 function key, it will display the current alarm until the condition is cleared. In addition, the alarm history screen will show the history of the last 100 alarms. The alarm can now be reset and cleared from the control system by pressing the “Alarm Reset” function key F7. **<u>Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.</u>**

4. Manual Control Screens

When changing the control state of a component, the user will select the control by its function key, and then select the desired corresponding state mode key (Auto/Off/Hand). The PanelView allows ½ second between selections. The user may need to try the selection several times before understanding the time allowed for entries. In addition, the user cannot press the buttons at the same time. The selection key must be pressed first, and then the mode key. For example, to change the spiral belt to Auto mode, first press F3 (Belt Select) and release, and then press F11 (Auto) and release. The state of the spiral belt mode at the bottom of the button will change to AUTO when completed.

5. Security

The Main screen and Alarm Silence have no security. Anyone can access them at any time. However, the other screens are password protected. The visibility of the screen navigation buttons are control by the Logged on user. To change, the current user will press the Login function key. There are 4 levels of security described below.

- Default – no password – can access Main, Alarm Banner, and Alarm Silence Only.
- Operator1 – password 12 – can access Start Control, Current Alarms, Alarm History, and the Alarm Reset Function.
- Operator2 – password 221 – can access Operator1's screens and the Evaporator Control Screen.
- Operator3 – password 911 – can access all screens. Which include Belt Manual Control, Evaporator Manual Control, Defrost Sequence, Auto Defrost Schedule, Temperature Hold Control, and Calibration Screen

Keep in mind that any of these passwords can be changed from the Calibration screen (see section V.1 Calibration Screen).

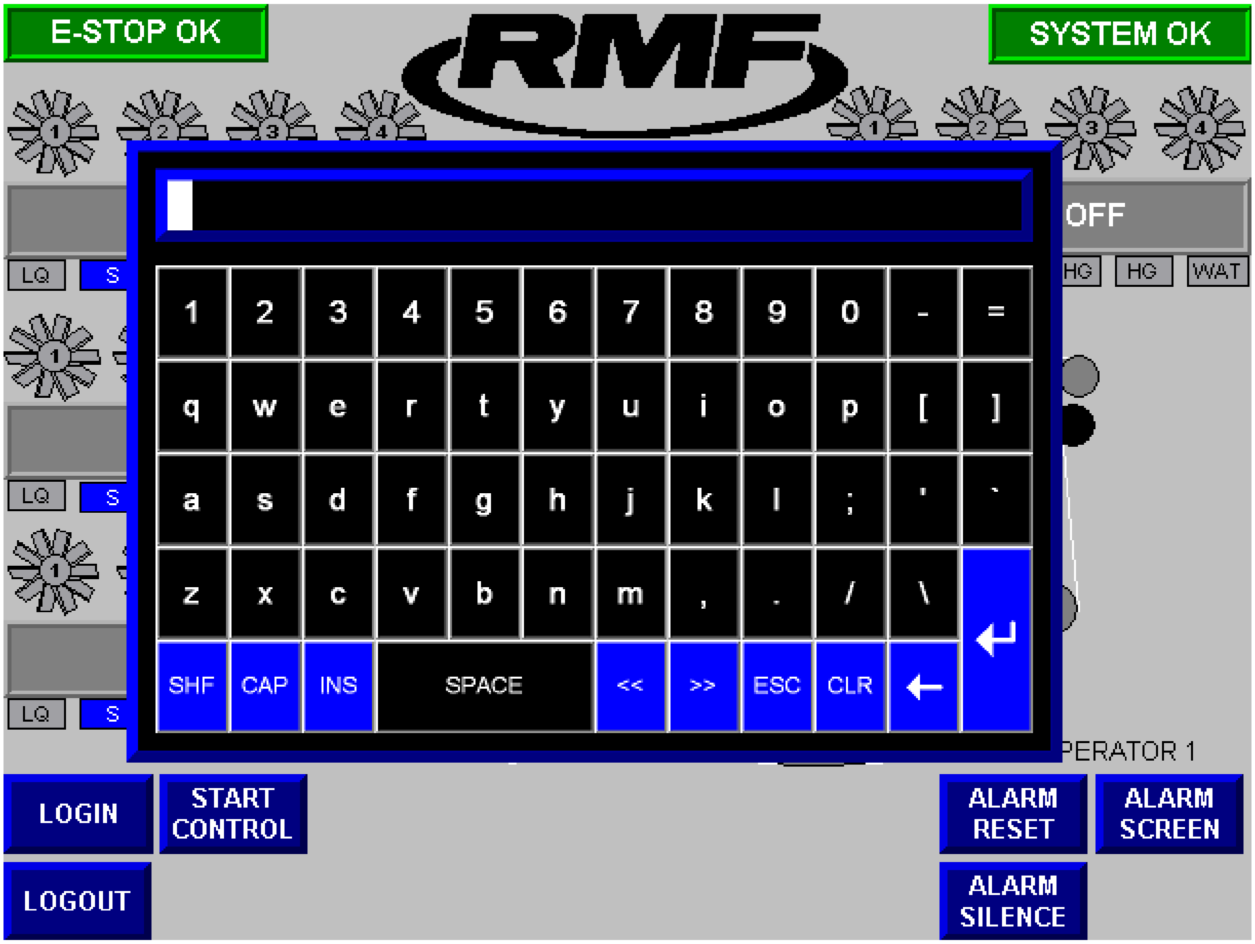


Figure 2

When the login key (**F1**) is selected, a banner will appear on the screen (figure 1). Using the keypad enter the appropriate password, followed by the enter/return key. The banner will close and process the password entered. If the password is correct, the corresponding user will appear on the bottom right side of the screen. If the password is incorrect the current user will be logged off. There is an inactivity timer in the program; if there is no activity for 30 thirty minutes the current user will be logged off and the screen will be switched to the one shown in figure 2.

II. START CONTROL

1. Main Menu Screen (F16 from all other screens)

The main menu provides access to all areas of the system. The function keys on the screen list the control screens and alarm functions that are accessible from the Main Menu. Simply touch the function key for the screen you would like to be displayed. The visibility of the menu buttons are controlled by the user logged on. If one of the Operators is not logged on, then only the Alarm Silence and Login buttons are available. The Main screen provides information for the following:

- E-Stop status
- System status
- Current Spiral temperature
- Evaporator status including:
  - Evaporator operating status:
    - Evap Off
    - Evap On
    - Evap in Defrost
    - Evap Terminate
  - Fan status
  - Valve status
- Spiral drive including:
  - Operating status
  - Drive amperage
- Currently logged in operator
- Current date and time

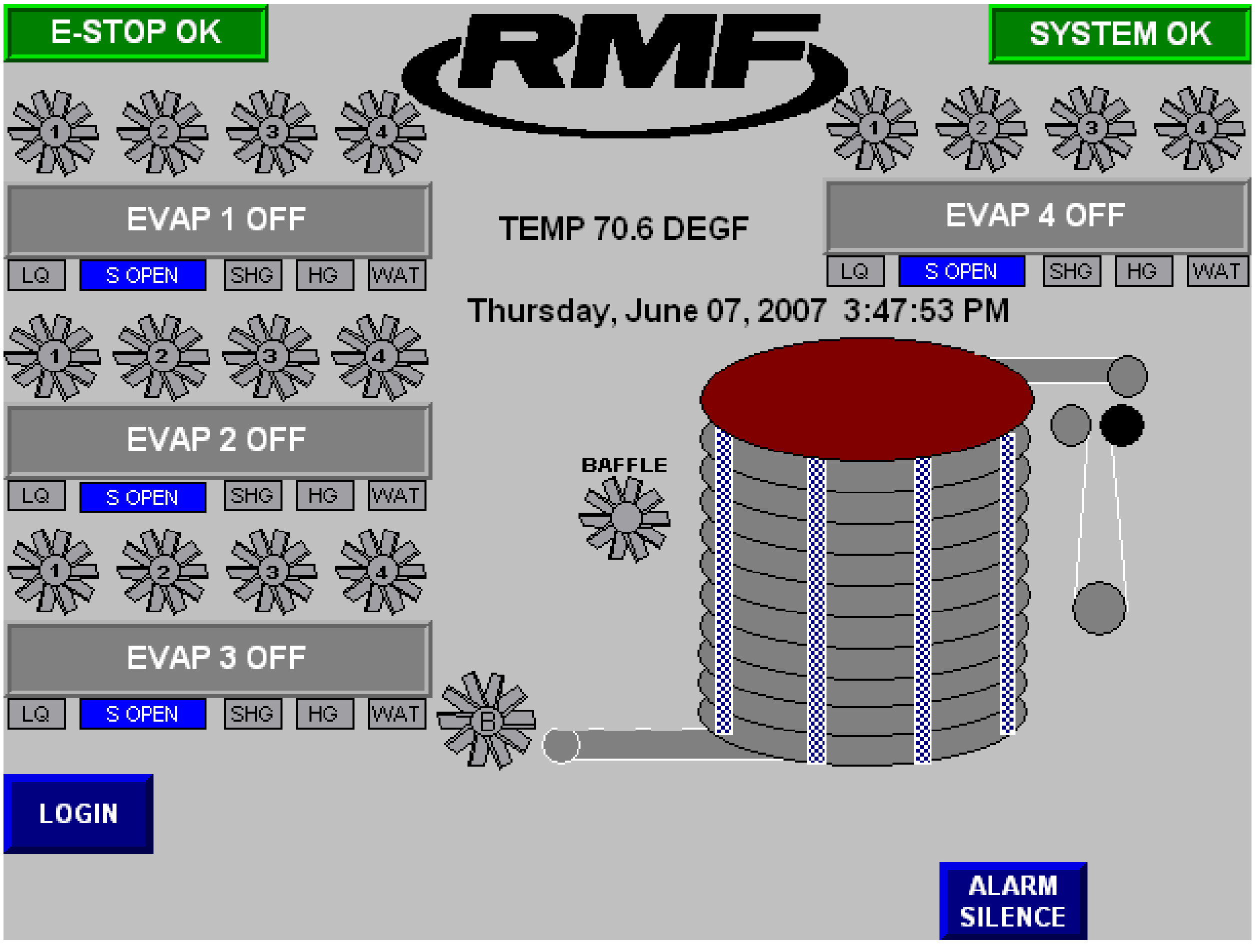


Figure 3

The following function keys are available on the Main Screen:

F1 - Login: The login function key opens the Login Selection Screen on page 5.
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced by pressing the Alarm Silence function key during the current alarm.

After an Operator has logged into the system the "Main Screen" will change to view to all options available to the security level logged in. After the Operator 3 has logged into the system the "Main Screen" will change to view all access screens available:

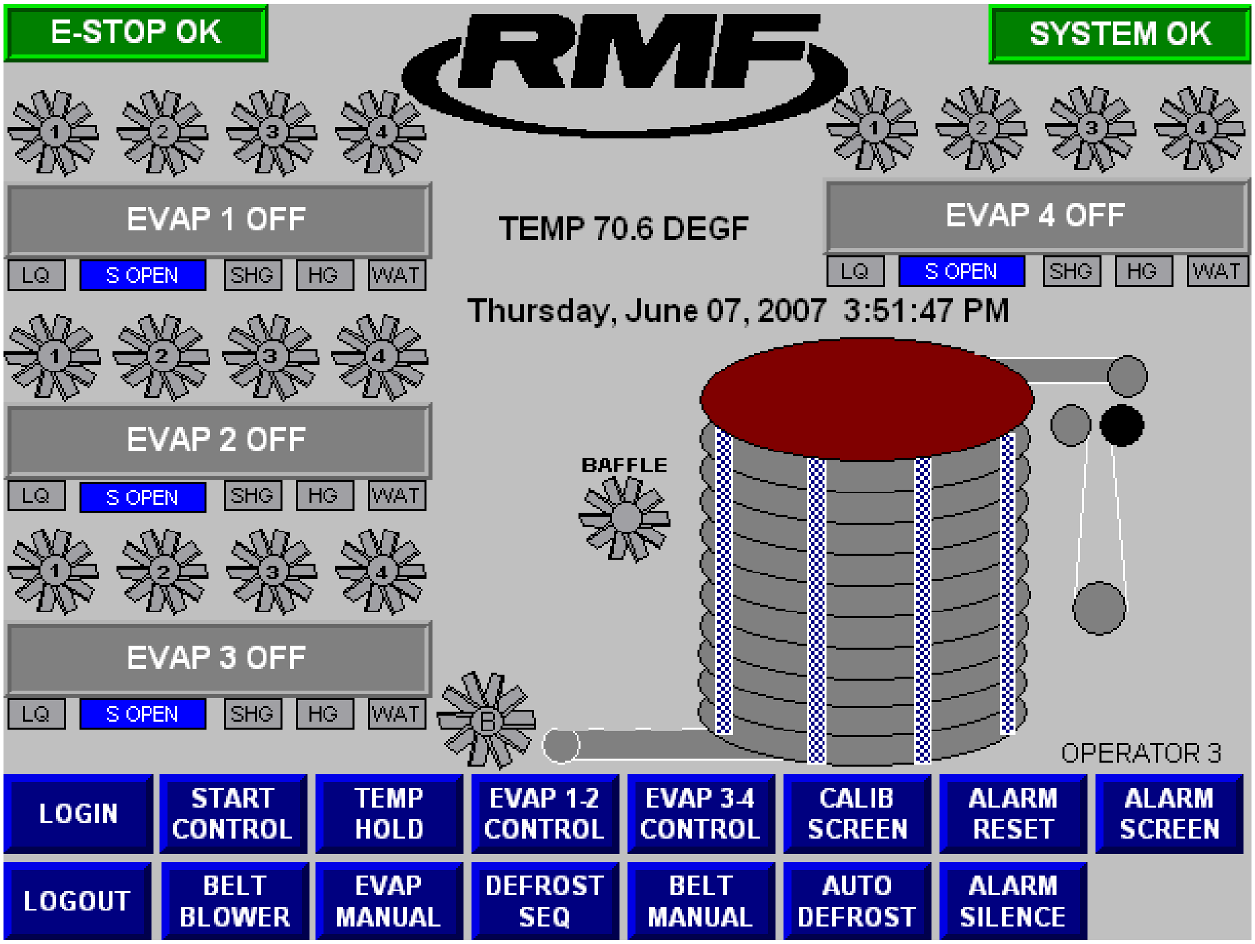


Figure 4

The following function keys are available on the Main screen:

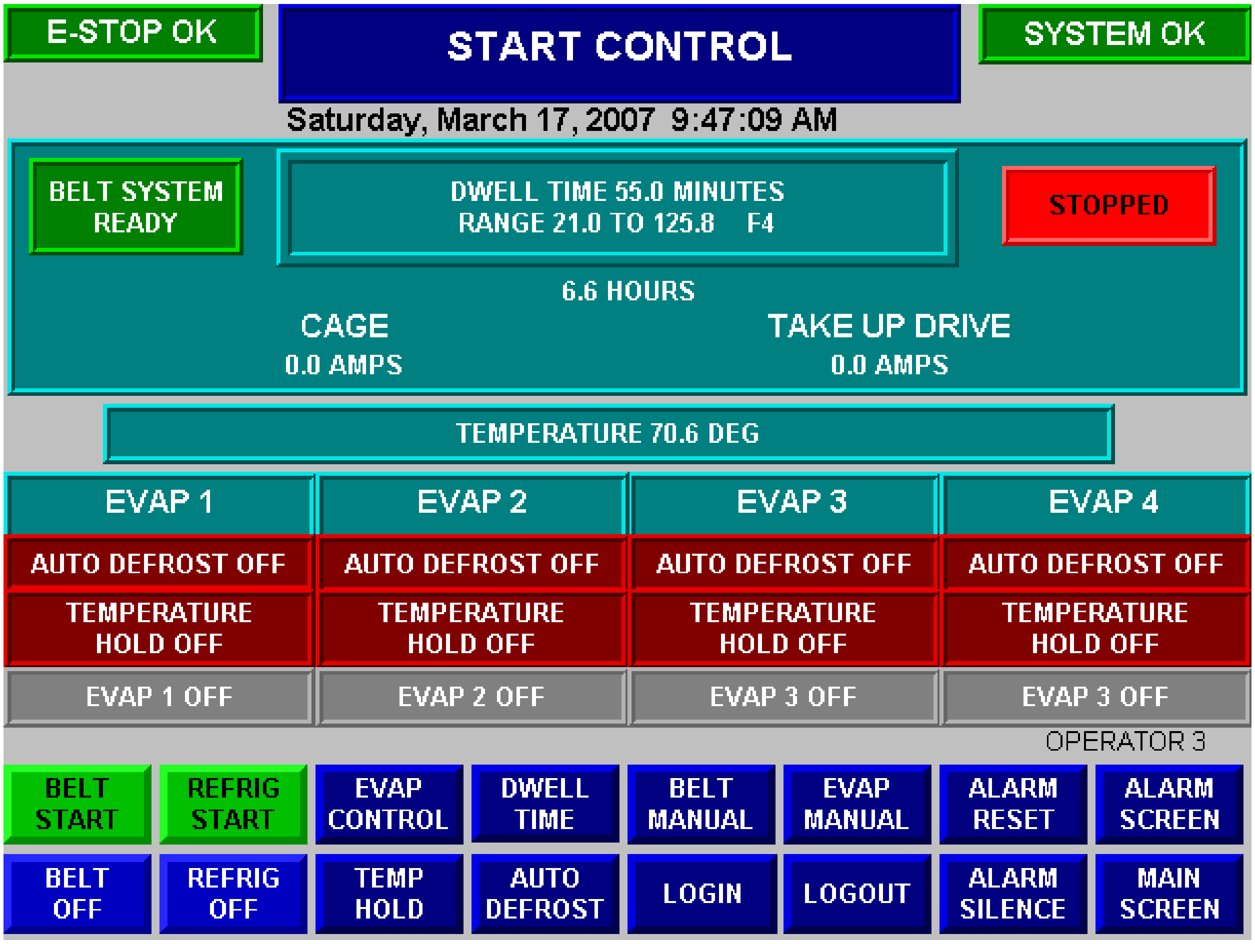
F1 – Login: The login function key opens the Login Selection Screen on page 5.
F2 – Start Control: Selects the Start Control, section II.2 Start Control
F3 – Temp Hold: Selects the Temperature Hold, section IV.5 Temperature Hold
F4 – Evap Control 1-2: Selects the Evaporator Control, section IV.1 Evaporator Control
F5 – Evap Control 3-4: Selects the Evaporator Control, section IV.1 Evaporator Control
F6 – Calib Screen: Selects the Calibration Screen, section V.1 Calibration Screen
F7 -Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**
F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms

F9 - Logout: Logs off the currently logged in user.
F10 – Belt Blower: Selects the Belt Blower Screen, section II.3 Belt Blower Control
F11 - Evap Manual: Selects the Evap Manual, section IV.2 Evaporator Manual Control.
F12 - Defrost Sequence: Selects the Defrost Sequence, section IV.3 Evaporator Defrost Sequence Timing.
F13 - Belt Manual: Selects the Belt Manual Control, section III.1 Belt Manual Control.
F14 - Auto Defrost: Selects the Auto Defrost Schedule screen, section IV.4 Auto Defrost.
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 – [No Function]

2. Start Control

The start control screen contains all the information necessary to run the spiral freezer system. The following conditions and information is displayed:

- Current operating dwell time
- Range of dwell time possible
- Readiness of the main spiral belt drive
- Operating hours
- Main drive AMP reading
- Take-Up drive AMP reading
- The operating state of the evaporators showing the evaporator status related to the auto defrosts, temperature hold, and defrost step.
- Currently logged in operator
- Current date and time
- Temperature



Saturday, March 17, 2007 9:47:09 AM

BELT SYSTEM READY

DWELL TIME 55.0 MINUTES
RANGE 21.0 TO 125.8 F4

STOPPED

6.6 HOURS

CAGE
0.0 AMPS

TAKE UP DRIVE
0.0 AMPS

TEMPERATURE 70.6 DEG

EVAP 1	EVAP 2	EVAP 3	EVAP 4
AUTO DEFROST OFF	AUTO DEFROST OFF	AUTO DEFROST OFF	AUTO DEFROST OFF
TEMPERATURE HOLD OFF	TEMPERATURE HOLD OFF	TEMPERATURE HOLD OFF	TEMPERATURE HOLD OFF
EVAP 1 OFF	EVAP 2 OFF	EVAP 3 OFF	EVAP 3 OFF

OPERATOR 3

Figure 5

The following function keys are available on the Start Control screen:

F1 - Belt Start: Starts the spiral belt drives when in Auto mode. If the spiral is not ready to run, press the “Alarm Screen” button to see what may be keeping the spiral from entering the ready state. If there are no spiral belt alarms, then verify that the spiral belt is in Auto mode.
F2 - Refrig Start: Starts all refrigeration valve controls that are in Auto mode.
F3 – Evap Control: Selects the Evaporator Control, section IV.1 Evaporator Control
F4 - Dwell Time: Enter the desired product dwell time for the spiral system.
F5 - Belt Manual: Selects the Belt Manual Control, section III.1 Belt Manual Control.
F6 - Evap Manual: Selects the Evap Manual, section IV.2 Evaporator Manual Control.
F7 - Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**
F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms
F9 - Belt Off: Stops the spiral belt drives when in Auto mode.

F10 - Refrig Off: Stops all refrigeration valve controls that are in Auto mode.
F11 - Temp Hold: Selects the Temperature Hold, section IV.5 Temperature Hold
F12 - Auto Defrost: Selects the Auto Defrost Schedule screen, section IV.4 Auto Defrost.
F13 – Login: The login function key opens the Login Selection Screen on page 5.
F14 - Logout: Logs off the currently logged in user.
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

3. Belt Blower Control

The belt blower control screen provides access to the routine and determines its duration. The following conditions and information is displayed:

- Cycle status
- Cycle time
- Cycle speed
- Cycle time remaining
- Completion status (leave belt running or stop belt when complete)
- Currently logged in operator

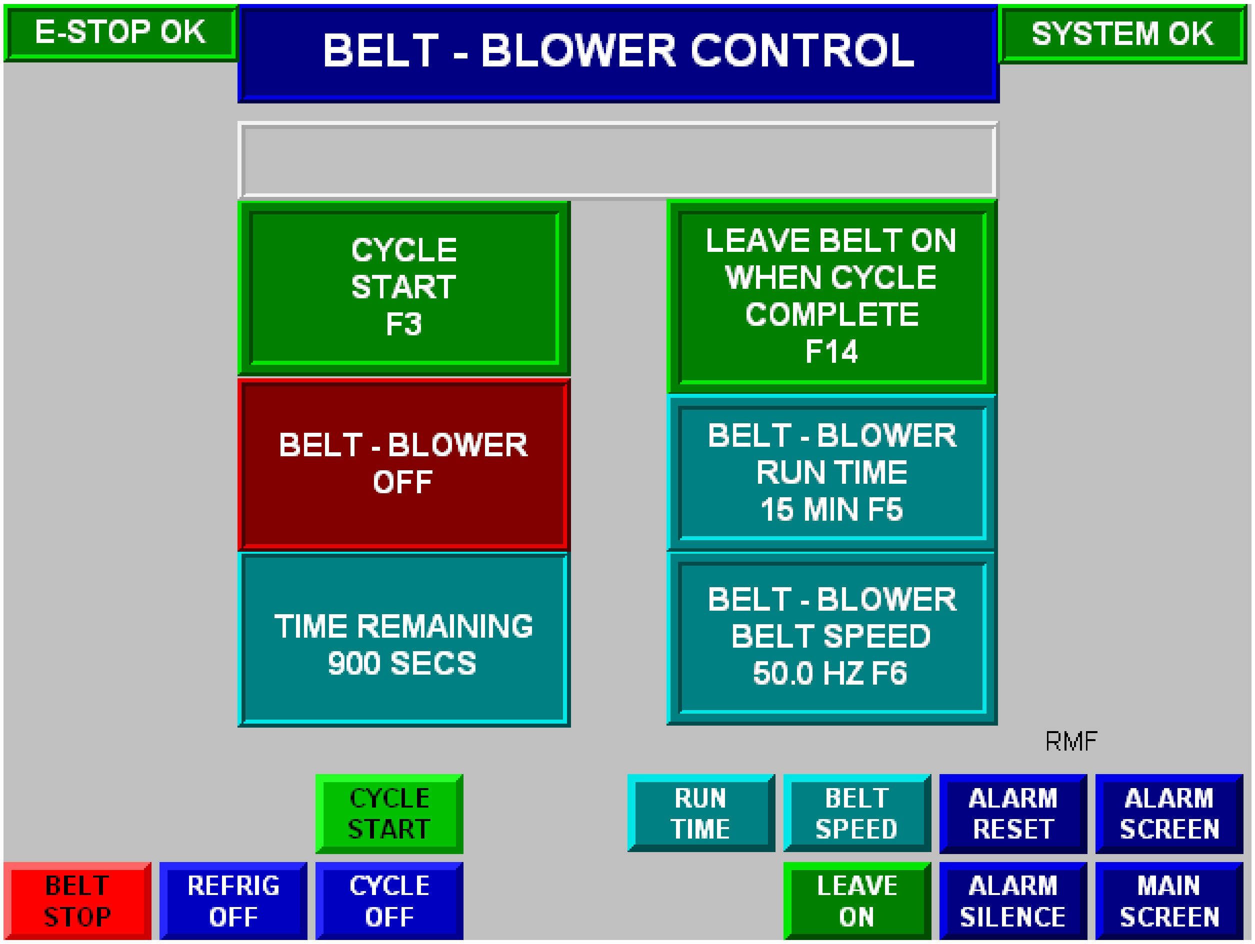


Figure 6

The following function keys are available on the Clean Control screen:

F1 - [No Function]
F2 - [No Function]
F3 – Cycle Start: Starts the Spiral Belt drive in auto mode. If the Spiral is not ready to run, press the "Alarm Screen" button to see what may be keeping the Spiral from entering the ready state. If there are no Spiral Belt alarms, then verify that the Spiral Belt is in Auto Mode. This will switch the belt from the Dwell Time speed to the speed shown in the "Belt Blower Belt Speed" box. The refrigeration will be shutdown as well.
F4 - [No Function]
F5 – Belt Blower Run Time: Sets the duration of the cycle in minutes.
F6 – Belt Speed: This selects the desired belt speed during the wash cycle.
F7 -Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**

F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms
F9 - Belt Off: Stops the spiral belt drives when in auto mode. If the belt is stopped with this button or any of the safeties, then when restarted the “Time Remaining” will not be reset, it will continue where it left off.
F10 – Refrig Off: Stops all refrigeration valve controls that are in auto mode.
F11 – Cycle Off: The stops the clean cycle and resets the time remaining.
F12 - [No Function]
F13 - [No Function]
F14 – Leave On/Shut Off: Select the condition of the belt drive when the clean cycle timer is done.
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

III.BELT MANUAL CONTROL

1. Belt Manual Control

The belt manual control screen provides access to the belt drive and determines its auto/manual mode. The following conditions and information is displayed:

- Operating hours
- Spiral drive AMP reading
- Take-up drive AMP reading
- Command signal to drives in hertz
- Status and control of the main spiral belt drive
- Manual speed setting for main spiral belt drive
- Status and control of the Baffle Fan Motor
- Belt Blower Fan Status
- Currently logged in operator

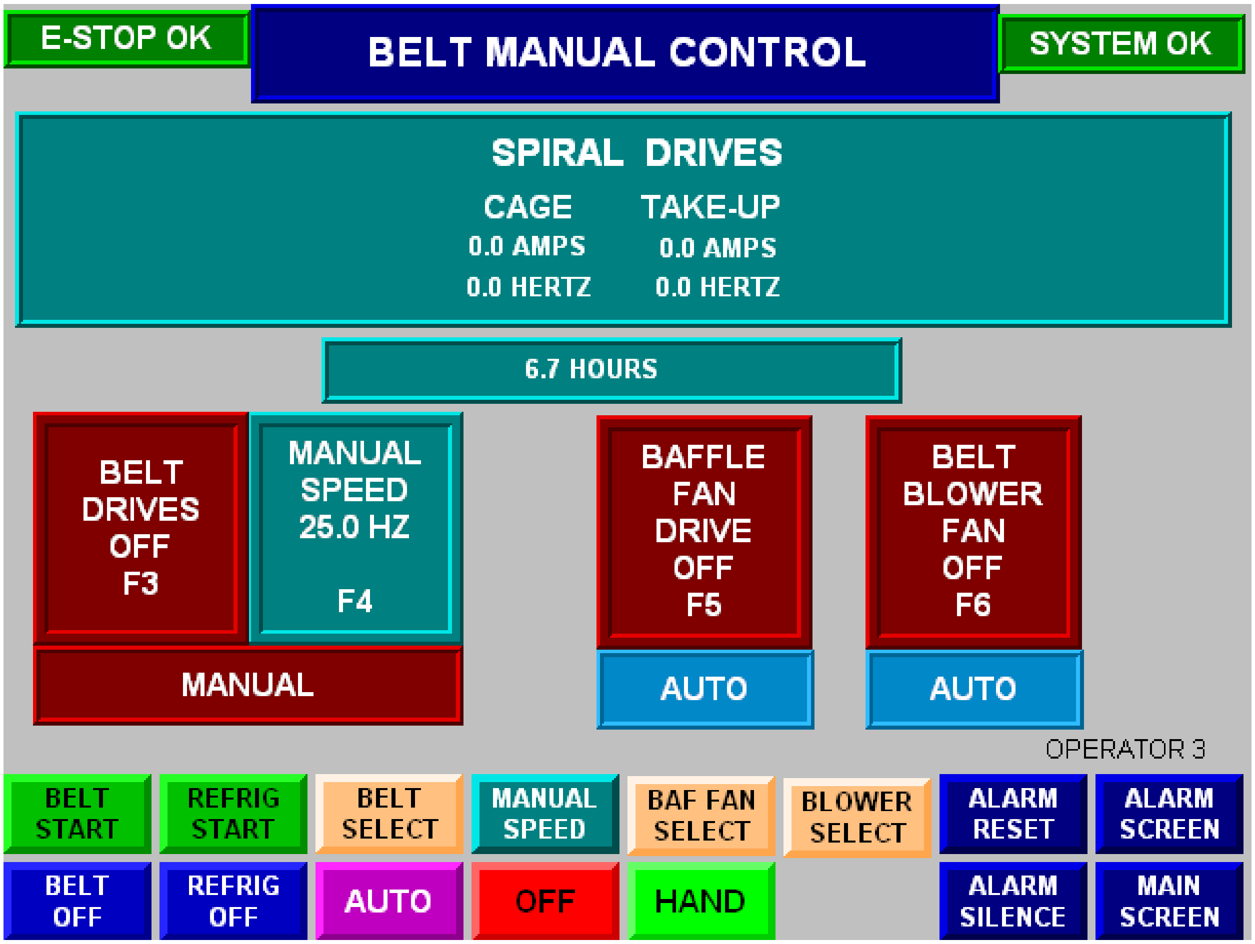


Figure 7

The following function keys are available on the Belt Manual Control screen:

F1 - Belt Start: Starts the spiral belt drives when in Auto mode. If the spiral is not ready to run, press the “Alarm Screen” button to see what may be keeping the spiral from entering the ready state. If there are no spiral belt alarms, then verify that the spiral belt is in Auto mode.
F2 – Refrig Start: Starts all refrigeration valve controls that are in Auto mode.
F3 – Belt Select: This function key selects the spiral main belt drive. After the selection has been made, the user can change the control state of that drive (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F4 - Manual Speed: Sets the manual speed that the spiral main belt drive will run when the drive is placed in Hand (manual on).
F5 – Baffle Fan Select: This function key selects the baffle fan drive. After the selection has been made, the user can change the control state of that drive (Auto/Off/Hand) by next selecting the desired corresponding mode function key.

F6 – Belt Blower Fan Select: This function key selects the Belt Blower fan. After the selection has been made, the user can change the control state of that fan Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F7 -Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**
F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms
F9 - Belt Off: Stops the spiral belt drives when in Auto mode.
F10 – Refrig Off: Stops all refrigeration valve controls that are in Auto mode.
F11 - Auto: Select the Auto button after selecting the “Belt Select” or other select button to change the status of the device to Auto mode.
F12 - Off: Select the Off button after selecting the “Belt Select” or other select button to change the status of the device to Off mode. (Manually Off).
F13 - Hand: Select the Hand button after selecting the “Belt Select” or other select button to change the status of the device to Hand mode. (Manually On)
F14 – [No Function]
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

IV. EVAPORATOR AND DEFROST CONTROL

1. *Evaporator Control*

The Evaporator Control screen gives an overview of the control conditions of the evaporators and the current condition for each individual evaporator. The screen shows conditions for Evaporator 1 & 2, select Evap 3-4 to view these evaporators, the following conditions are shown:

- Refrigeration controls, on or off
- Evaporator Defrost Cycle, on or off
- Evaporator Defrost Cycle termination status.(if coming out of a defrost cycle)
- Temperature Hold Control, on or off
- Auto Defrost Control, on or off
- Time and date of the last defrost
- Currently logged in operator
- Current date and time
- Temperature controls, on

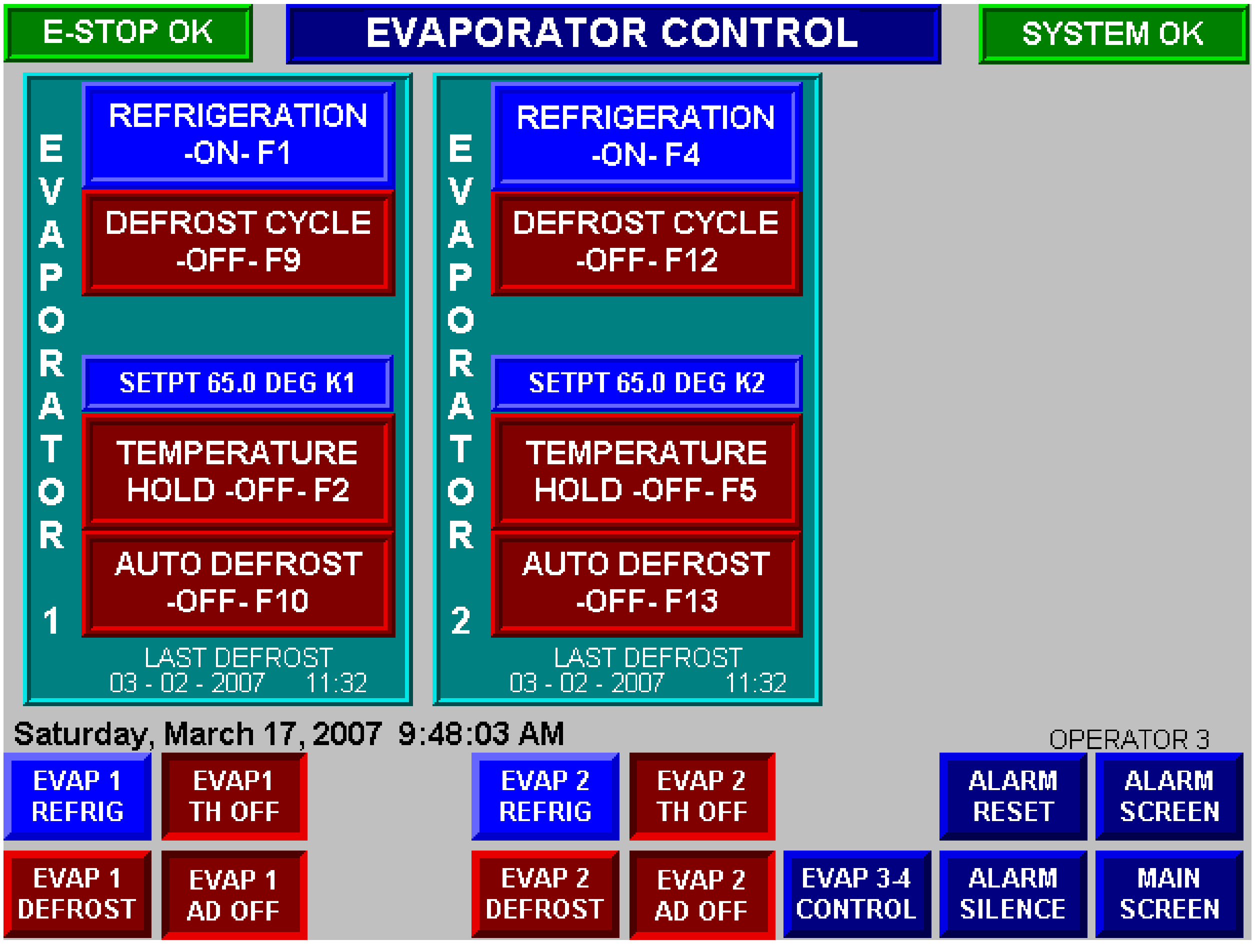


Figure 8

The following function keys are available on the Evaporator Control screen:

F1 – Evap 1 Refrig: Toggle Evaporator 1 Refrigeration On/Off. All refrigeration valve controls in auto will be affected.
F2 – Evap 1 Hold: Toggle the Evaporator 1 hold control On/Off.
F3 – [No Function]
F4 – Evap 2 Refrig: Toggle Evaporator 2 Refrigeration On/Off. All refrigeration valve controls in auto will be affected.
F5 – Evap 2 Hold: Toggle the Evaporator 2 hold control On/Off.
F6 – [No Function].
F7 –Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**
F8 – Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms
F9 – Evap 1 Defrost: Toggle evaporator 1 Defrost Cycle On/Off.
F10 – Evap 1 AutoDefrost: Sets the Evaporator 1 auto defrost enable On, when enabled the evaporator will defrost as scheduled. (Section IV.4)

F11 – [No Function]
F12 – Evap 1 Defrost: Toggle evaporator 2 Defrost Cycle On/Off.
F13 – Evap 1 AutoDefrost: Sets the Evaporator 2 auto defrost enable On, when enabled the evaporator will defrost as scheduled. (Section IV.4)
F14 – Evap Control 3-4: Selects the Evaporator Control, section IV.1 Evaporator Control for evaporator 3 & 4.
F15 – Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen
K1 – Evap 1 Setpoint: The Liquid Setpoint is the internal enclosure air temperature at which the refrigeration liquid valve will open. The Liquid Setpoint should be set to the desired maximum temperature for the spiral system during production. **NOTE**: The air temperature will swing below the Liquid Setpoint. The Liquid Temperature Control is not a finite temperature control. Optional "finite" temperature control is available, but will require additional control panel modifications and the correct modulating refrigeration control valves supplied by the refrigeration contractor or by others.
K2 – Evap 2 Setpoint: The Liquid Setpoint is the internal enclosure air temperature at which the refrigeration liquid valve will open. The Liquid Setpoint should be set to the desired maximum temperature for the spiral system during production. **NOTE**: The air temperature will swing below the Liquid Setpoint. The Liquid Temperature Control is not a finite temperature control. Optional "finite" temperature control is available, but will require additional control panel modifications and the correct modulating refrigeration control valves supplied by the refrigeration contractor or by others.

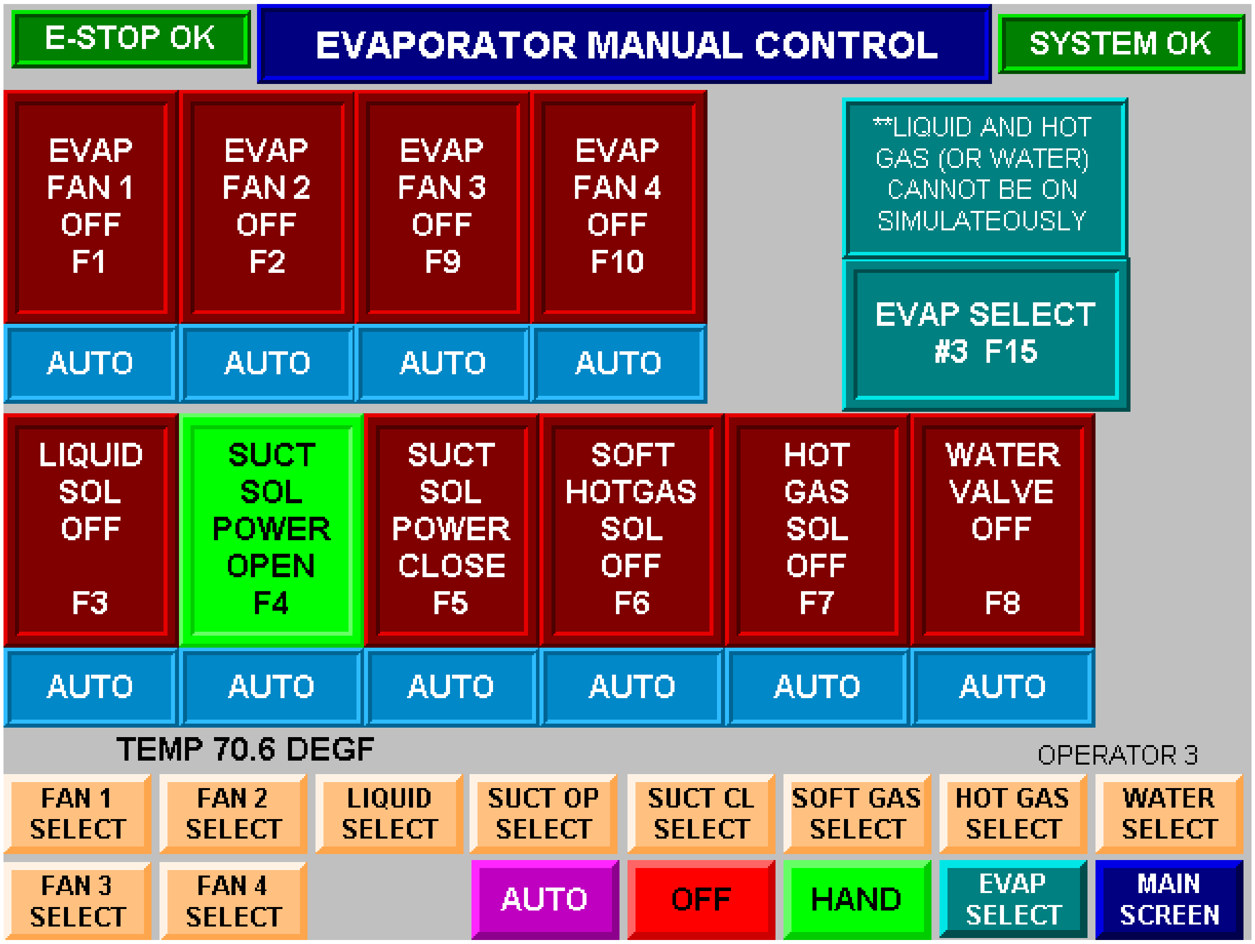
NOTE THE ABOVE FUNCTION KEYS WILL BE THE SAME FOR EVAPORATOR 3 & 4.

2. Evaporator Manual Control

The Evaporator Manual Control screen allows the user to set the auto/manual mode of the refrigeration valves and evaporator fans. The groups of fans and valves controlled are listed below:

- Evaporator Fans
- Liquid Solenoid
- Suction Solenoid Power Open
- Suction Solenoid Power Close
- Soft Hot Gas Solenoid
- Hot Gas Solenoid
- Water Valve

To change the state of a fan or valve, first select the fan or valve, and then select the desired state of the fan or valve (Auto/Off/Hand) by selecting the corresponding function key. Only the fans or valves with their modes in Auto will start when the "Refrigeration Start" function key is pressed or when a defrost sequence is initiated.



**LIQUID AND HOT GAS (OR WATER) CANNOT BE ON SIMULATEOUSLY

TEMP 70.6 DEGF

Figure 9

The following function keys are available on the Evaporator Manual Control screen:

F1 – Fan 1 Select: Selects Fan 1 of the currently selected coil. After the selection has been made the user can change state of the fan (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F2 – Fan 2 Select: Selects Fan 2 of the currently selected coil. After the selection has been made the user can change state of the fan (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F3 - Liquid Select: Selects the Liquid Solenoid of the currently selected coil. After the selection has been made the user can change state of the valve (Auto/Off/Hand) by next selecting the desired corresponding mode function key. The Liquid Solenoid controls the refrigerant liquid feed to the coil. **LIQUID AND HOT GAS OR WATER CANNOT BE ON SIMULATEOUSLY**
F4 - Suction OP Select (open): Selects the suction solenoid of the currently selected coil. After the selection has been made the user can change state of the valve (Auto/Off/Hand) by next selecting the desired corresponding mode function key.

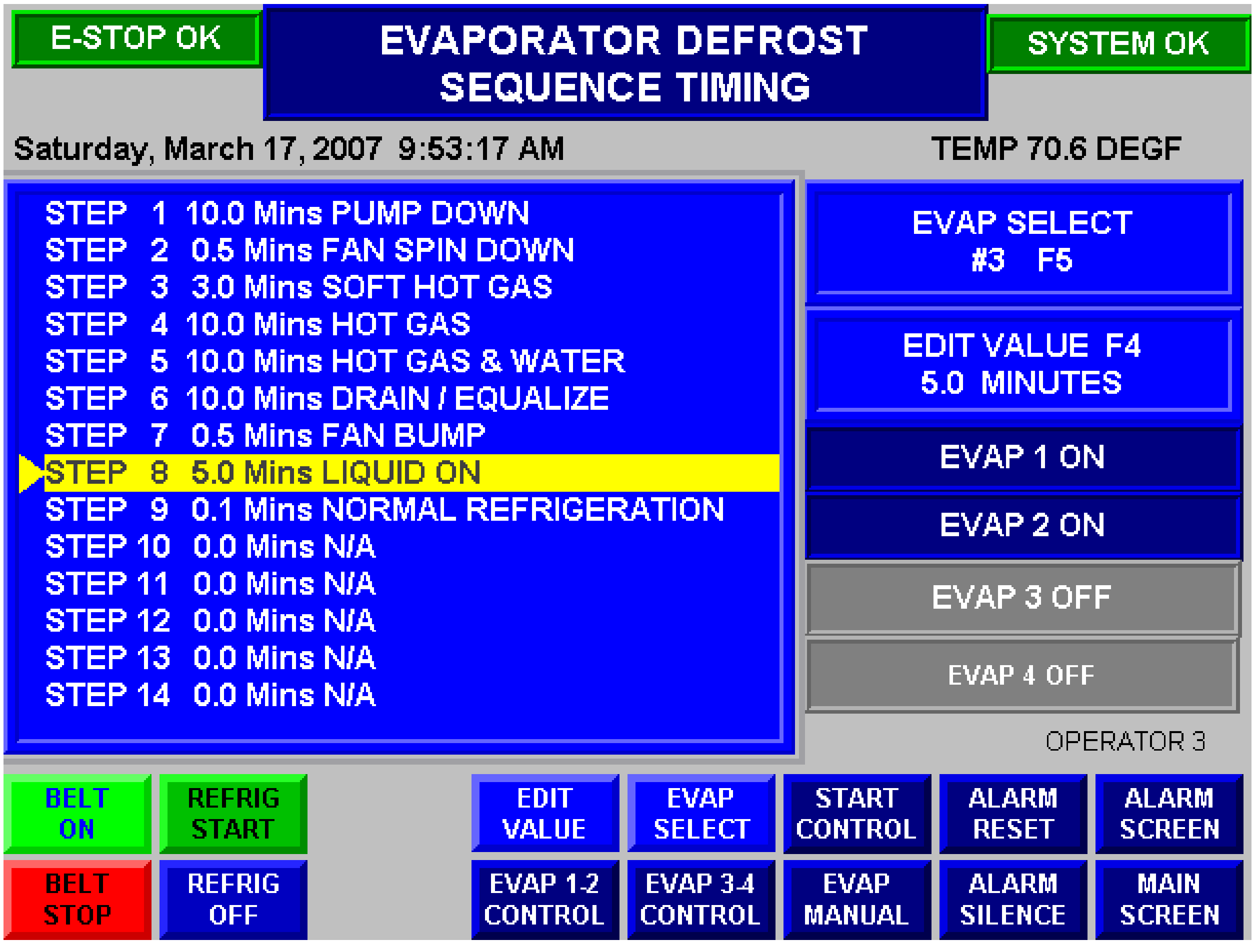
F5 - Suction CL Select (close): Selects the suction solenoid of the currently selected coil. After the selection has been made the user can change state of the valve (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
****Suction Bleed:** When both Suction Close and Suction Open solenoids are off together, this forces a condition in the valve to be in the Bleed/Equalize position.
F6 – Soft Hot Gas Select: Selects the Soft Hot Gas Solenoid of the currently selected coil. After the selection has been made the user can change state of the valve (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F7 – Hot Gas Select: Selects the Hot Gas Solenoid of the currently selected coil. After the selection has been made the user can change state of the valve (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F8 – Water Select: Selects the Water Valve of the currently selected coil. After the selection has been made the user can change state of the valve (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F9 – Fan 3 Select: Selects Fan 3 of the currently selected coil. After the selection has been made the user can change state of the fan (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F10 – Fan 4 Select: Selects Fan 4 of the currently selected coil. After the selection has been made the user can change state of the fan (Auto/Off/Hand) by next selecting the desired corresponding mode function key.
F11 – [No Function]
F12 - Auto: Select the Auto button after selecting the “Evap Fan” or other select button to change the status of the device to Auto mode.
F13 - Off: Select the Off button after selecting the “Evap Fan” or other select button to change the status of the device to Off mode (Manually Off).
F14 - Hand: Select the Hand button after selecting the “Evap Fan” or other select button to change the status of the device to Hand mode (Manually On).
F15 –Evap Select: Selects the Evaporator coil that you want to make changes to by entering the number of the evaporator and pressing enter.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

3. Evaporator Defrost Sequence Timing

The Evaporator Defrost Sequence Timing screen allows the user to control the time each individual defrost step runs. The currently selected coil is displayed on the right hand side of the display in the Evap Select control. The defrost steps are on the left hand side of the display. The user is not allowed to change the order of the steps, only the duration times. The time entered by the user is in “seconds”, the time displayed on the screen is in “minutes”. Selection is done by using the arrows keys on the bottom right of the PanelView keypad. When a coil goes into defrost, the following steps will be followed:

- Step 1: Pumpdown – Time period the refrigerant feed to the coil is turn off.
- Step 2: Fan Spin Down – Time period to allow fans to stop.
- Step 3: Soft Hot Gas On – Time period the soft hot gas feed is on.

- Step 4: Hot Gas On – Time period the hot gas feed is on.
- Step 5: Hot Gas and Water On – Time period the hot gas and water is turned on together.
- Step 6: Drain/Bleed – Allows water to clear before refrigeration is turned on and relieved the hot gas pressure from the coil.
- Step 7: Fan bump – Time period the fans will run to remove water droplets.
- Step 8: Liquid ON – Time period the liquid feed to the coil is turned on without the fans on.
- Step 9: Normal Refrigeration – Time period is set at 1 sec. to return the coil refrigeration back to normal operation.



EVAPORATOR DEFROST SEQUENCE TIMING

Saturday, March 17, 2007 9:53:17 AM
TEMP 70.6 DEGF

STEP 1 10.0 Mins PUMP DOWN
STEP 2 0.5 Mins FAN SPIN DOWN
STEP 3 3.0 Mins SOFT HOT GAS
STEP 4 10.0 Mins HOT GAS
STEP 5 10.0 Mins HOT GAS & WATER
STEP 6 10.0 Mins DRAIN / EQUALIZE
STEP 7 0.5 Mins FAN BUMP
STEP 8 5.0 Mins LIQUID ON
STEP 9 0.1 Mins NORMAL REFRIGERATION
STEP 10 0.0 Mins N/A
STEP 11 0.0 Mins N/A
STEP 12 0.0 Mins N/A
STEP 13 0.0 Mins N/A
STEP 14 0.0 Mins N/A

Figure 10

The following function keys are available on the Evaporator Defrost Sequence Timing screen:

F1 - Belt Start: Starts the spiral belt drives when in Auto mode. If the spiral is not ready to run, press the “Alarm Screen” button to see what may be keeping the spiral from entering the ready state. If there are no spiral belt alarms, then verify that the spiral belt is in Auto mode.

F2 - Refrig Start: Starts all refrigeration valve controls that are in Auto mode.

F3 – [No Function]

F4 - Edit Value: Allows the users to set the time period of the defrost step selected. The user will need to do the following to edit a defrost step value

- Highlight the defrost step to edit by using the arrow keys on the lower right hand side of the display.
- Press the enter key (the wide key above the arrow keys on the right hand side).
- Select the Edit Value function key. The user will be prompted to enter a new timer value for that defrost step. The time entered is in “seconds”, the time displayed on the screen is in “minutes”.
- Press the enter key and the new timer value will be accepted.

F5 – Evap Select: Selects the Evaporator coil that you want to make changes to by entering the number of the evaporator and pressing enter.

F6 – Start Control: Selects the Start Control screen, section II.2 Start Control

F7 - Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**

F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms

F9 – Belt Off: Stops the spiral belt drives when in Auto mode.

F10 – Refrig Off: Stops all refrigeration valve controls that are in Auto mode.

F11 – [No Function]

F12 – Evap Control 1-2: Selects the Evaporator Control, section IV.1 Evaporator Control.

F13 – Evap Control 3-4: Selects the Evaporator Control, section IV.1 Evaporator Control.

F14 - Evap Manual: Selects the Evap Manual, section IV 2 Evaporator Manual Control.

F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.

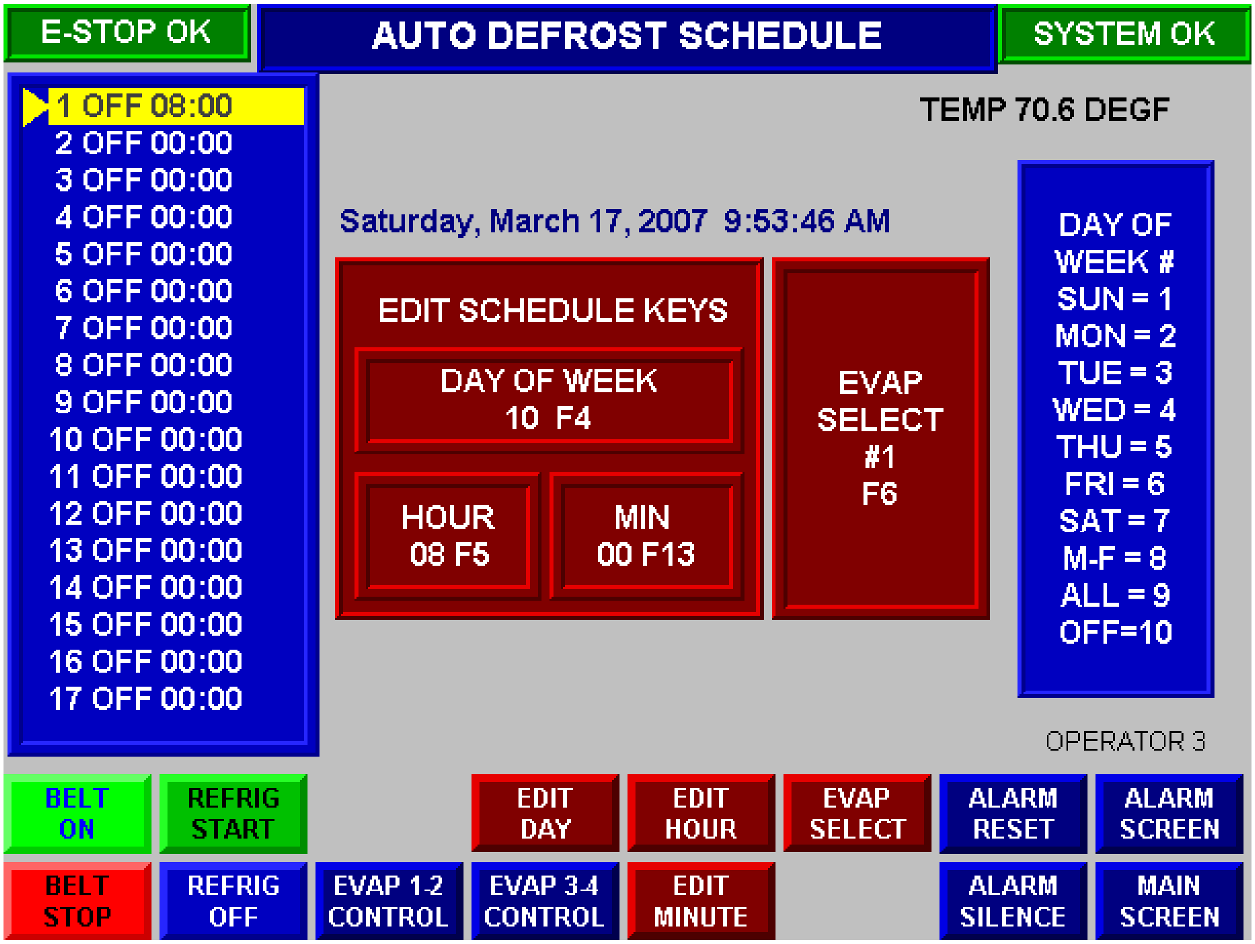
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

4. Auto Defrost Schedule

The Auto Defrost Schedule screen allows the user to control the date and time that the refrigerated coils are automatically defrosted. Note the Auto Defrost Schedule will defrost per the schedule with or without the coil refrigeration on. The following controls and status indicators are available:

- Scheduled defrosting of the currently selected coil is displayed on the left hand side of the screen designated by position numbers. The defrost schedule is listed with position number, day of the week, and time. There are 30 available positions. For all of the positions that are not used, enter a “10” for the day of the week. This will cause the position to do nothing when the position time matches the current time. Keep in mind that Auto Defrost must be "ON" at the Evaporator Control Screen. Use the arrows on the bottom right of the keypad to change the highlighted position when editing positions.

- Evap control screen access
- Current Spiral temperature
- Current Date and Time
- Currently logged in operator



E-STOP OK
AUTO DEFROST SCHEDULE
SYSTEM OK

1 OFF 08:00
2 OFF 00:00
3 OFF 00:00
4 OFF 00:00
5 OFF 00:00
6 OFF 00:00
7 OFF 00:00
8 OFF 00:00
9 OFF 00:00
10 OFF 00:00
11 OFF 00:00
12 OFF 00:00
13 OFF 00:00
14 OFF 00:00
15 OFF 00:00
16 OFF 00:00
17 OFF 00:00

TEMP 70.6 DEGF

Saturday, March 17, 2007 9:53:46 AM

EDIT SCHEDULE KEYS
DAY OF WEEK 10 F4
HOUR 08 F5
MIN 00 F13
EVAP SELECT #1 F6

DAY OF WEEK #
SUN = 1
MON = 2
TUE = 3
WED = 4
THU = 5
FRI = 6
SAT = 7
M-F = 8
ALL = 9
OFF=10

OPERATOR 3

Figure 11

The following function keys are available on the Auto Defrost Schedule screen:

F1 - Belt Start: Starts the spiral belt drives when in Auto mode. If the spiral is not ready to run, press the "Alarm Screen" button to see what may be keeping the spiral from entering the ready state. If there are no spiral belt alarms, then verify that the spiral belt is in Auto mode.
F2 - Refrig Start: Starts all refrigeration valve controls that are in Auto mode.
F3 - [No Function]

F4 - Edit Day: For the current position, enter the day of the week that the selected coil will start a defrost cycle. The available selections are:

- OFF [10]
- Individual days Sunday through Saturday [1 through 7]
- All week days Monday through Friday [8]
- All days [9]

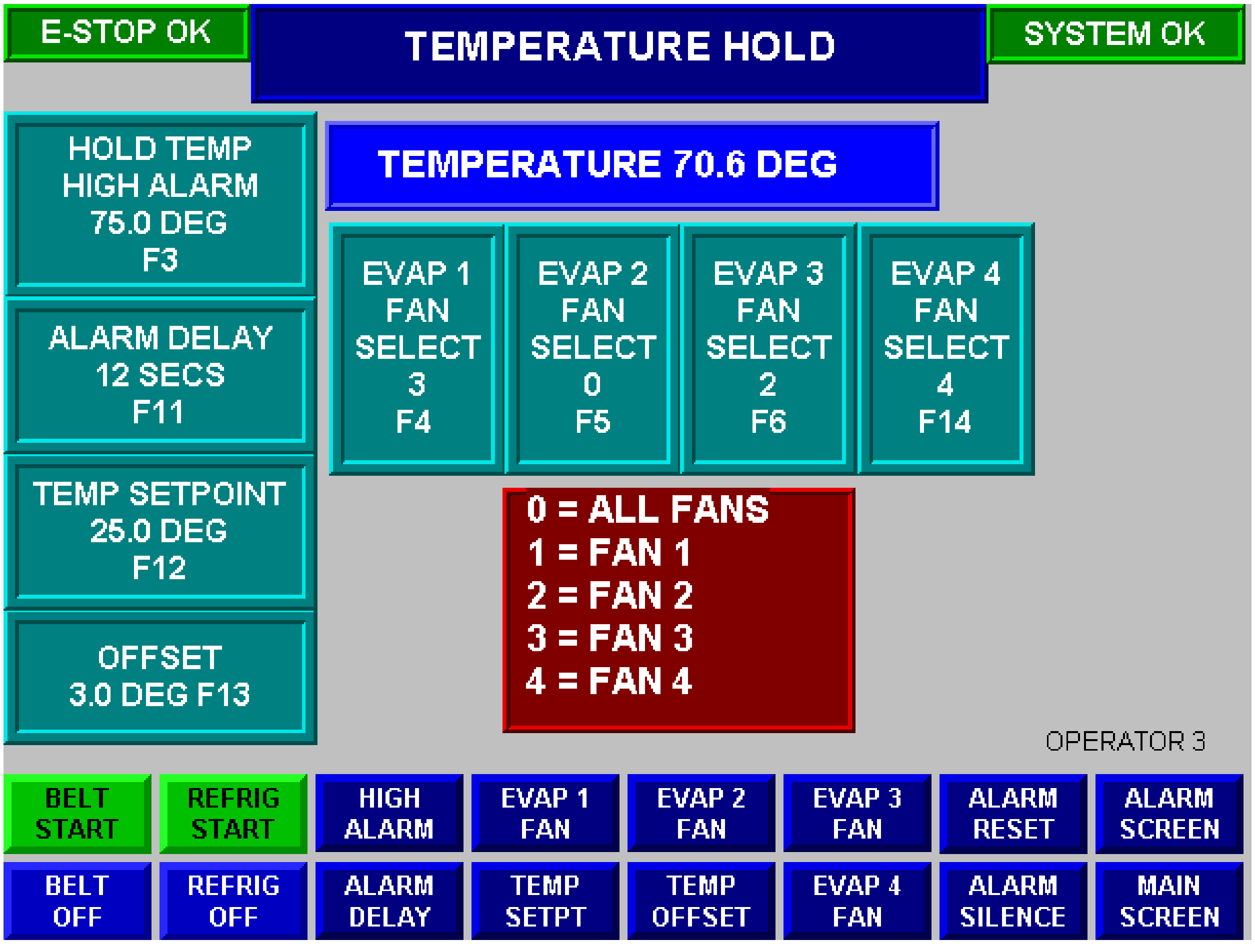
.

F5 – Edit Hour: For the current position, enter the hour that selected coil will start a defrost cycle.
F6 - Evap Select: Selects the Evaporator coil that you want to make changes to by entering the number of the evaporator and pressing enter.
F7 - Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**
F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms
F9 – Belt Off: Stops the spiral belt drives when in Auto mode.
F10 - Refrig Off: Stops all refrigeration valve controls that are in Auto mode.
F11 – Evap Control 1-2: Selects the Evaporator Control, section IV.1 Evaporator Control
F12 – Evap Control 3-4: Selects the Evaporator Control, section IV.1 Evaporator Control
F13 – Edit Minute: For the current position, enter the minute that selected coil will start a defrost cycle.
F14 – [No Function]
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

5. Temperature Hold

The Temperature Hold screen allows the user to maintain the air temperature at or below the set temperature inside the spiral system enclosure for an extended period of time without product production. The following controls and status indicators are available:

- The current Spiral system enclosure temperature
- Hold Temp High Alarm set point. This alarm is exclusive to the Temperature Hold mode.
- Alarm Delay set point
- Evaporator fan selectors
- Temperature set point that refrigerant liquid will turn on (degrees)
- Offset temperature (degree) for the refrigerant liquid feed on and off
- Currently logged in operator



E-STOP OK

TEMPERATURE HOLD

SYSTEM OK

TEMPERATURE 70.6 DEG

HOLD TEMP HIGH ALARM 75.0 DEG F3

ALARM DELAY 12 SECS F11

TEMP SETPOINT 25.0 DEG F12

OFFSET 3.0 DEG F13

EVAP 1 FAN SELECT 3 F4

EVAP 2 FAN SELECT 0 F5

EVAP 3 FAN SELECT 2 F6

EVAP 4 FAN SELECT 4 F14

0 = ALL FANS
1 = FAN 1
2 = FAN 2
3 = FAN 3
4 = FAN 4

OPERATOR 3

Figure 12

The following function keys are available on the Temperature Hold Control screen:

F1 - Belt Start: Starts the spiral belt drives when in Auto mode. If the spiral is not ready to run, press the “Alarm Screen” button to see what may be keeping the spiral from entering the ready state. If there are no spiral belt alarms, then verify that the spiral belt is in Auto mode.
F2 - Refrig Start: Starts all refrigeration valve controls that are in Auto mode.
F3 - High Alarm: The High Alarm is the temperature at which the controls will alarm of high temperature inside the spiral system enclosure when it is above the Hold Temp High Alarm set point. This alarm is exclusive to the Temperature Hold mode. See section V.1, for the general operation High Temp alarm.
F4 – Evap 1 Fan: Selects the number of fans used to maintain temperature when using Evaporator 1. The available options are:

- 0 = All fans.
- 1 = Fan 1 only.
- 2 = Fan 2 only.
- 3 = Fan 3 only.
- 4 = Fan 4 only.

F5 – Evap 2 Fan: Selects the number of fans used to maintain temperature when using Evaporator 1. The available options are:

- 0 = All fans.
- 1 = Fan 1 only.
- 2 = Fan 2 only.
- 3 = Fan 3 only.
- 4 = Fan 4 only.

F6 – Evap 3 Fan: Selects the number of fans used to maintain temperature when using Evaporator 1. The available options are:

- 0 = All fans.
- 1 = Fan 1 only.
- 2 = Fan 2 only.
- 3 = Fan 3 only.
- 4 = Fan 4 only.

F7 - Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**

F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms

F9 - Belt Off: Stops the spiral belt drives when in Auto mode.

F10 - Refrig Off: Stops all refrigeration valve controls that are in Auto mode.

F11 - Alarm Delay: The Alarm Delay is a time delay, after the Hold Temp High Alarm temperature is met, before the alarm will sound. The time delay gives enough time to insure that the temperature inside the spiral system enclosure is above the high temperature alarm setting. It is recommended to set the delay time between 2 and 5 minutes.

F12 – Temp Setpoint: The Temperature setting is the internal enclosure air temperature at which the refrigeration liquid valve to the coil(s) will turn on. The Temperature Set point should be set at the desired maximum temperature of the product. **NOTE**: The air temperature will swing below the Hold Temperature Setpoint. The Hold Temperature Control is not a finite temperature control. Optional "finite" temperature control is available, but will require additional control panel modifications and the correct modulating refrigeration control valves supplied by the refrigeration contractor or by others.

F13 - Offset: The value deducted from the set point to create a Dead Band. The offset should be set a minimum of 5 degrees or more below the desired hold temperature of the product or spiral system to avoid short cycling the refrigeration system.

F14 – Evap 4 Fan: Selects the number of fans used to maintain temperature when using Evaporator 1. The available options are:

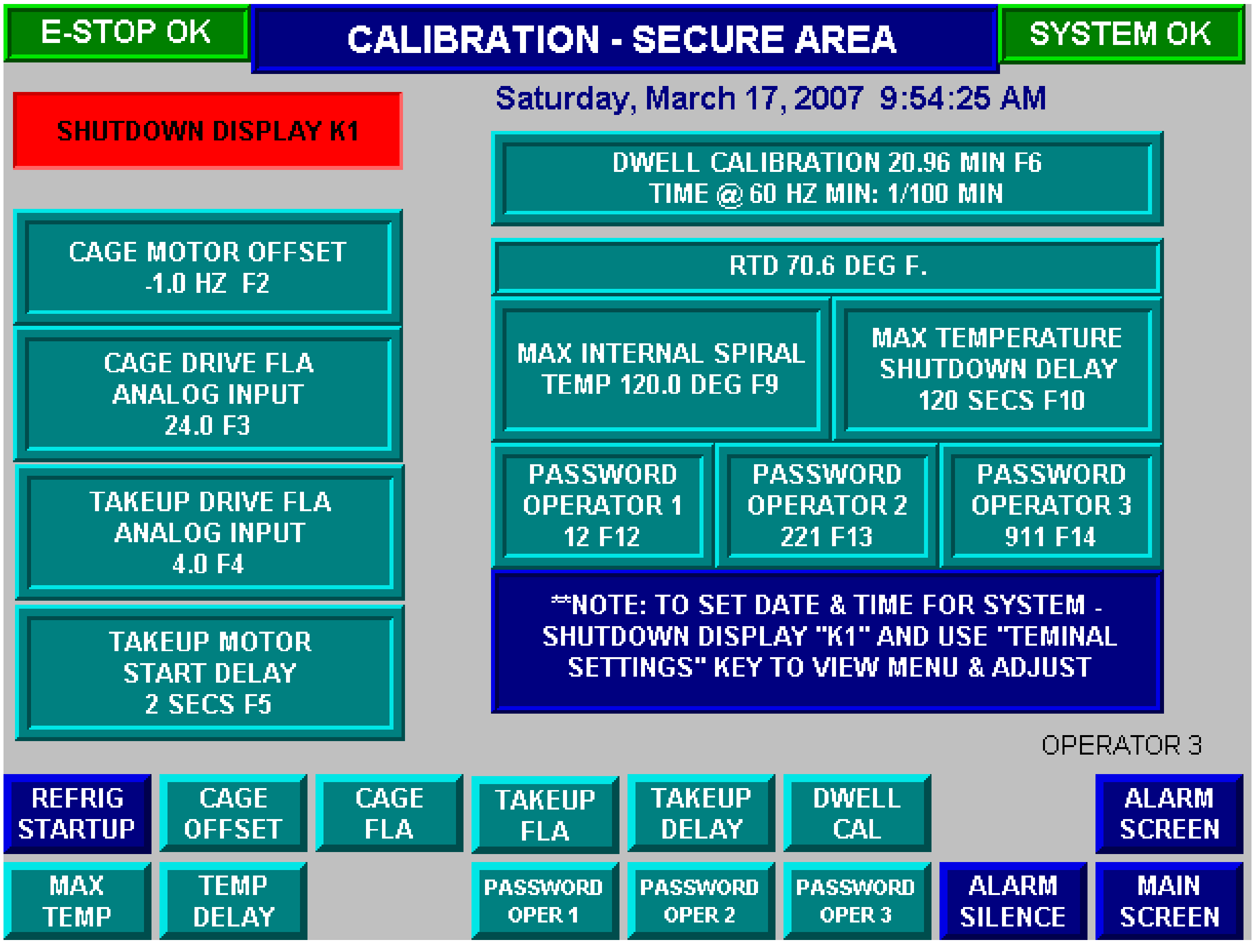
- 0 = All fans.
- 1 = Fan 1 only.
- 2 = Fan 2 only.
- 3 = Fan 3 only.
- 4 = Fan 4 only.

F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

V. CALIBRATION

1. Calibration Screen

The Calibration Screen is used for initial calibration of the system. CAUTION – The values in this screen are typically only changed in the initial calibration of the system. They are seldom changed after official startup. Please check with a supervisor before making any changes. Be advised that changes to this screen can cause the freezer system to function incorrectly.



Saturday, March 17, 2007 9:54:25 AM

DWELL CALIBRATION 20.96 MIN F6
TIME @ 60 HZ MIN: 1/100 MIN

CAGE MOTOR OFFSET -1.0 HZ F2

RTD 70.6 DEG F.

CAGE DRIVE FLA ANALOG INPUT 24.0 F3

MAX INTERNAL SPIRAL TEMP 120.0 DEG F9

MAX TEMPERATURE SHUTDOWN DELAY 120 SECS F10

TAKEUP DRIVE FLA ANALOG INPUT 4.0 F4

PASSWORD OPERATOR 1 12 F12

PASSWORD OPERATOR 2 221 F13

PASSWORD OPERATOR 3 911 F14

TAKEUP MOTOR START DELAY 2 SECS F5

**NOTE: TO SET DATE & TIME FOR SYSTEM - SHUTDOWN DISPLAY "K1" AND USE "TEMINAL SETTINGS" KEY TO VIEW MENU & ADJUST

OPERATOR 3

Figure 13

The following function keys are available on the Calibration screen:

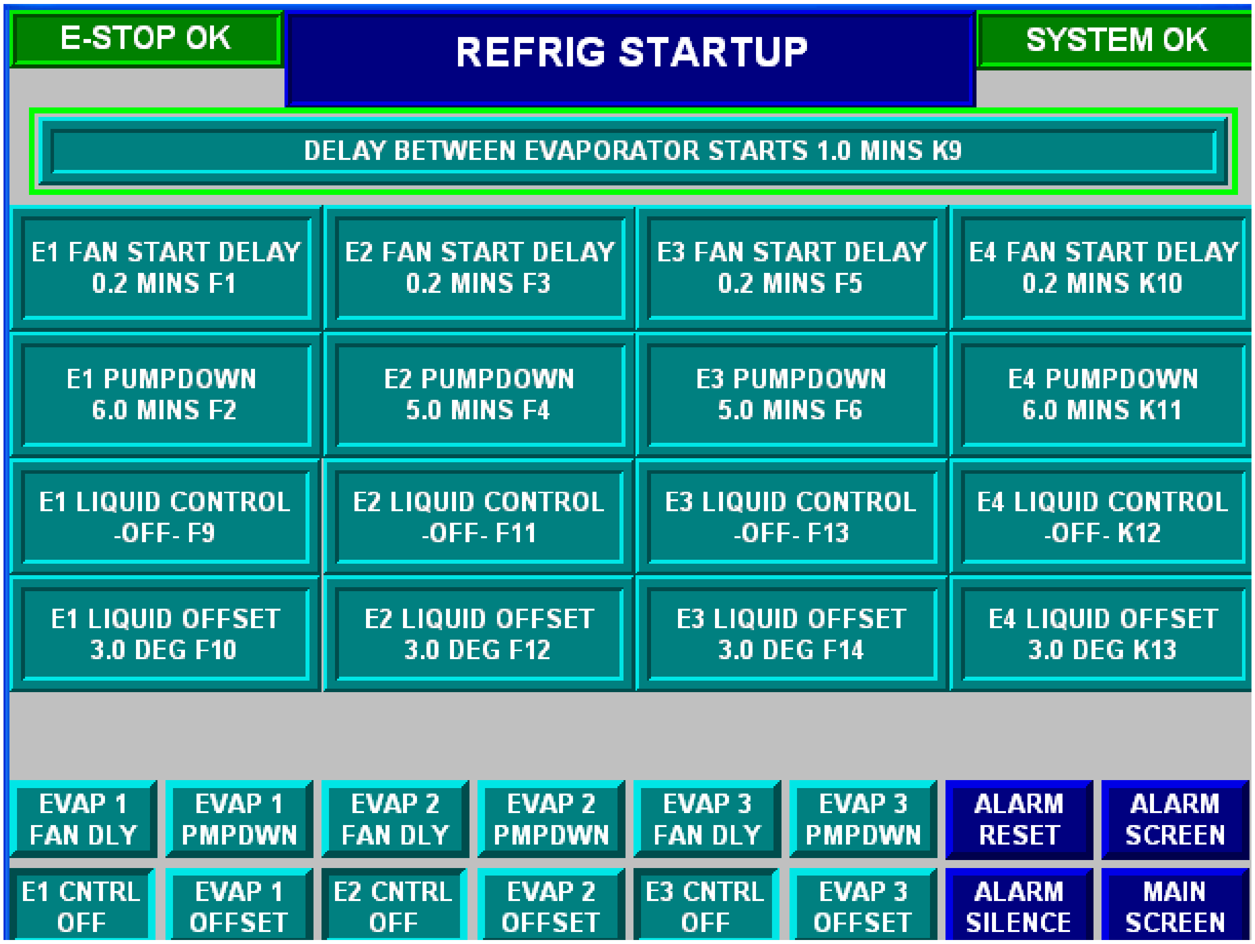
F1 – Refrig Startup: Selects the Refrig Startup screen, section V.2 Refrigeration Startup

F2 – Cage Offset: Enter the required offset Hz for the cage belt drive relative to the take-up drive Hz.
F3 – Cage FLA: Used to set the main spiral drive motor (VFD) full load ampere calibration.
F4 – Takeup FLA: Used to set the spiral take-up motor (VFD) full load ampere calibration.
F5 – Takeup Delay: Start delay time of the takeup drive after the cage drive.
F6 – Dwell Cal: This is the actual spiral system minimum dwell time. This setting is only used to initially calibrate the spiral system dwell range. (Do not change!)
F7 – [No Function]
F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms
F9 – Max Temp: The Max Temp is the temperature at which an alarm will occur if the temperature inside the spiral system enclosure exceeds the Max Temp setting.
F10 – Temp Delay: The Temp Delay is a time delay, after the Max Temp is met, before the alarm will sound. The time delay gives enough time to insure that the spiral system enclosure inside temperature is above the maximum temperature setting. It is recommended to set the temperature at 120 degrees and the time delay between 2 and 5 minutes. If the temperature is still at or above the Max Temp, after the temp delay period the total system will shutdown.
F11 – [No Function]
F12 - Password Oper 1: This is used to modify the password for this user.
F13 - Password Oper 2: This is used to modify the password for this user.
F14 - Password Oper 3: This is used to modify the password for this user.
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

2. Refrigeration Startup

The Refrigeration Startup screen allows the user to adjust the amount of time for Evaporator startup functions. The following controls or status indicators are available:

- Delay between Evaporator Starts
- Delay between Evaporator Fans starting
    - Fan 1
    - Fan 2
    - Fan 3
    - Fan 4
- Evaporator pump down period
- Evaporator Liquid Control Select
- Liquid Control Offset
- Currently logged in operator



DELAY BETWEEN EVAPORATOR STARTS 1.0 MINS K9

E1 FAN START DELAY 0.2 MINS F1
E2 FAN START DELAY 0.2 MINS F3
E3 FAN START DELAY 0.2 MINS F5
E4 FAN START DELAY 0.2 MINS K10
E1 PUMPDOWN 6.0 MINS F2
E2 PUMPDOWN 5.0 MINS F4
E3 PUMPDOWN 5.0 MINS F6
E4 PUMPDOWN 6.0 MINS K11
E1 LIQUID CONTROL -OFF- F9
E2 LIQUID CONTROL -OFF- F11
E3 LIQUID CONTROL -OFF- F13
E4 LIQUID CONTROL -OFF- K12
E1 LIQUID OFFSET 3.0 DEG F10
E2 LIQUID OFFSET 3.0 DEG F12
E3 LIQUID OFFSET 3.0 DEG F14
E4 LIQUID OFFSET 3.0 DEG K13

Figure 14

The following function keys are available on the Refrig Startup screen:

F1 – Evap 1 Fan Dly: Enter the amount of time between starting the fans for this Evaporator.
F2 - Evap 1 Pmpdwn: Enter the amount of time the Evaporator will spend in pump down mode after shutting the refrigeration off.
F3 – Evap 2 Fan Dly: Enter the amount of time between starting the fans for this Evaporator.
F4 - Evap 2 Pmpdwn: Enter the amount of time the Evaporator will spend in pump down mode after shutting the refrigeration off.
F5 – Evap 3 Fan Dly: Enter the amount of time between starting the fans for this Evaporator.
F6 - Evap 3 Pmpdwn: Enter the amount of time the Evaporator will spend in pump down mode after shutting the refrigeration off.
F7 - Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the**

alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.

F8 - Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms

F9 – E1 Liquid On/Off: Toggles the evaporator Liquid Control On/Off. When selecting On, the setpoint adjustment will appear on the "Evap Control" screen IV 1. When selected Off, there will be no Liquid Control. The liquid feed will remain On during normal operation.

F10 – Evap 1 Offset: Enter the amount of degrees to subtract from the temperature setpoint to create a differential or deadband. This value along with the setpoint will create the temperature on and off points for controlling the refrigeration or liquid feed valve.

F11 – E2 Liquid On/Off: Toggles the evaporator Liquid Control On/Off. When selecting On, the setpoint adjustment will appear on the "Evap Control" screen IV 1. When selected Off, there will be no Liquid Control. The liquid feed will remain On during normal operation.

F12 – Evap 2 Offset: Enter the amount of degrees to subtract from the temperature setpoint to create a differential or deadband. This value along with the setpoint will create the temperature on and off points for controlling the refrigeration or liquid feed valve.

F13 – E3 Liquid On/Off: Toggles the evaporator Liquid Control On/Off. When selecting On, the setpoint adjustment will appear on the "Evap Control" screen IV 1. When selected Off, there will be no Liquid Control. The liquid feed will remain On during normal operation.

F14 – Evap 3 Offset: Enter the amount of degrees to subtract from the temperature setpoint to create a differential or deadband. This value along with the setpoint will create the temperature on and off points for controlling the refrigeration or liquid feed valve.

F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.

F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

K10 – Evap 4 Fan Dly: Enter the amount of time between starting the fans for this Evaporator.

K11 - Evap 4 Pmpdwn: Enter the amount of time the Evaporator will spend in pump down mode after shutting the refrigeration off.

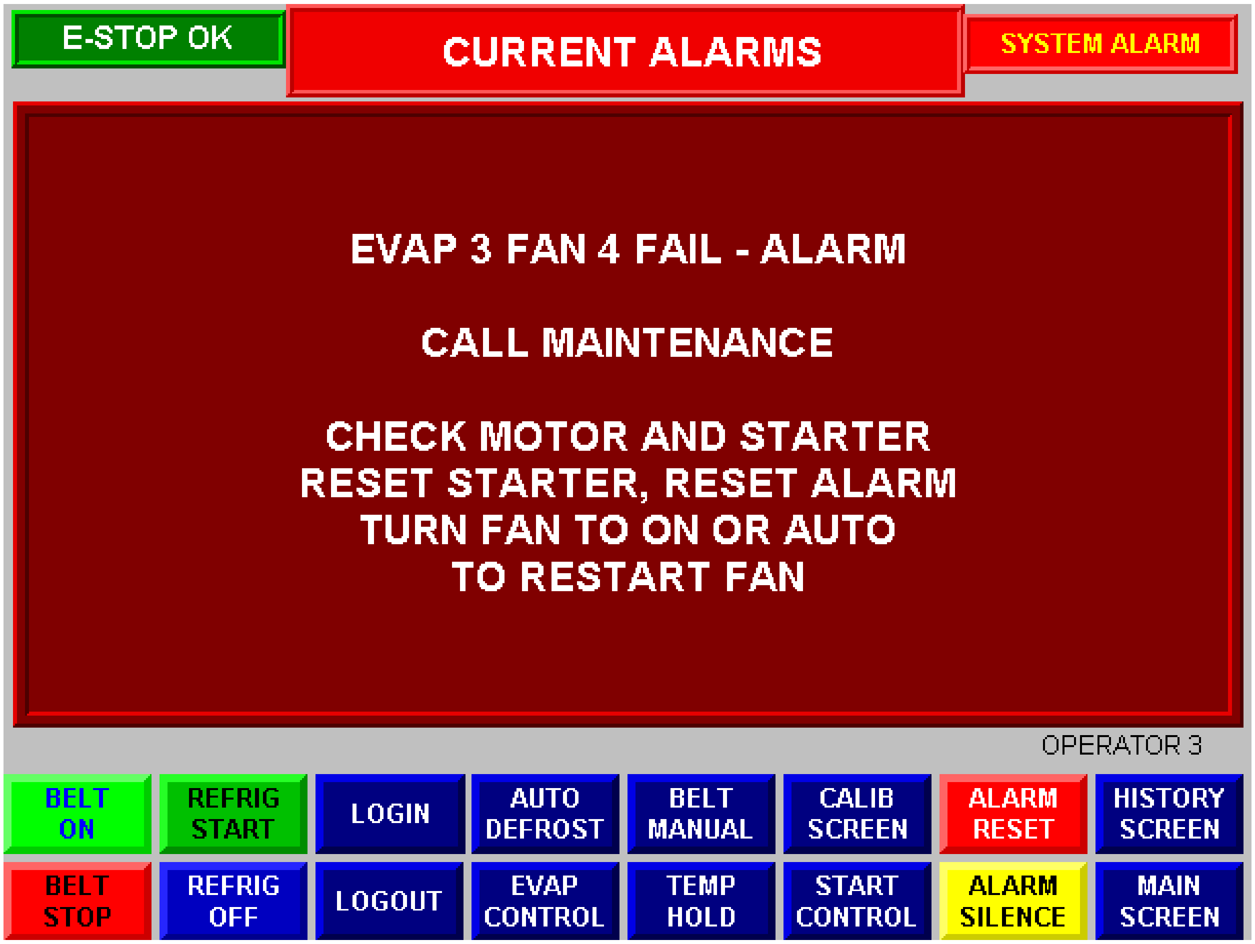
K12 – E4 Liquid On/Off: Toggles the evaporator Liquid Control On/Off. When selecting On, the setpoint adjustment will appear on the "Evap Control" screen IV 1. When selected Off, there will be no Liquid Control. The liquid feed will remain On during normal operation.

K13 – Evap 4 Offset: Enter the amount of degrees to subtract from the temperature setpoint to create a differential or deadband. This value along with the setpoint will create the temperature on and off points for controlling the refrigeration or liquid feed valve.

VI. ALARMS

1. Current Alarms

The Current Alarm screen displays all current system alarms. The alarms will remain on the screen until the alarm is reset. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.** Once the alarm condition has cleared, the alarm can now be reset and cleared from the control system by pressing the "Alarm Reset" function key. Once the alarms have been reset, if the alarm condition is still present on the spiral system the alarm will return on the display.



EVAP 3 FAN 4 FAIL - ALARM

CALL MAINTENANCE

CHECK MOTOR AND STARTER
RESET STARTER, RESET ALARM
TURN FAN TO ON OR AUTO
TO RESTART FAN

Figure 15

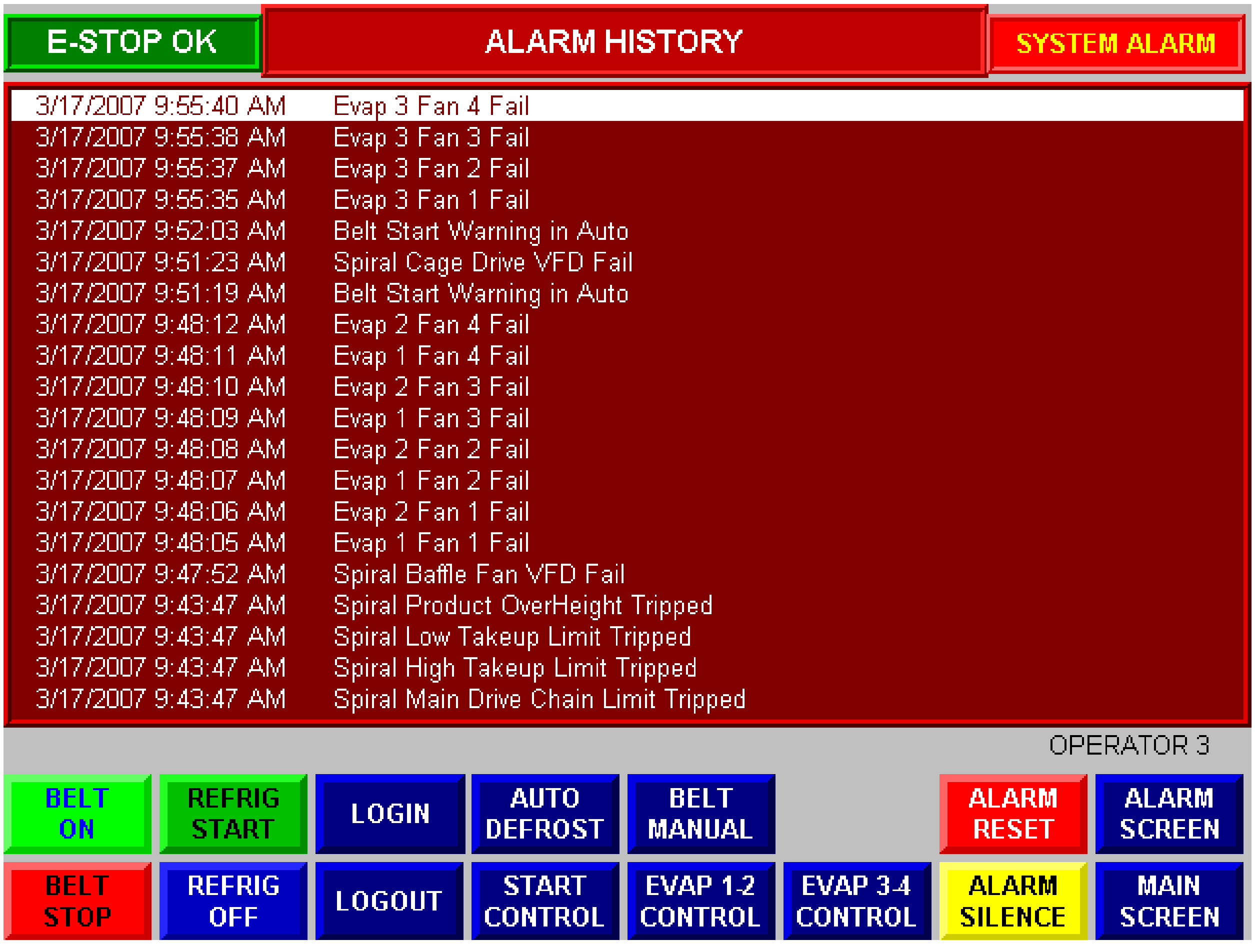
The following function keys are available on the Current Alarm screen:

F1 - Belt Start: Starts the spiral belt drives when in Auto mode. If the spiral is not ready to run, press the "Alarm Screen" button to see what may be keeping the spiral from entering the ready state. If there are no spiral belt alarms, then verify that the spiral belt is in Auto mode.

F2 – Refrig Start: Starts all refrigeration valve controls that are in Auto mode.
F3 – Login: The login function key opens the Login Selection Screen on page 5.
F4 – Auto Defrost: Selects the Auto Defrost Schedule screen, section IV.4 Auto Defrost.
F5 - Belt Manual: Selects the Belt Manual Control, section III.1 Belt Manual Control.
F6 - Calib Screen: Selects the Calibration screen, section V.1 Calibration Screen.
F7 - Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**
F8 – History Screen: Selects the Alarm History screen, section VI.2 Alarm History
F9 – Belt Stop: Stops the spiral belt drives that are in Auto mode.
F10 – Refrig Off: Stops all refrigeration valve controls that are in Auto mode.
F11 - Logout: Logs off the currently logged in user.
F12 - Evap Control: Selects the Evaporator Control, section IV.1 Evaporator Control
F13 - Temp Hold: Selects the Temperature Hold, section IV.5 Temperature Hold
F14 - Start Control: Selects the Start Control screen, section II.2 Start Control
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen

2. *Alarm History*

The Alarm History screen displays the last 100 system alarms. The date / time / descriptions of the each alarm are displayed in descending order.



3/17/2007 9:55:40 AM	Evap 3 Fan 4 Fail
3/17/2007 9:55:38 AM	Evap 3 Fan 3 Fail
3/17/2007 9:55:37 AM	Evap 3 Fan 2 Fail
3/17/2007 9:55:35 AM	Evap 3 Fan 1 Fail
3/17/2007 9:52:03 AM	Belt Start Warning in Auto
3/17/2007 9:51:23 AM	Spiral Cage Drive VFD Fail
3/17/2007 9:51:19 AM	Belt Start Warning in Auto
3/17/2007 9:48:12 AM	Evap 2 Fan 4 Fail
3/17/2007 9:48:11 AM	Evap 1 Fan 4 Fail
3/17/2007 9:48:10 AM	Evap 2 Fan 3 Fail
3/17/2007 9:48:09 AM	Evap 1 Fan 3 Fail
3/17/2007 9:48:08 AM	Evap 2 Fan 2 Fail
3/17/2007 9:48:07 AM	Evap 1 Fan 2 Fail
3/17/2007 9:48:06 AM	Evap 2 Fan 1 Fail
3/17/2007 9:48:05 AM	Evap 1 Fan 1 Fail
3/17/2007 9:47:52 AM	Spiral Baffle Fan VFD Fail
3/17/2007 9:43:47 AM	Spiral Product OverHeight Tripped
3/17/2007 9:43:47 AM	Spiral Low Takeup Limit Tripped
3/17/2007 9:43:47 AM	Spiral High Takeup Limit Tripped
3/17/2007 9:43:47 AM	Spiral Main Drive Chain Limit Tripped

Figure 16

The following function keys are available on the Alarm History screen:

F1 - Belt Start: Starts the spiral belt drives when in Auto mode. If the spiral is not ready to run, press the “Alarm Screen” button to see what may be keeping the spiral from entering the ready state. If there are no spiral belt alarms, then verify that the spiral belt is in Auto mode.
F2 – Refrig Start: Starts all refrigeration valve controls that are in Auto mode.
F3 – Login: The login function key opens the Login Selection Screen on page 5.
F4 – Auto Defrost: Selects the Auto Defrost Schedule screen, section IV.4 Auto Defrost.
F5 - Belt Manual: Selects the Belt Manual Control, section III.1 Belt Manual Control.
F6 - [No Function]
F7 - Alarm Reset: Will clear all the current alarms and reset the control system. The current alarm will be displayed again if the problem has not been resolved. **Clear the alarm only after maintenance has checked and fixed all problems related with the alarm on the spiral system.**
F8 – Alarm Screen: Selects the Alarm Screen, section VI.1 Current Alarms
F9 – Belt Stop: Stops the spiral belt drives that are in Auto mode.
F10 – Refrig Off: Stops all refrigeration valve controls that are in Auto mode.

F11 - Logout: Logs off the currently logged in user.
F12 - Start Control: Selects the Start Control screen, section II.2 Start Control
F13 - Evap Control 1-2: Selects the Evaporator Control, section IV.1 Evaporator Control
F14 - Evap Control 3-4: Selects the Evaporator Control, section IV.1 Evaporator Control
F15 - Alarm Silence: If the alarm horn is sounding, the horn will be silenced during the current alarm.
F16 - Main Screen: Return to the Main Menu screen, section II.1 Main Menu Screen.

3. Possible Alarms

The following is a list of all system alarms:

Emergency Stop Active
Remote Belt Shutdown
Enclosure High Temperature
Shutdown
Temperature Hold High Temperature
Belt Start Warning in Auto
Belt Start Warning in Manual
Spiral Upper Safety Cord Tripped
Spiral Lower Safety Cord Tripped
Spiral Upper Lift Tripped
Spiral Lower Lift Tripped
Spiral Main Drive Chain Limit Tripped
Spiral High Take up Limit Tripped
Spiral Low Take up Limit Tripped
Spiral Product Over Height Tripped
Spiral Cage Drive VFD Fail
Spiral Take up Drive VFD Fail
Spiral Baffle Fan VFD Fail
Evap 1 Fan 1 Fail
Evap 1 Fan 2 Fail
Evap 1 Fan 3 Fail
Evap 1 Fan 4 Fail
Evap 1 Fan 5 Fail
Evap 1 Fan 6 Fail
Evap 2 Fan 1 Fail
Evap 2 Fan 2 Fail
Evap 2 Fan 3 Fail
Evap 2 Fan 4 Fail
Evap 2 Fan 5 Fail
Evap 2 Fan 6 Fail
Evap 3 Fan 1 Fail
Evap 3 Fan 2 Fail
Evap 3 Fan 3 Fail
Evap 3 Fan 4 Fail
Evap 4 Fan 1 Fail
Evap 4 Fan 2 Fail
Evap 4 Fan 3 Fail
Evap 4 Fan 4 Fail

L2 SYSTEMS INC.
9704 50th Place West, Mukilteo, WA 98275 / (425) 493-0195

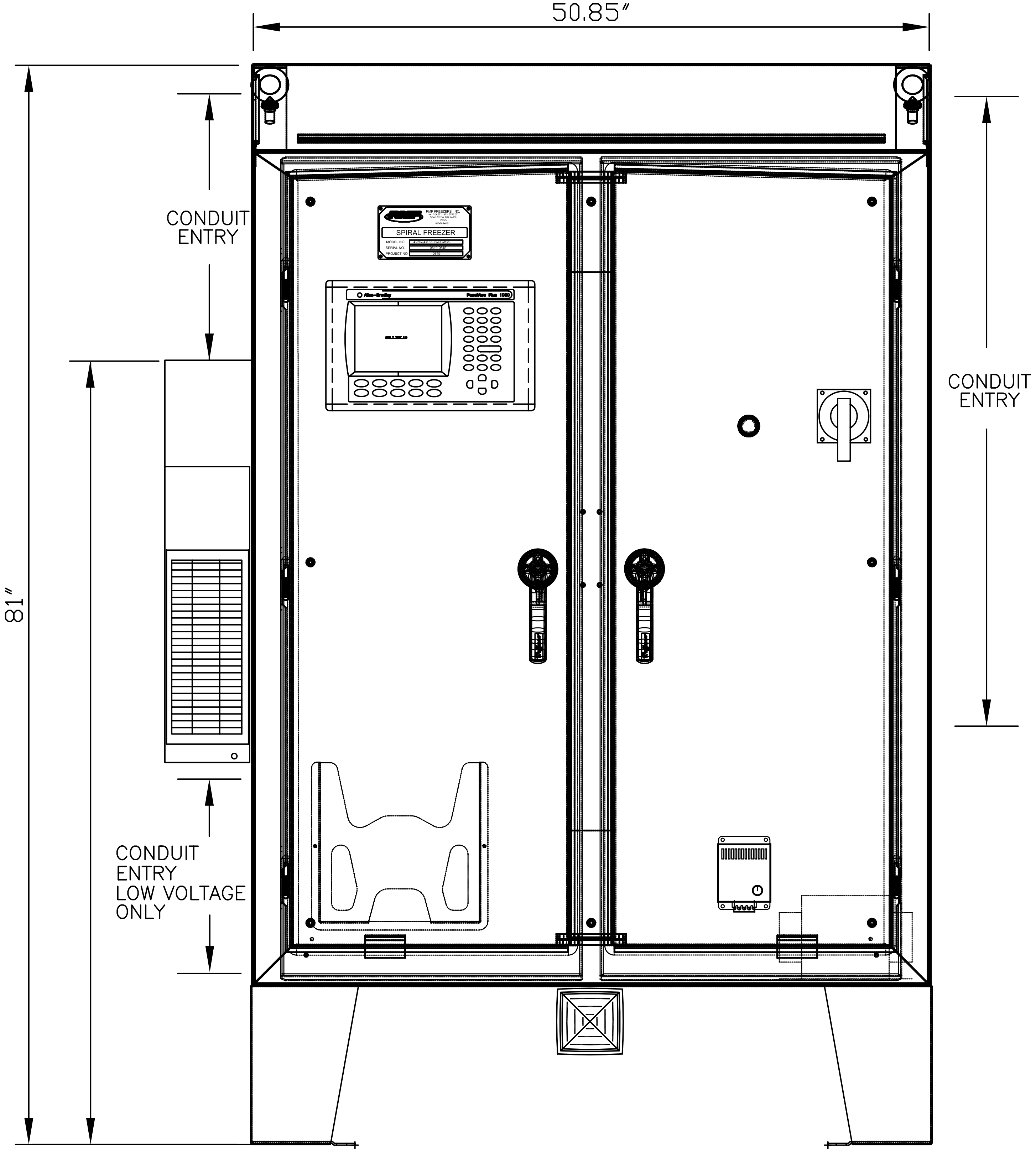
West Liberty Foods
Tremonton, Utah

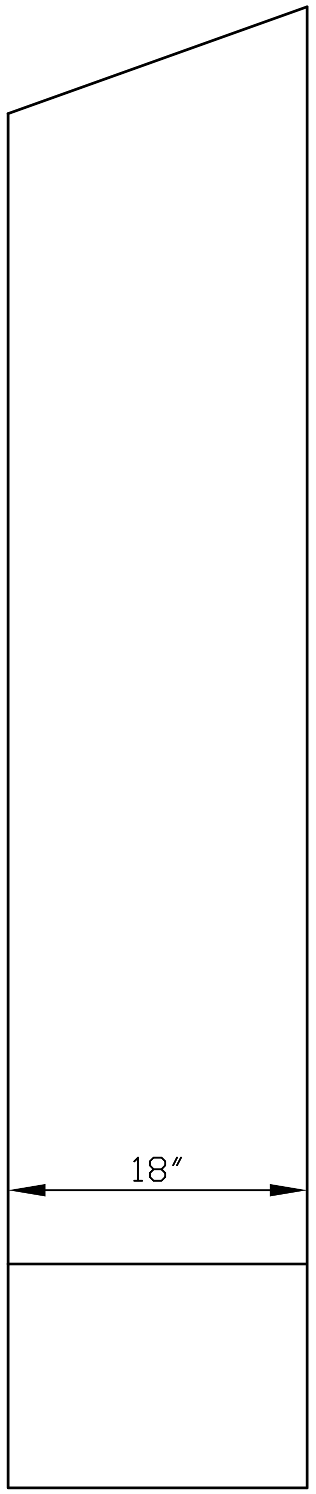
BILL OF MATERIALS
L2 JOB NO. 61108

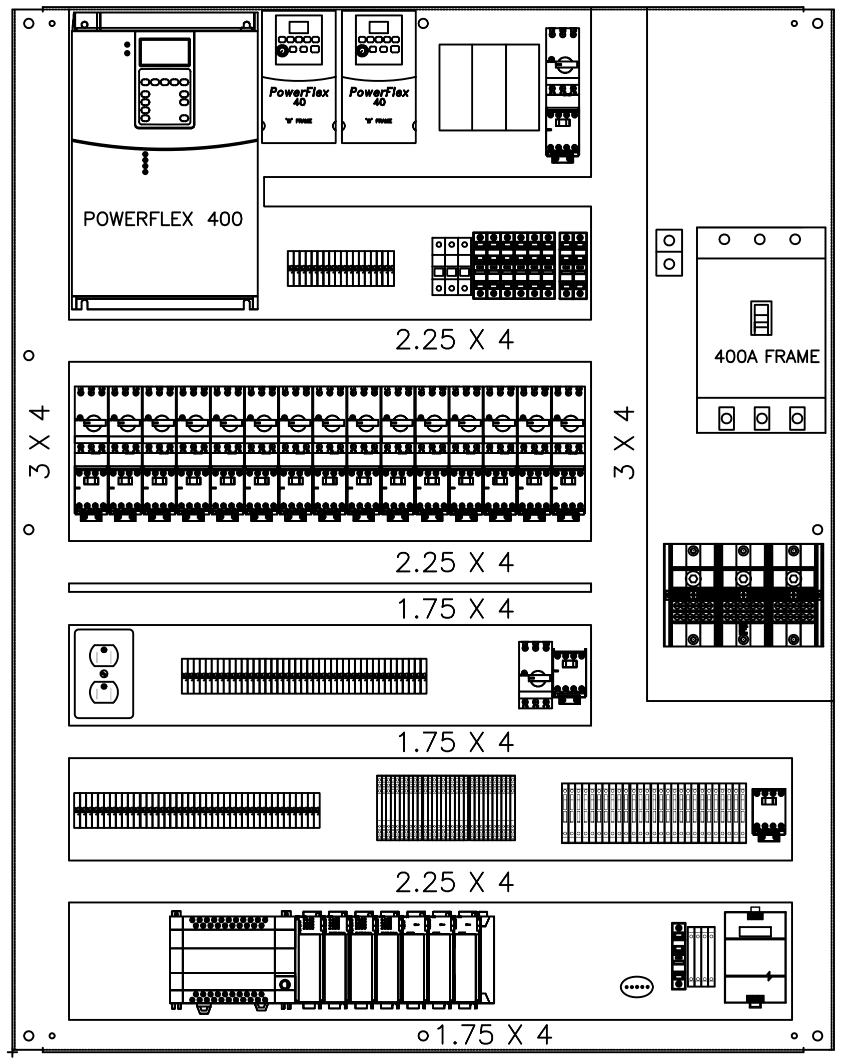
Item #	Qty	Description	Manufacturer Part #	Manufacturer	Vendor	P.O. #
1	1	Enclosure, 62" x 51" x 18" Nema 4X Stainless Steel, with Sloped Top	WS625118SS	Hoffman	North Coast	061108-01
2	1	BackPan	A60P48	Hoffman	North Coast	061108-01
3	1	Leg Kit, 12" Tall, 18" Deep, Stainless Steel	AFK1218SS	Hoffman	North Coast	061108-01
4	1	Heater, 200 Watts	DAH2001A	Hoffman	North Coast	061108-01
5	1	A/C Unit, 1800BTU, 120VAC, 7.8 Amps UL Type 4X, Stainless Steel	IQ1800VS-126-SS	Ice Cube	Ice Cube	061108-09
6	1	Handle	RHOH4	Siemens	Ind Control	061108-03
7	1	Shaft	RHOSXD	Siemens	Ind Control	061108-03
8	1	Operator	RHOJBO	Siemens	Ind Control	061108-03
9	1	Main Circuit Breaker, 400 amp	JXD63B400	Siemens	Ind Control	061108-03
10	6	Main Circuit Breaker Lugs	TA1L6750	Siemens	Ind Control	061108-04
11	1	Power Distribution Block	1492-PD31123	Allen-Bradley	North Coast	061108-05
12	1	Power Distribution Block Cover	1492-PBC3	Allen-Bradley	North Coast	061108-07
13	1	Transformer, 2kVA, Finger Safe Terminals	Y-2000	Sola	North Coast	061108-02
14	1	Circuit Breaker, 2 pole, 10 amp	1492-CB2G100	Allen-Bradley	North Coast	061108-02
15	1	Circuit Breaker, 1 pole, 25 amp	1492-CB1G250	Allen-Bradley	North Coast	061108-02
16	1	Circuit Breaker, 1 pole, 15 amp	1489-A1C150	Allen-Bradley	North Coast	061108-02
17	2	Circuit Breaker, 1 pole, 10 amp	1489-A1C100	Allen-Bradley	North Coast	061108-02
18	2	Circuit Breaker, 1 pole, 5 amp	1489-A1C050	Allen-Bradley	North Coast	061108-02
19	1	PowerFlex400 Variable Frequency Drive for 40hp motor, LED HIM	22C-D060A103	Allen-Bradley	North Coast	061108-02
20	1	PowerFlex40 Variable Frequency Drive for 2hp motor, LED HIM	22B-D4P0N104	Allen-Bradley	North Coast	061108-02
21	1	PowerFlex40 Variable Frequency Drive for 1/2hp motor, LED HIM	22B-D1P4N104	Allen-Bradley	North Coast	061108-02
22	1	Fuse Holder, 3 pole with indicators, Class J, 100 Amp, Space Saving	61038J	Ferraz-Shawmut	North Coast	061108-02
23	2	Fuse Holder, 3 pole with indicators, class CC	USCC3I	Ferraz-Shawmut	North Coast	061108-02
24	3	Drive Fuse, 80 amp	AJT80	Ferraz-Shawmut	North Coast	061108-02
25	3	Drive Fuse, 6 amp	ATDR6	Ferraz-Shawmut	North Coast	061108-02
26	3	Drive Fuse, 3 amp	ATDR3	Ferraz-Shawmut	North Coast	061108-02
27	16	Motor Starter / Protector, 480 VAC, 16-20 amp overload	140M-C2E-C20	Allen-Bradley	North Coast	061108-02
27A	1	Motor Starter / Protector, 480 VAC, 10-16 amp overload	140M-C2E-C16	Allen-Bradley	North Coast	061108-09
28	17	Aux Contact, internal mounting	140M-C-AFA10	Allen-Bradley	North Coast	061108-02
29	17	Lockable Rotary Handle for 140M Series Motor Protector	140M-C-KN	Allen-Bradley	North Coast	061108-02
30	17	ECO-Connecting Module, 25AMP, Interconnection of 140M MCP AND 100-M Contactors	140M-C-PEC23	Allen-Bradley	North Coast	061108-02
31	16	Contactor, 460 VAC, 23 amp	100-C23D10	Allen-Bradley	North Coast	061108-02
31A	1	Contactor, 460 VAC, 16 amp	100-C16D10	Allen-Bradley	North Coast	061108-09
32	17	Interface, Electronic (w/AC Coils Only) 18-30VDC INPUT, 110-240VAC Coil Voltage	100-JE	Allen-Bradley	North Coast	061108-02
33	1	Micrologix 1500 Base DC Power, 16 DC IN, 12 DC OUT	1764-28BXB	Allen-Bradley	North Coast	061108-02

Item #	Qty	Description	Manufacturer Part #	Manufacturer	Vendor	P.O. #
34	1	Micrologix Processor	1764-LRP	Allen-Bradley	North Coast	061108-02
35	1	Micrologix Right End Cap Terminator	1769-ECR	Allen-Bradley	North Coast	061108-02
36	1	4 Channel Analog Input Module, Single Ended or Differential Inputs	1769-IF4	Allen-Bradley	North Coast	061108-02
37	1	Analog Output Module 2-Point 4-20mA	1769-OF2	Allen-Bradley	North Coast	061108-02
38	1	Discrete Input Module 16Point 24VDC Sinking	1769-IQ16	Allen-Bradley	North Coast	061108-02
39	3	Discrete Output Module 16Point 24VDC Sourcing	1769-OB16	Allen-Bradley	North Coast	061108-02
40	1	RS232 Micrologix Cable, 8-Pin Mini TO 9-Pin D Shell, 6 FT	2711-NC21	Allen-Bradley	North Coast	061108-06
41	1	Panelview 1000 Plus, Keypad/Touch DF1 & Ethernet Communications	2711P-B10C4D1	Allen-Bradley	North Coast	061108-02
42	1	Duplex Receptacle, 15 Amp, Ivory	5320I	Leviton	North Coast	Stock
43	1	Simplex Receptacle, 20 Amp, Ivory	5361I	Leviton	North Coast	Stock
44	2	Single Gang Box	58351.5	Steel City	North Coast	Stock
45	1	Safety Control Relay, 120VAC coil, 8 contacts	700S-CF620DC	Allen-Bradley	North Coast	Stock
46	1	Safety Control Relay, Aux Contact Block, 2 NO Contacts	100-SA20	Allen-Bradley	North Coast	Stock
47	30	Terminal Relay, 24VDC SPDT, 1A 24VDC Rated Gold Plated Contacts	700-HLT1Z24	Allen-Bradley	North Coast	061108-02
48	1	Power Supply, 24VDC240 Watt, 10.0 A Output, Din-Rail Mounted	PS5R-SG24	Idec	Ind Control	Stock
49	1	2 Position., Illuminated, Push-Pull/Twist Red, Mushroom HD	800H-FRXTQH24RA1	Allen-Bradley	North Coast	Stock
50	1	Jumbo E-Stop Button Red	800T-N209RE1	Allen-Bradley	North Coast	061108-02
51	27	Fused terminals, AC	1494-H4	Allen-Bradley	North Coast	Stock
52	2	Fused terminals, DC	1494-H5	Allen-Bradley	North Coast	Stock
53	27	Fuses, 3 amp, time delay	GDL3	Ferraz-Shawmut	North Coast	061108-02
54	1	Fuses, 5 amp, time delay	GDL5	Ferraz-Shawmut	North Coast	Stock
55	1	Fuses, 2 amp, time delay	GDL2	Ferraz-Shawmut	North Coast	Stock
56	107	Terminal	1492-J6	Allen-Bradley	North Coast	061108-02
57	9	Grounding Terminal	1492-JG6	Allen-Bradley	North Coast	Stock
58	3	Terminal	1492-W16	Allen-Bradley	North Coast	Stock
59	19	Terminal End Block	1492-EAJ35	Allen-Bradley	North Coast	Stock
60	14	Terminal End Barrier	1492-EBJ3	Allen-Bradley	North Coast	Stock
61	1	Horn, 3/4" NPT	876-N5	Edwards	North Coast	061108-02
62	1	Meyer's Hub for Horn installation to panel, 3/4"	TB-H075	Thomas & Betts	North Coast	Stock
63	1	Short Nipple for Horn installation to panel, 3/4"DIA, 3/4"L	NIP34XCLOSE	Generic	North Coast	Stock
64	1	Grip	CGB114	Crouse	North Coast	Stock
65	1	RTD Box	BWF B5V	BWF	North Coast	061108-02
66	1	RTD, 100 ohm platinum	R1T185L483-006-00-13-T3J012-0	Pyromation	Field Inst & Cont	Stock
67	1	RTD Signal Converter -50 to 150 F Deg	440-385U-S (-50-120F)	Pyromation	Field Inst & Cont	Stock
69	1	Nameplates (see drawing for inscriptions)	Custom	Harbour Pointe	Harbour Pointe	Custom

L2 SYSTEMS INC. 9704 50th Place West, Mukilteo, WA 98275 / (425) 493-0195			West Liberty Foods Tremonton, Utah	BILL OF MATERIALS L2 JOB NO. 61108		
Item #	**Qty**	**Description**	**Manufacturer Part #**	**Manufacturer**	**Vendor**	**P.O. #**
70	3	Enclosure Nema 4X Stainless Steel	A606CHNFSS	Hoffman	North Coast	061108-01
71	3	Backpan	A6P6	Hoffman	North Coast	061108-01
72	6	Proximity Switch, 24VDC, 3-Wire, -40 Degree, Stainless Steel, Shielded	871TM-M10NP18-D4	Allen-Bradley	North Coast	061108-02
73	5	Quick Disconnect Cord, 4-Wire, -40 Degree, Teflon, 5 Meters	889D-F4HC-5	Allen-Bradley	North Coast	061108-02
74	1	Quick Disconnect Cord, 4-Wire, -40 Degree, Teflon, 10 Meters	889D-R4HC-10	Allen-Bradley	North Coast	Stock
75	8	Cord Grip Water Tight	SHC1020CR	Hubbell	North Coast	061108-02
76	2	Lifeline 4, Cable Pull Switch, > 75M, Quick Disconnect	440E-L13141	Allen-Bradley	North Coast	061108-02
77	2	Quick Disconnect Cord, 4-Wire, -40 Degree, Teflon, 5 Meters	889M-F12X9AE-5	Allen-Bradley	North Coast	061108-02
78	2	Cable Rope & Tensioner Kit, 30Meters	440E-A13083	Allen-Bradley	North Coast	061108-02

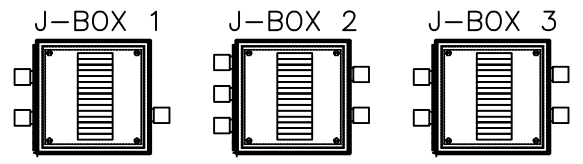




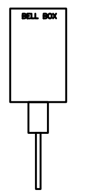


SAFETY CORD J-BOXES

PACKED LOOSE COMPONENTS



TEMPERATURE RTD



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
B	GDL	2/13/07	SHOP ASBUILT	C	GDL	5/3/07	UPDATE SAFETY PINOUTS
A1	GDL	1/12/07	PRELIMINARY – UPGRADE MAIN DRIVE & ADD BAFFLE FAN	D	GDL	6/5/07	ADD BELT BLOWER
A	GDL	12/18/06	PRELIMINARY NOT FOR CONSTRUCTION				

PROJECT: WEST LIBERTY FOODS

LOCATION: TREMONTON, UT

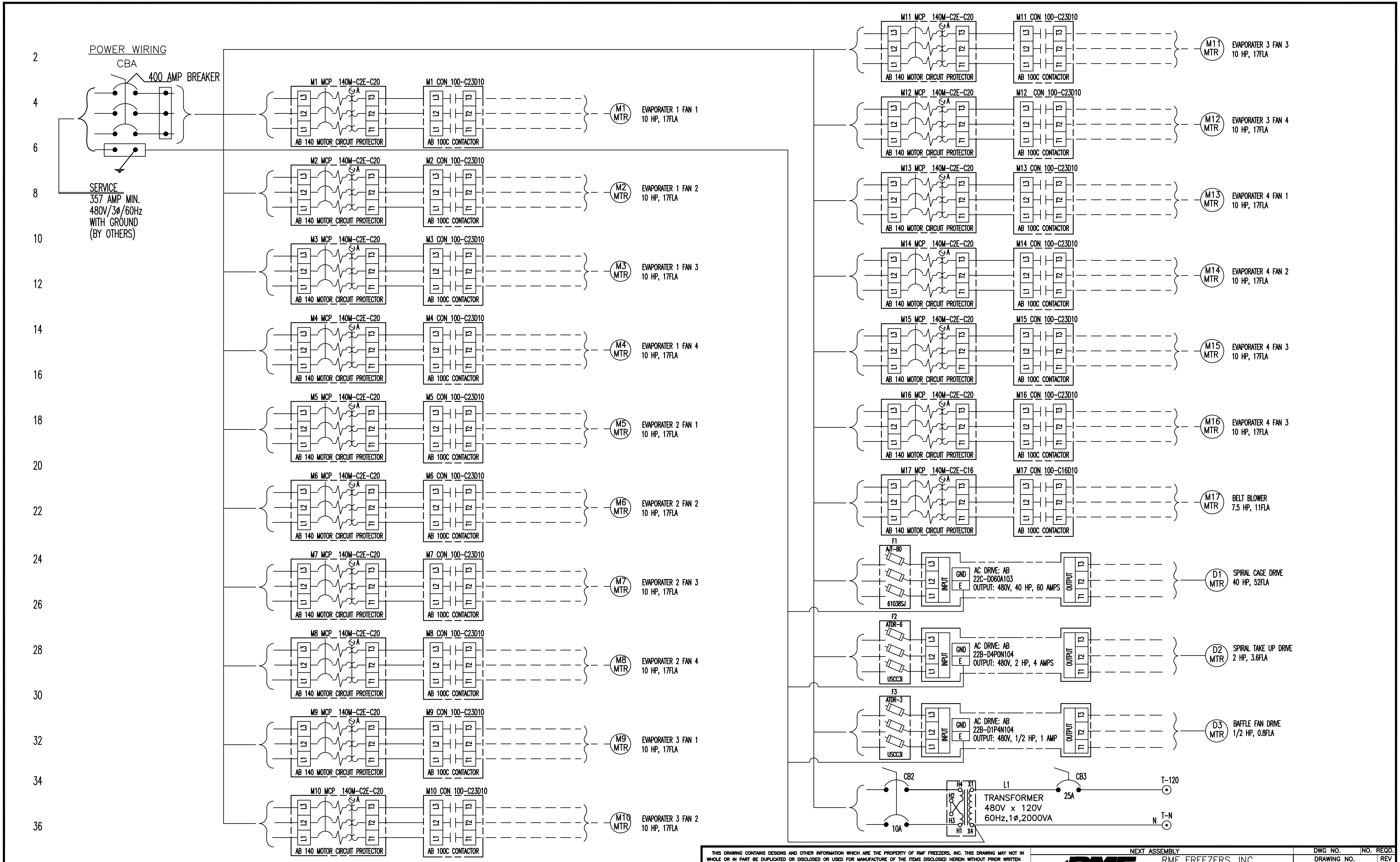
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE PANEL LAYOUT
SPIRAL FREEZER - 0619-064S

DWG NO.
NO. REQD.
DRAWING NO. 0619D1001
REV D
D
SCALE 1 = 9.65
L2-061108



REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS
B	GDL	2/13/07	SHOP ASBUILT

REV	BY	DATE	DESCRIPTION
D	GDL	6/5/07	ADD BELT BLOWER

THIS DRAWING CONTAINS DESIGNS AND OTHER INFORMATION WHICH ARE THE PROPERTY OF RMF FREEZERS, INC. THIS DRAWING MAY NOT IN WHOLE OR IN PART BE DUPLICATED OR DISCLOSED OR USED FOR MANUFACTURE OF THE ITEMS DISCLOSED HEREIN WITHOUT PRIOR WRITTEN PERMISSION OF RMF FREEZERS, INC. AND IS LOANED SUBJECT TO RETURN ON DEMAND.

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

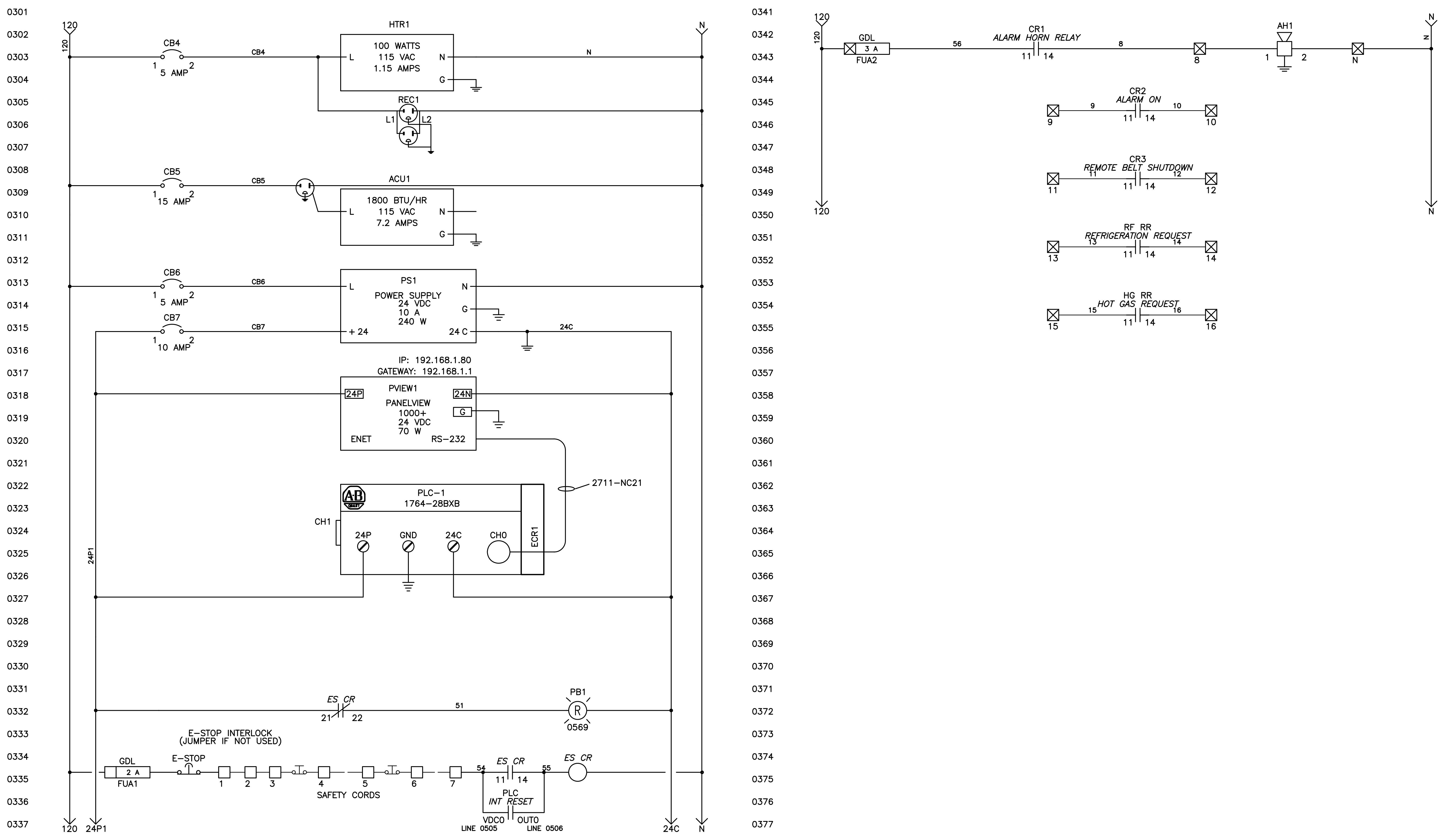
DRAWN BY GDL 12/18/06
CHECKED BY GDL 12/18/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE POWER WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1002
REV D
D
SCALE NONE
L2-061108



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

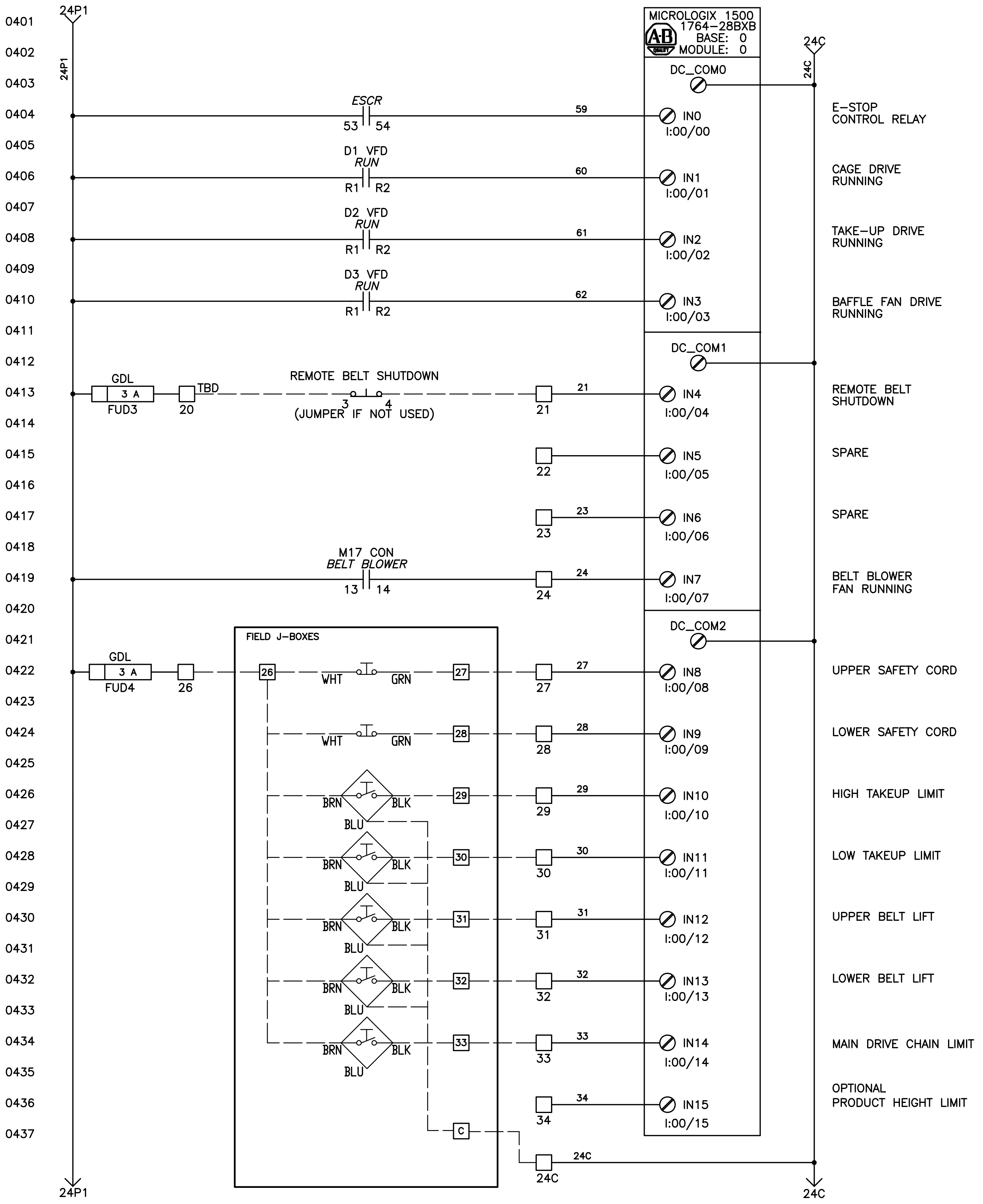
DRAWN BY	GDL	12/1/06
CHECKED BY	GDL	12/1/06
APPROVED BY		

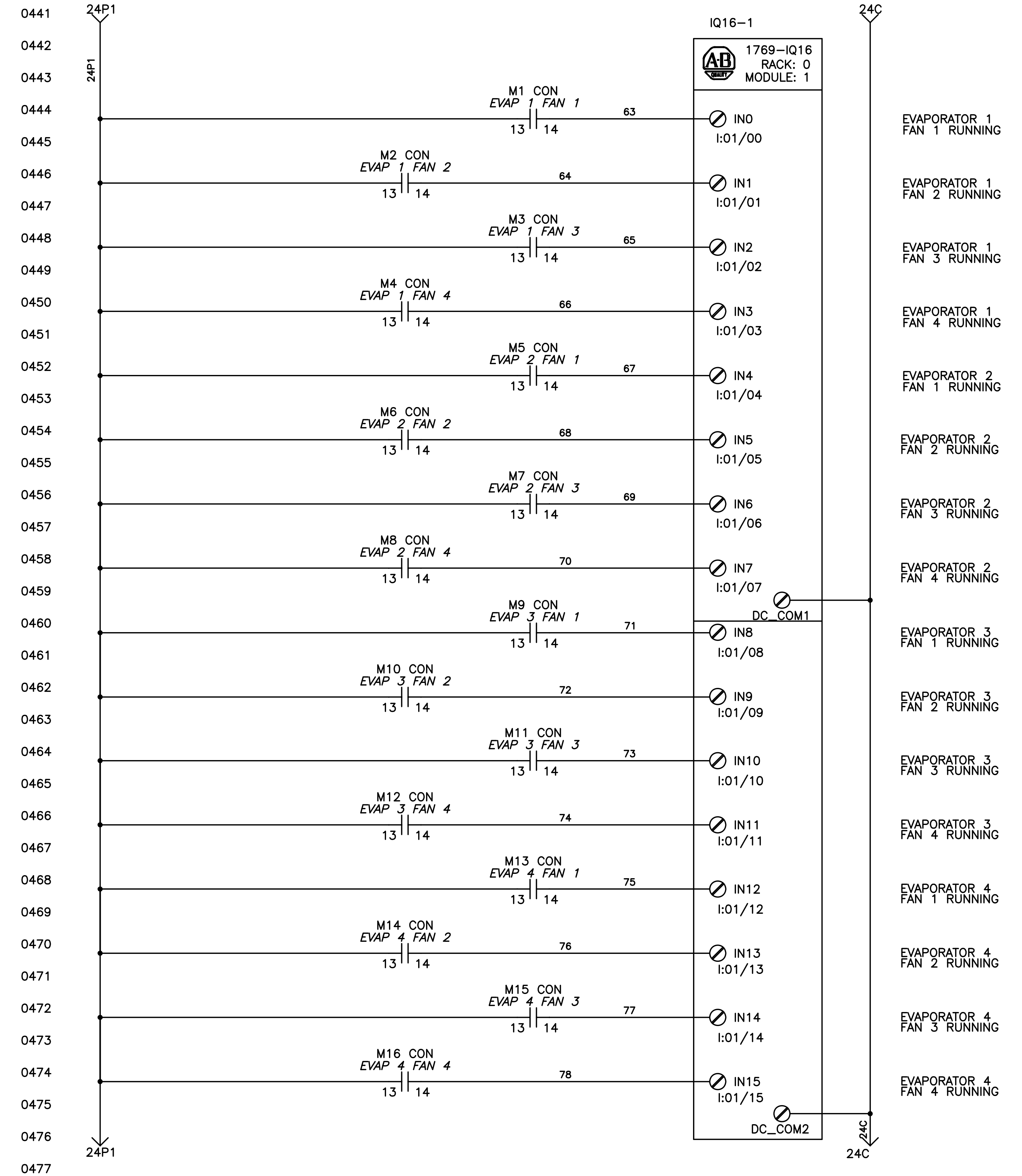
NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE
POWER WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. | NO. REQD.
DRAWING NO. 0619D1003
REV D
D
SCALE NONE
L2-061108





REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

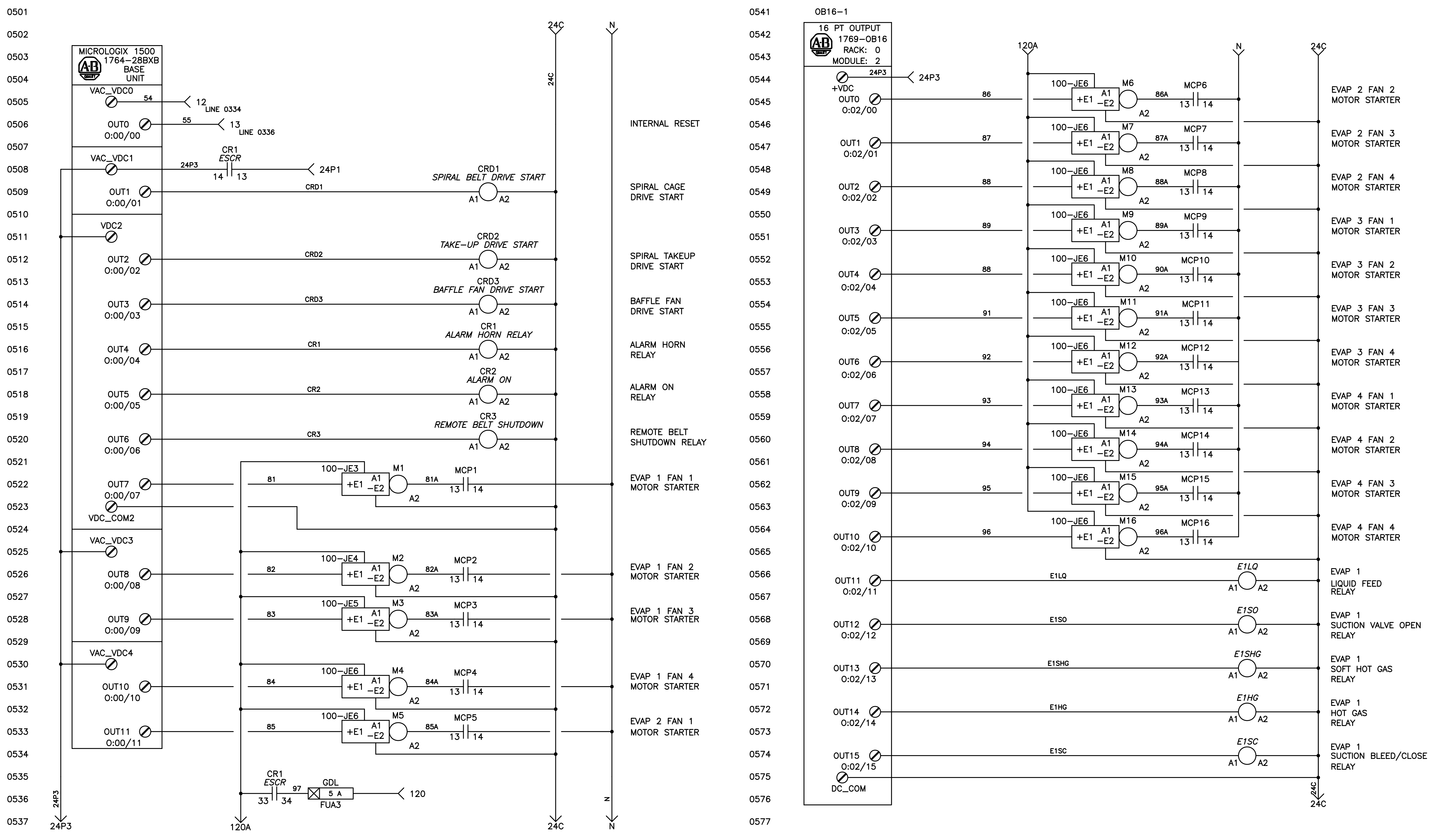
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE CONTROL WIRING
SPIRAL FREEZER - 0619-064S

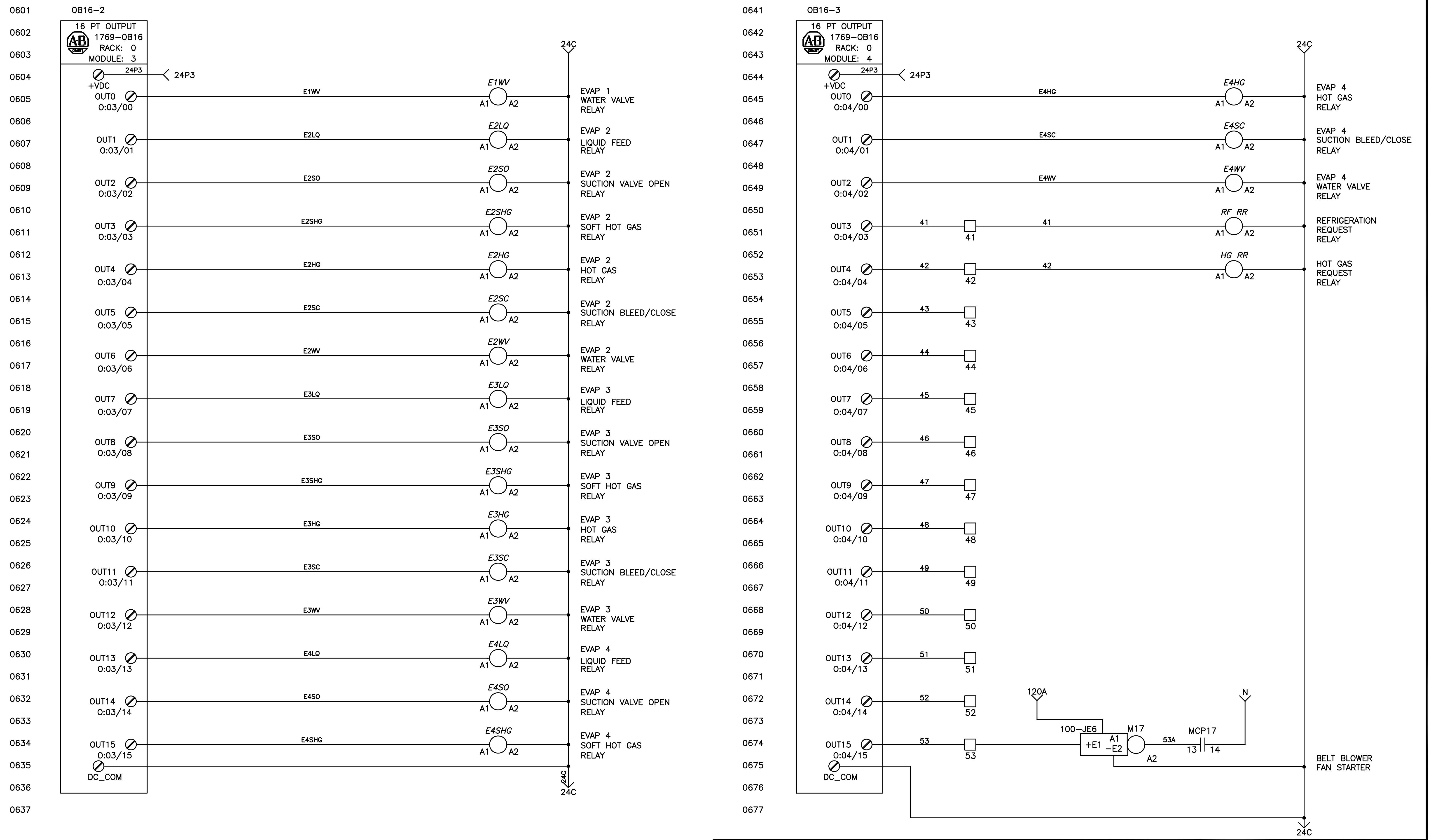
DWG NO. NO. REQD.
DRAWING NO. REV
0619D1004 D
D SCALE NONE
L2-061108



THIS DRAWING CONTAINS DESIGNS AND OTHER INFORMATION WHICH ARE THE PROPERTY OF RMF FREEZERS, INC. THIS DRAWING MAY NOT IN WHOLE OR IN PART BE DUPLICATED OR DISCLOSED OR USED FOR MANUFACTURE OF THE ITEMS DISCLOSED HEREIN WITHOUT PRIOR WRITTEN PERMISSION OF RMF FREEZERS, INC. AND IS LOANED SUBJECT TO RETURN ON DEMAND.

PROJECT: WEST LIBERTY FOODS	DRAWN BY GDL	12/1/06	NEXT ASSEMBLY	DWG NO.	NO. REQD.	
	CHECKED BY GDL	12/1/06	RMF FREEZERS, INC. 4417 EAST 119TH STREET GRANDVIEW, MO. 64030 U.S.A.	DRAWING NO.	REV	
LOCATION: TREMONTON, UT	APPROVED BY		TITLE CONTROL WIRING SPIRAL FREEZER - 0619-064S	0619D1005	D	
				D	SCALE NONE	L2-061108

REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER



THIS DRAWING CONTAINS DESIGNS AND OTHER INFORMATION WHICH ARE THE PROPERTY OF RMF FREEZERS, INC. THIS DRAWING MAY NOT IN WHOLE OR IN PART BE DUPLICATED OR DISCLOSED OR USED FOR MANUFACTURE OF THE ITEMS DISCLOSED HEREIN WITHOUT PRIOR WRITTEN PERMISSION OF RMF FREEZERS, INC. AND IS LOANED SUBJECT TO RETURN ON DEMAND.

PROJECT: WEST LIBERTY FOODS	DRAWN BY GDL	12/1/06	NEXT ASSEMBLY
	CHECKED BY GDL	12/1/06	
LOCATION: TREMONTON, UT	APPROVED BY		

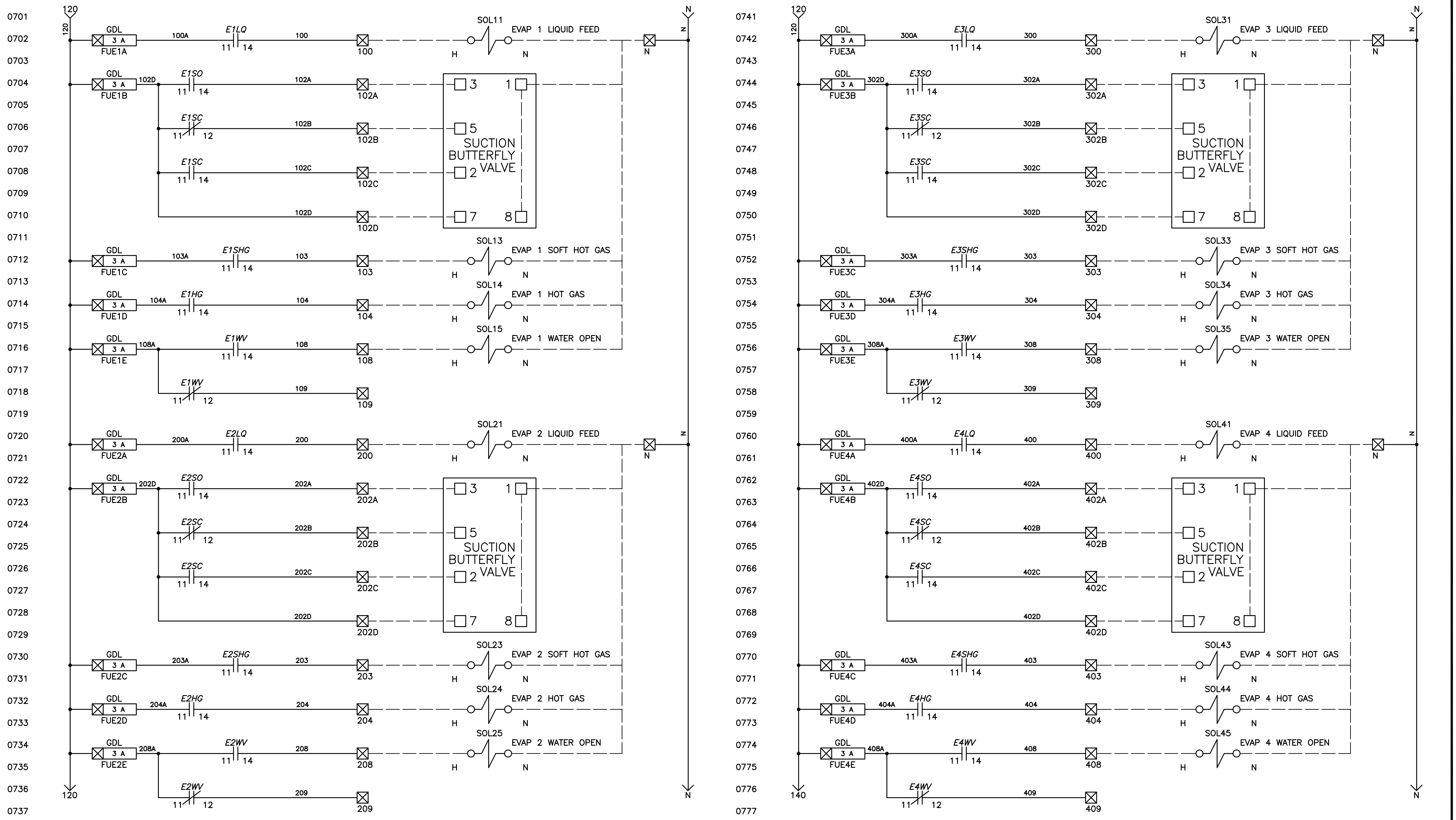
RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE CONTROL WIRING
SPIRAL FREEZER - 0619-064S

DWG NO.		NO. REQD.
DRAWING NO.		REV
0619D1006		D
D	SCALE NONE	
	L2-061108	

REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS
B	GDL	2/13/07	SHOP ASBUILT

REV	BY	DATE	DESCRIPTION
D	GDL	6/5/07	ADD BELT BLOWER



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

NEXT ASSEMBLY

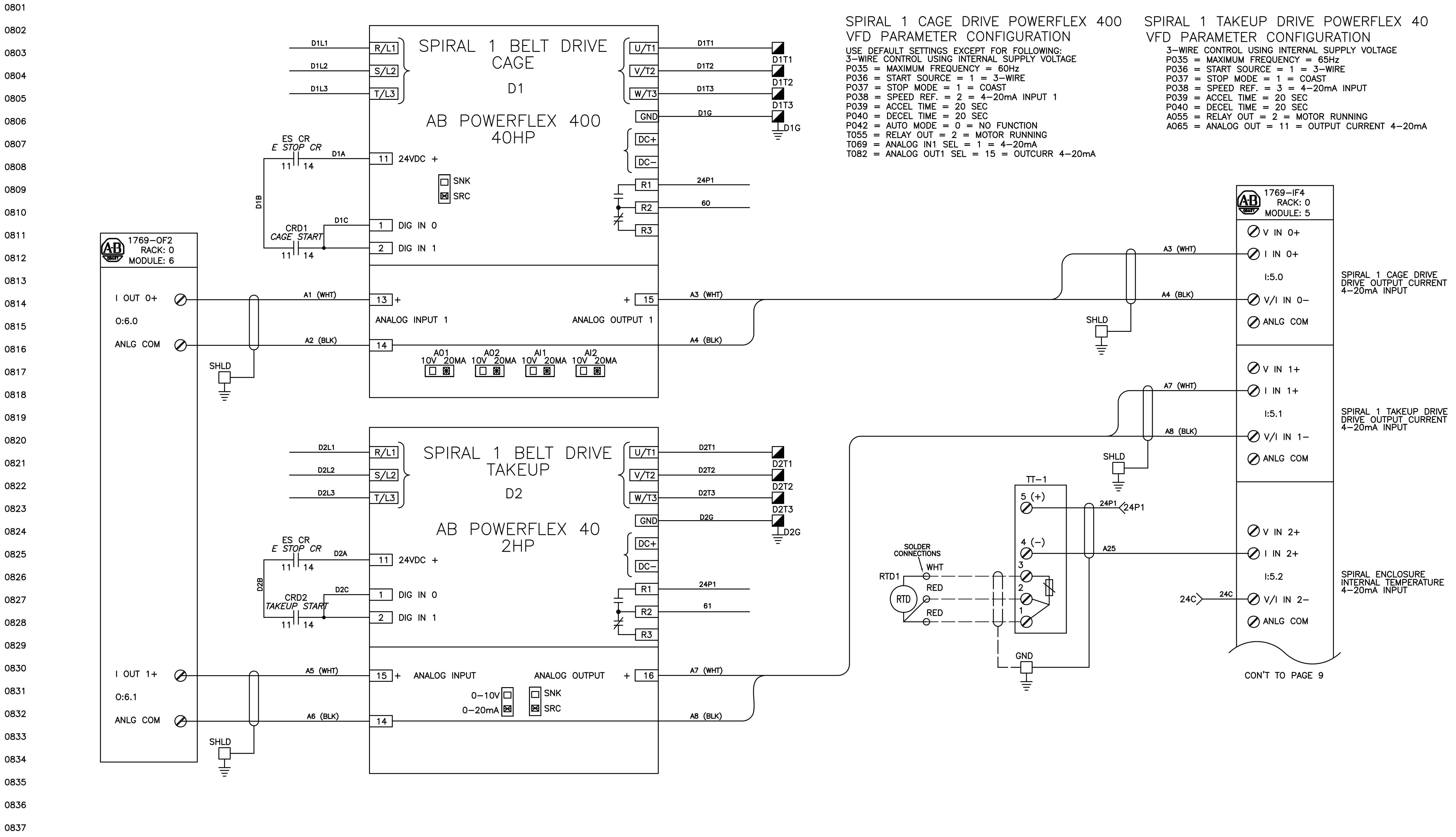
RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

DRAWN BY	GDL	12/1/06
CHECKED BY	GDL	12/1/06
APPROVED BY		

TITLE CONTROL WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1007
REV D
D
SCALE NONE
L2-061108



SPIRAL 1 CAGE DRIVE POWERFLEX 400 VFD PARAMETER CONFIGURATION

USE DEFAULT SETTINGS EXCEPT FOR FOLLOWING:
3−WIRE CONTROL USING INTERNAL SUPPLY VOLTAGE
P035 = MAXIMUM FREQUENCY = 60Hz
P036 = START SOURCE = 1 = 3−WIRE
P037 = STOP MODE = 1 = COAST
P038 = SPEED REF. = 2 = 4−20mA INPUT 1
P039 = ACCEL TIME = 20 SEC
P040 = DECEL TIME = 20 SEC
P042 = AUTO MODE = 0 = NO FUNCTION
T055 = RELAY OUT = 2 = MOTOR RUNNING
T069 = ANALOG IN1 SEL = 1 = 4−20mA
T082 = ANALOG OUT1 SEL = 15 = OUTCURR 4−20mA

SPIRAL 1 TAKEUP DRIVE POWERFLEX 40 VFD PARAMETER CONFIGURATION

3−WIRE CONTROL USING INTERNAL SUPPLY VOLTAGE
P035 = MAXIMUM FREQUENCY = 65Hz
P036 = START SOURCE = 1 = 3−WIRE
P037 = STOP MODE = 1 = COAST
P038 = SPEED REF. = 3 = 4−20mA INPUT
P039 = ACCEL TIME = 20 SEC
P040 = DECEL TIME = 20 SEC
A055 = RELAY OUT = 2 = MOTOR RUNNING
A065 = ANALOG OUT = 11 = OUTPUT CURRENT 4−20mA

C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER
REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

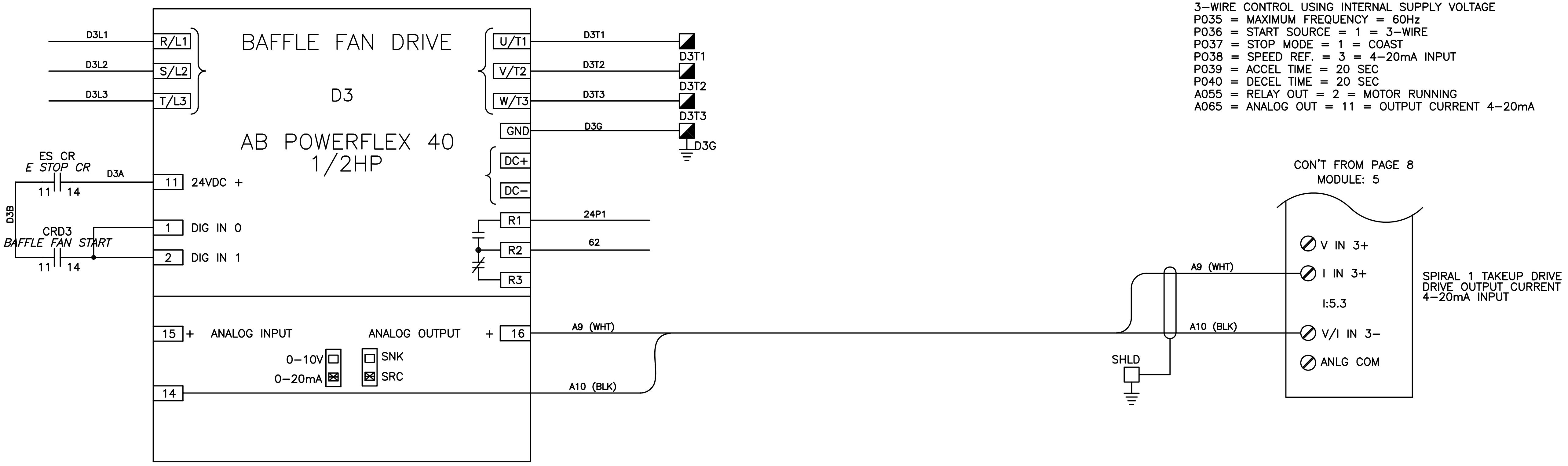
RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE VFD & TEMP WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. D
NO. REQD.
DRAWING NO. 0619D1008
REV D
SCALE NONE
L2-061108

BAFFLE FAN DRIVE POWERFLEX 40
VFD PARAMETER CONFIGURATION

3–WIRE CONTROL USING INTERNAL SUPPLY VOLTAGE
P035 = MAXIMUM FREQUENCY = 60Hz
P036 = START SOURCE = 1 = 3–WIRE
P037 = STOP MODE = 1 = COAST
P038 = SPEED REF. = 3 = 4–20mA INPUT
P039 = ACCEL TIME = 20 SEC
P040 = DECEL TIME = 20 SEC
A055 = RELAY OUT = 2 = MOTOR RUNNING
A065 = ANALOG OUT = 11 = OUTPUT CURRENT 4–20mA



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

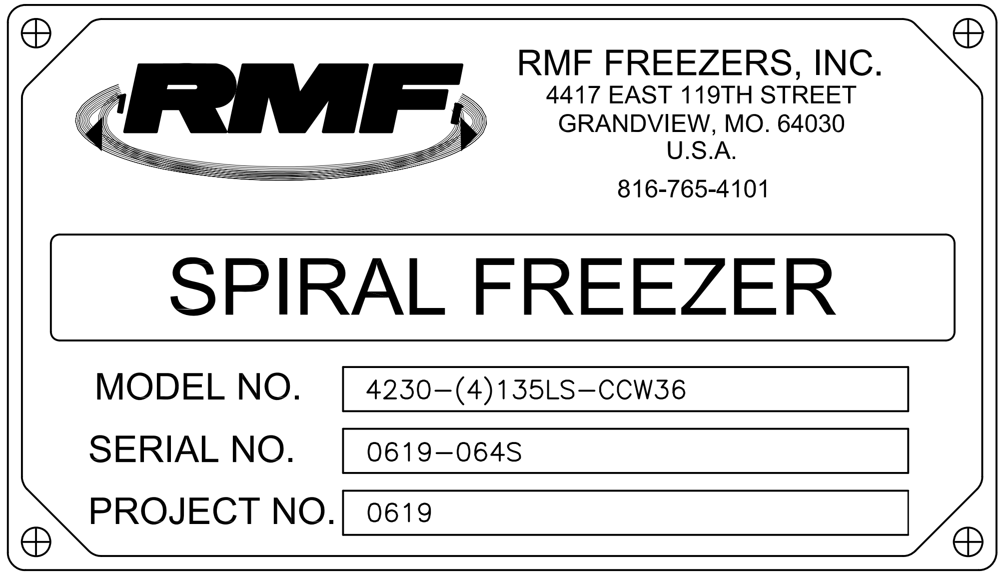
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE BAFFLE FAN VFD WIRING
SPIRAL FREEZER – 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1009 REV D
D SCALE NONE
L2–061108



RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

816-765-4101

SPIRAL FREEZER

MODEL NO. 4230-(4)135LS-CCW36
SERIAL NO. 0619-064S
PROJECT NO. 0619

NAMEPLATE2

DANGER
480
VAC
KEEP
OUT

REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

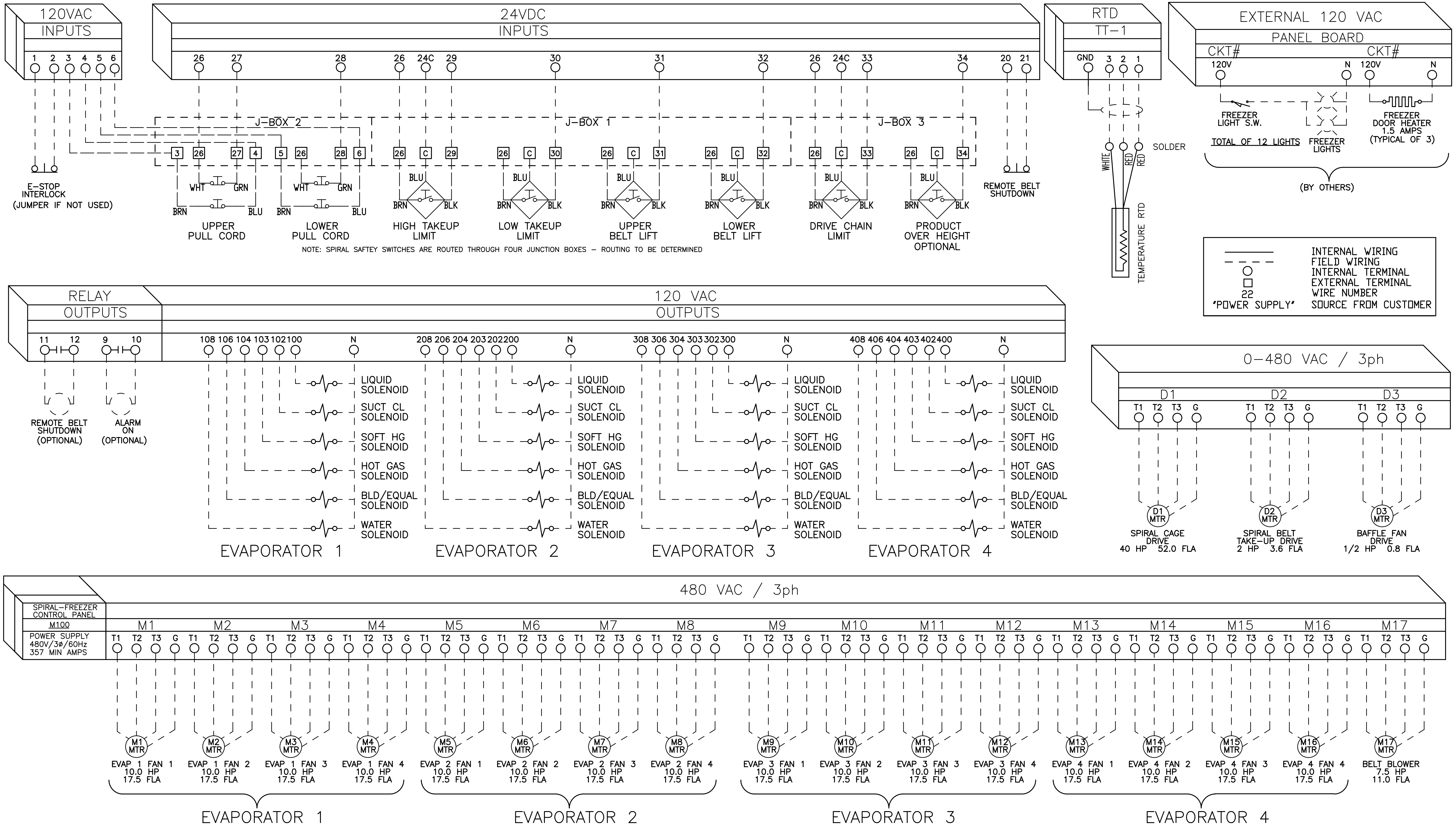
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE CONTROL WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1010 REV D
D SCALE NONE
L2-061108



NOTE: 1. USE 3-WIRE SHIELDED CABLE
ROUTE CABLE AWAY FROM POWER
SOLDER CONNECTIONS AT RTD

2. KEEP VFD TO MOTOR LEAD LENGTH TO A MINIMUM

3. WARNING THHN WIRE IS NOT TEMPERATURE RATED FOR SOME FREEZER APPLICATIONS
INSTALL WIRE RATED FOR DESIGNED TEMPERATURE

4. AFTER RTD IS INSTALLED IN ENCLOSURE
AND BEFORE CONNECTING TO TERMINALS AT THE PLC
MEASURE THE RESISTANCE BETWEEN
THE WHITE WIRE AND THE (RED OR BLACK WIRES)
RESISTANCE BETWEEN BLACK AND RED = .1 TO 10 OHMS
RESISTANCE BETWEEN BLACK AND WHITE = 100 TO 110 OHMS
RESISTANCE BETWEEN RED AND WHITE = 100 TO 110 OHMS

5. SEE PREFERRED CONDUIT ENTRY ON DWG 0504D1001

REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

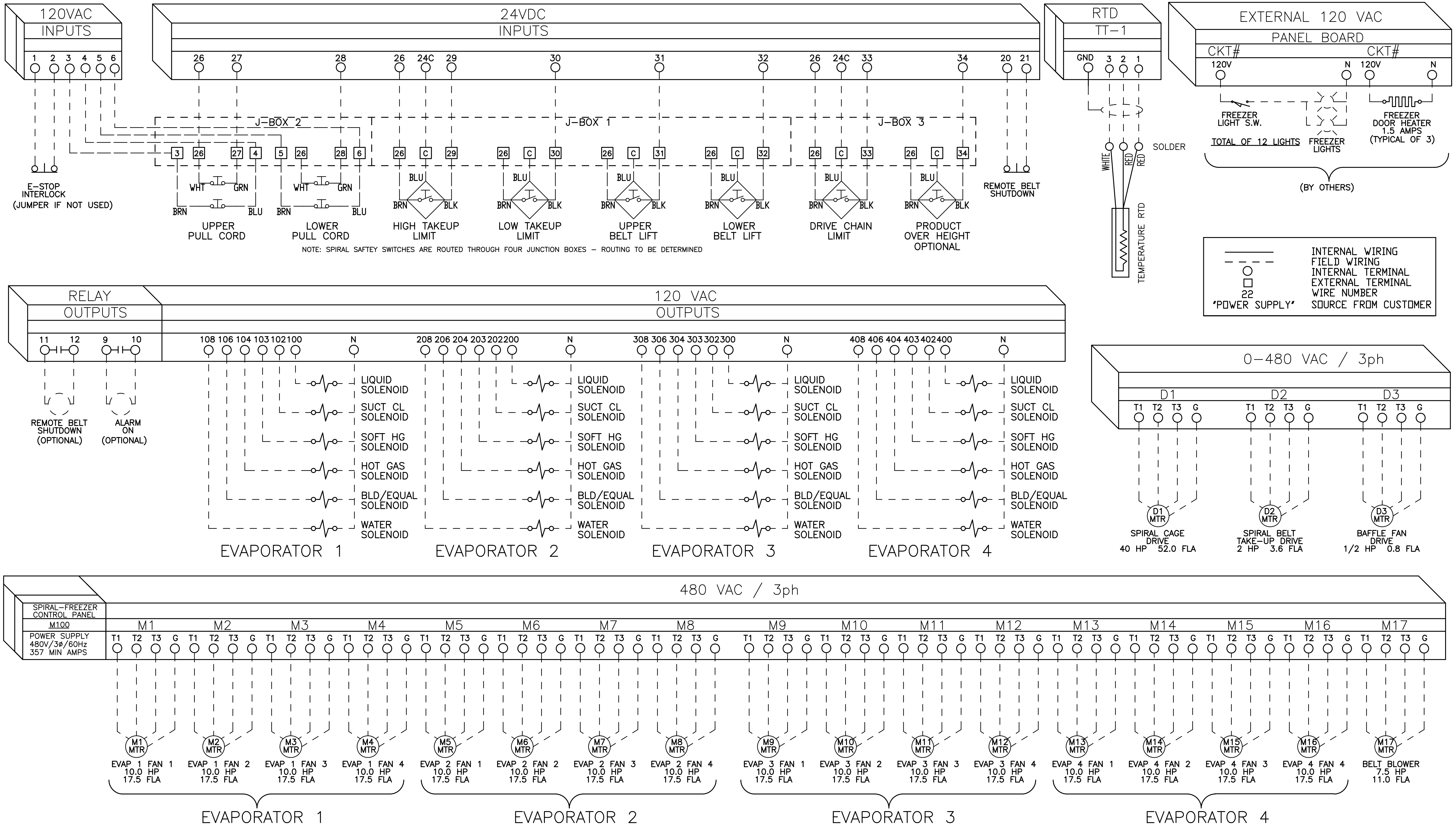
PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE
FIELD WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1011
REV D
D
SCALE NONE
L2-061108



NOTE: 1. USE 3-WIRE SHIELDED CABLE
ROUTE CABLE AWAY FROM POWER
SOLDER CONNECTIONS AT RTD

2. KEEP VFD TO MOTOR LEAD LENGTH TO A MINIMUM

3. WARNING THHN WIRE IS NOT TEMPERATURE RATED FOR SOME FREEZER APPLICATIONS
INSTALL WIRE RATED FOR DESIGNED TEMPERATURE

4. AFTER RTD IS INSTALLED IN ENCLOSURE
AND BEFORE CONNECTING TO TERMINALS AT THE PLC
MEASURE THE RESISTANCE BETWEEN
THE WHITE WIRE AND THE (RED OR BLACK WIRES)
RESISTANCE BETWEEN BLACK AND RED = .1 TO 10 OHMS
RESISTANCE BETWEEN BLACK AND WHITE = 100 TO 110 OHMS
RESISTANCE BETWEEN RED AND WHITE = 100 TO 110 OHMS

5. SEE PREFERRED CONDUIT ENTRY ON DWG 0504D1001

REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

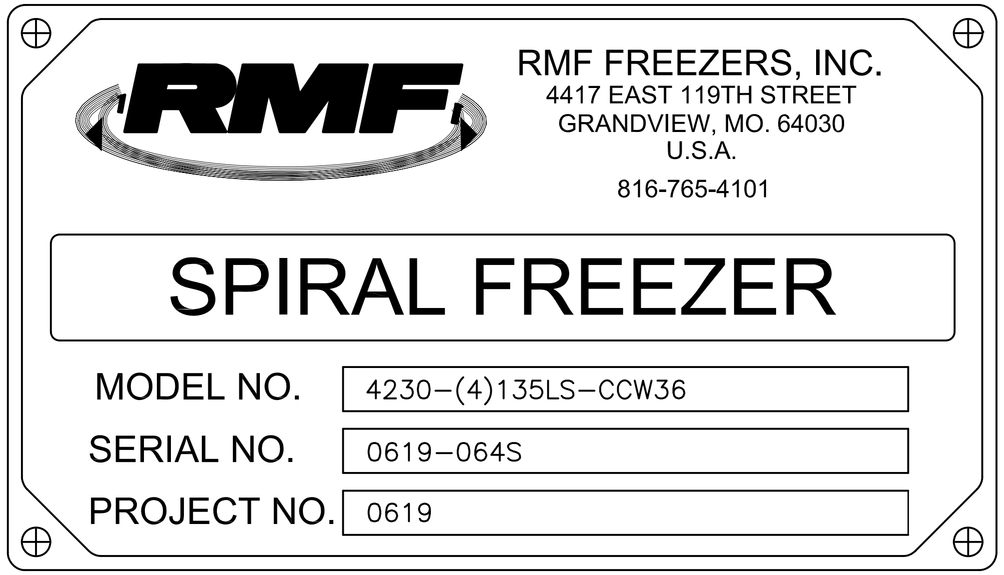
DRAWN BY	GDL	12/1/06
CHECKED BY	GDL	12/1/06
APPROVED BY		

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE
FIELD WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1011
REV D
D
SCALE NONE
L2-061108



NAMEPLATE2

DANGER
480
VAC
KEEP
OUT

REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

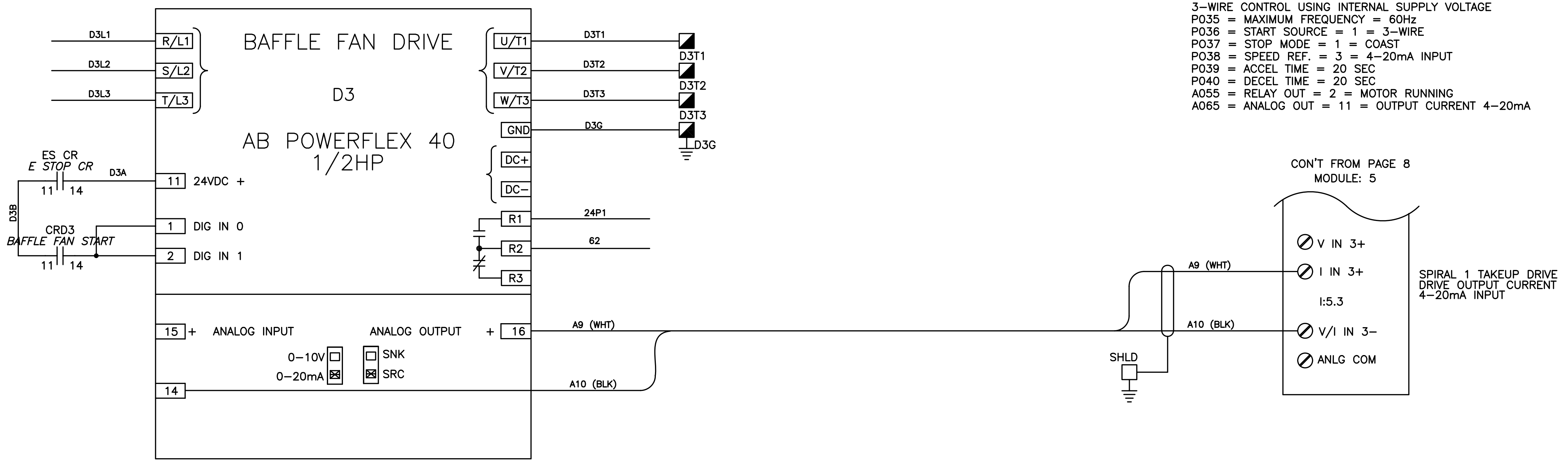
RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE CONTROL WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. | NO. REQD.
DRAWING NO. 0619D1010
REV D
D
SCALE NONE
L2-061108

BAFFLE FAN DRIVE POWERFLEX 40
VFD PARAMETER CONFIGURATION

3–WIRE CONTROL USING INTERNAL SUPPLY VOLTAGE
P035 = MAXIMUM FREQUENCY = 60Hz
P036 = START SOURCE = 1 = 3–WIRE
P037 = STOP MODE = 1 = COAST
P038 = SPEED REF. = 3 = 4–20mA INPUT
P039 = ACCEL TIME = 20 SEC
P040 = DECEL TIME = 20 SEC
A055 = RELAY OUT = 2 = MOTOR RUNNING
A065 = ANALOG OUT = 11 = OUTPUT CURRENT 4–20mA



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

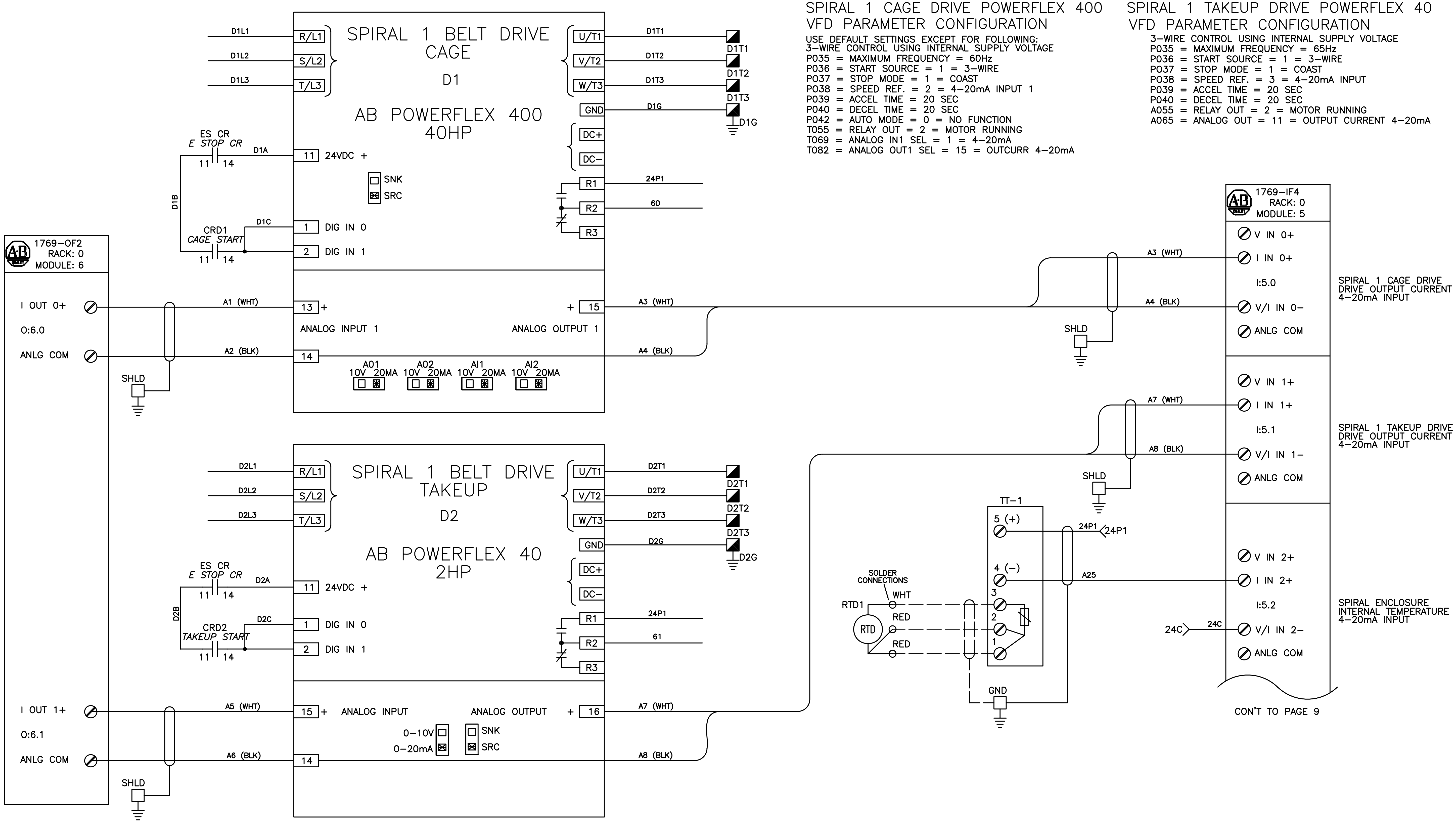
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF
RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE BAFFLE FAN VFD WIRING
SPIRAL FREEZER – 0619–064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1009 REV D
D SCALE NONE
L2–061108



SPIRAL 1 CAGE DRIVE POWERFLEX 400 VFD PARAMETER CONFIGURATION

USE DEFAULT SETTINGS EXCEPT FOR FOLLOWING:
3−WIRE CONTROL USING INTERNAL SUPPLY VOLTAGE
P035 = MAXIMUM FREQUENCY = 60Hz
P036 = START SOURCE = 1 = 3−WIRE
P037 = STOP MODE = 1 = COAST
P038 = SPEED REF. = 2 = 4−20mA INPUT 1
P039 = ACCEL TIME = 20 SEC
P040 = DECEL TIME = 20 SEC
P042 = AUTO MODE = 0 = NO FUNCTION
T055 = RELAY OUT = 2 = MOTOR RUNNING
T069 = ANALOG IN1 SEL = 1 = 4−20mA
T082 = ANALOG OUT1 SEL = 15 = OUTCURR 4−20mA

SPIRAL 1 TAKEUP DRIVE POWERFLEX 40 VFD PARAMETER CONFIGURATION

3−WIRE CONTROL USING INTERNAL SUPPLY VOLTAGE
P035 = MAXIMUM FREQUENCY = 65Hz
P036 = START SOURCE = 1 = 3−WIRE
P037 = STOP MODE = 1 = COAST
P038 = SPEED REF. = 3 = 4−20mA INPUT
P039 = ACCEL TIME = 20 SEC
P040 = DECEL TIME = 20 SEC
A055 = RELAY OUT = 2 = MOTOR RUNNING
A065 = ANALOG OUT = 11 = OUTPUT CURRENT 4−20mA

C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER
REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

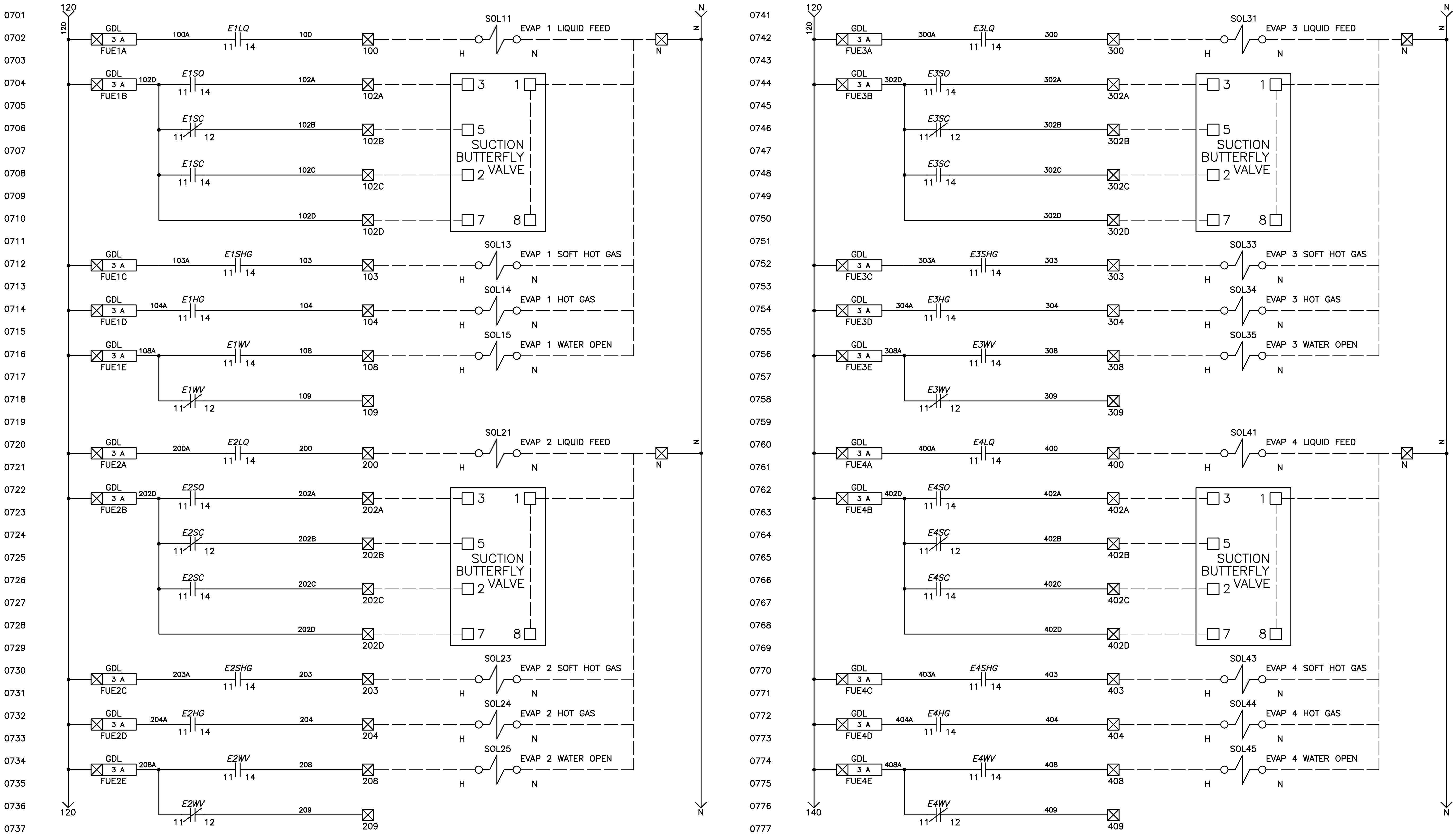
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE VFD & TEMP WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1008 REV D
D
SCALE NONE
L2−061108



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS

LOCATION: TREMONTON, UT

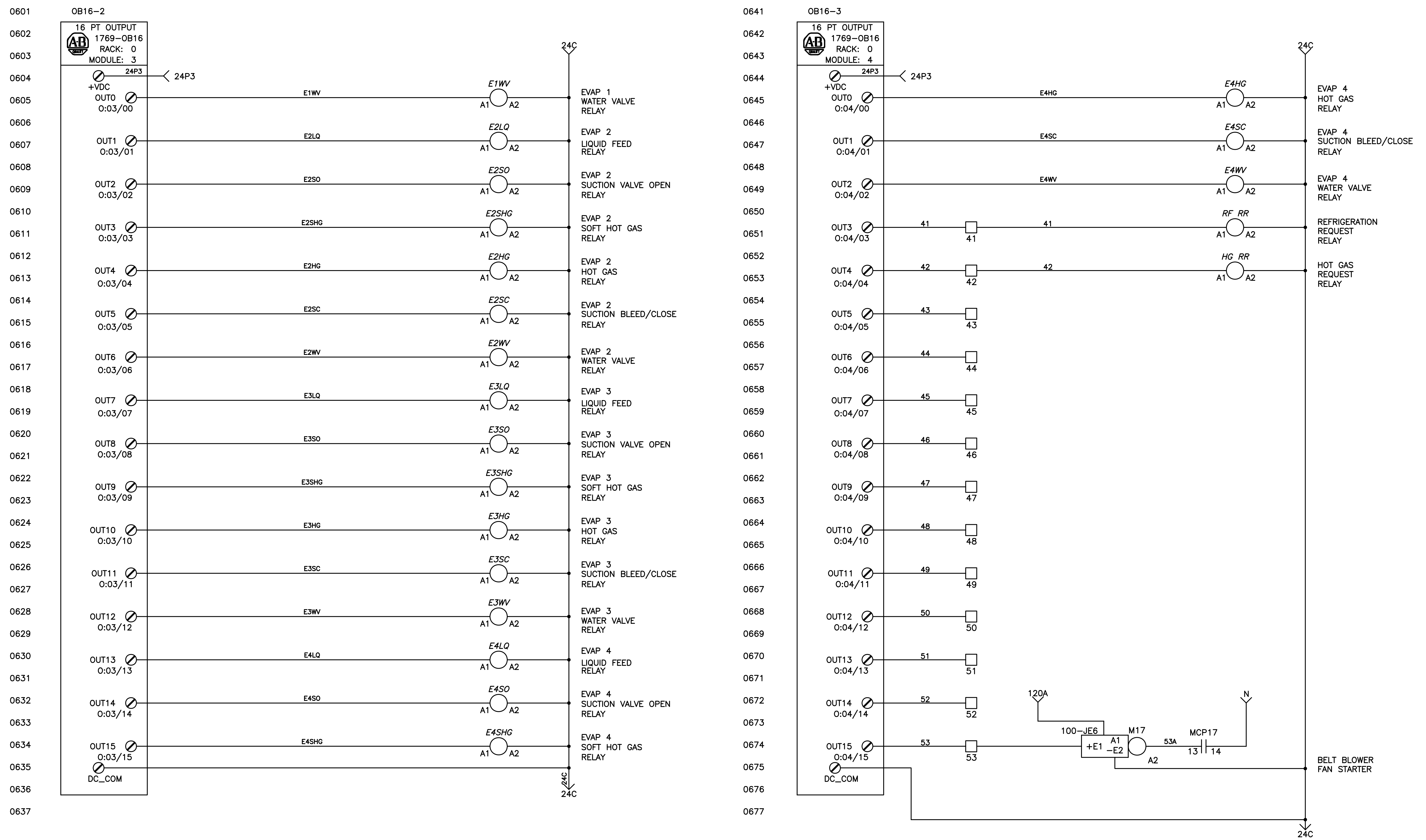
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE CONTROL WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1007
REV D
D
SCALE NONE
L2-061108



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

NEXT ASSEMBLY

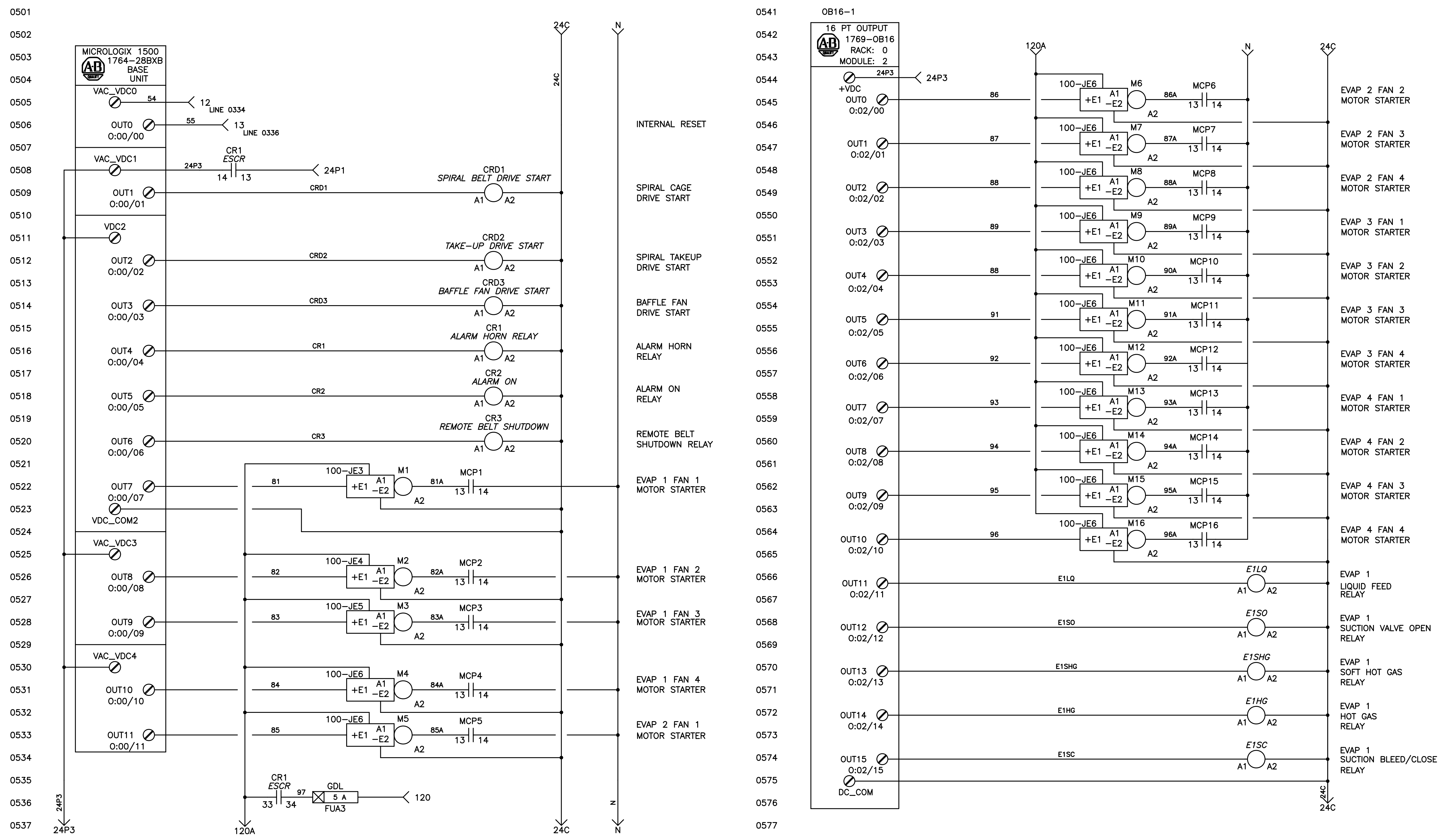
RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

DRAWN BY	GDL	12/1/06
CHECKED BY	GDL	12/1/06
APPROVED BY		

TITLE CONTROL WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. 0619D1006 REV D
D SCALE NONE
L2-061108



REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS
B	GDL	2/13/07	SHOP ASBUILT

REV	BY	DATE	DESCRIPTION
D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

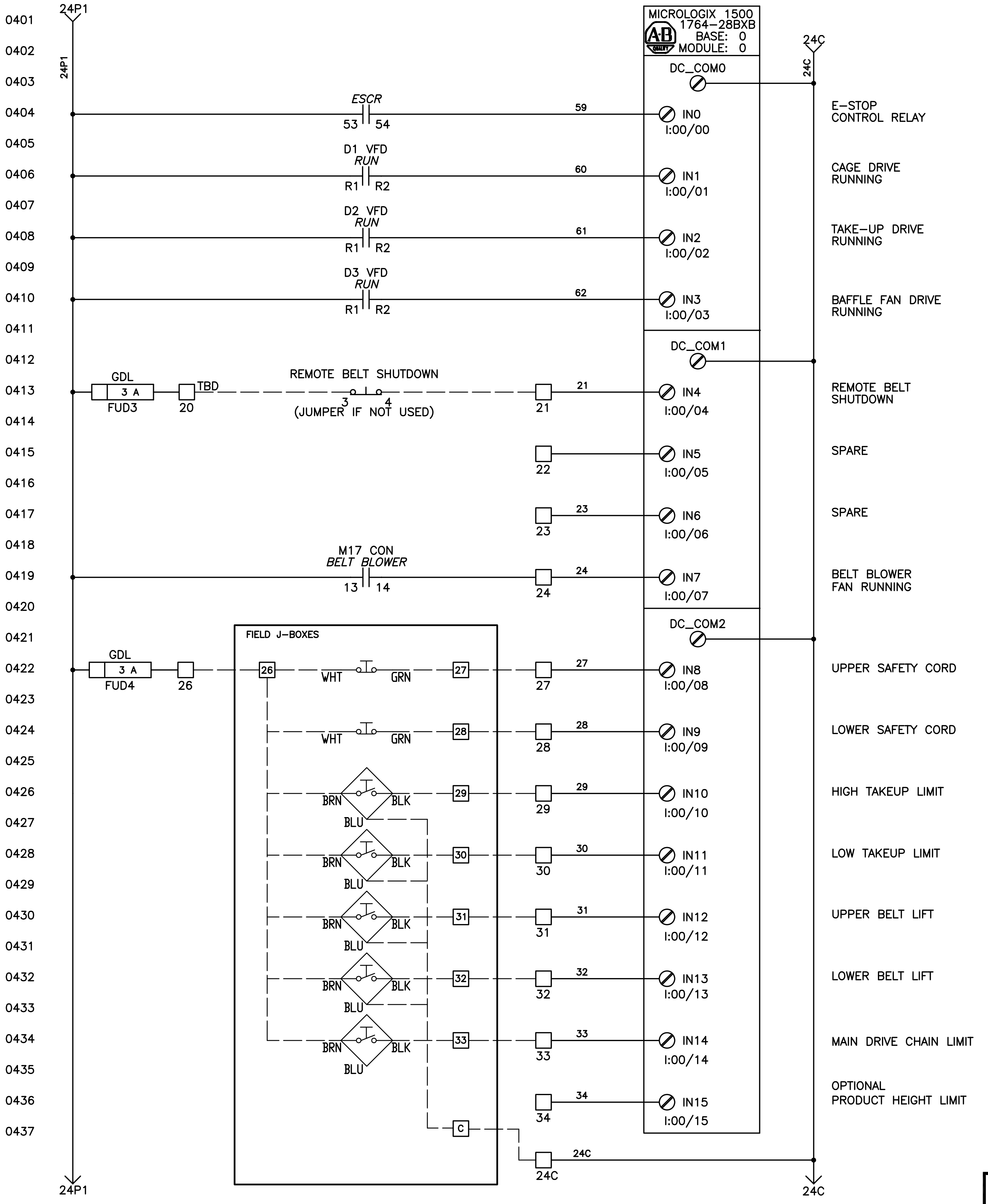
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

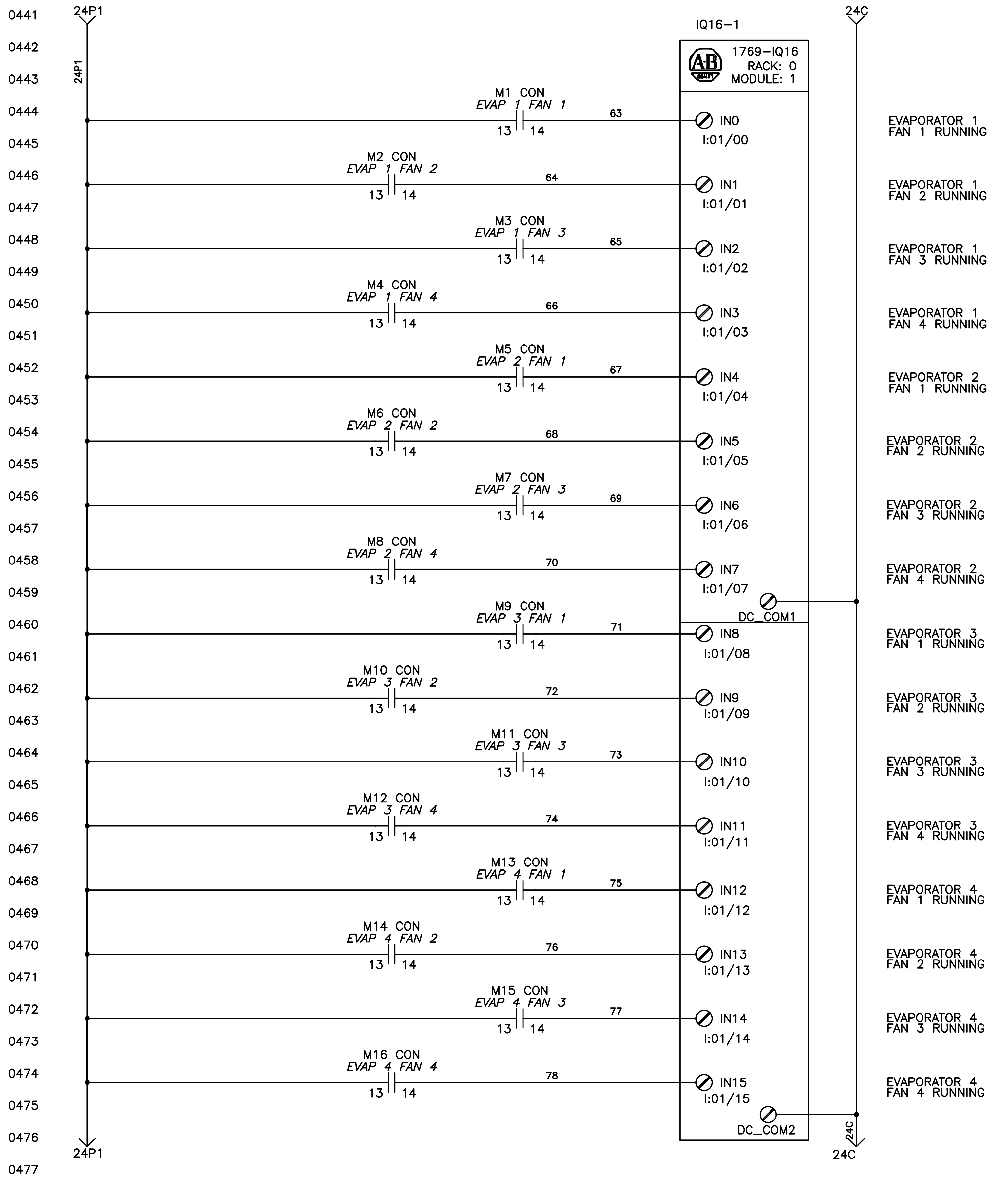
NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE
CONTROL WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. NO. REQD.
DRAWING NO. REV
0619D1005 D
D SCALE NONE
L2-061108





C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER
REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

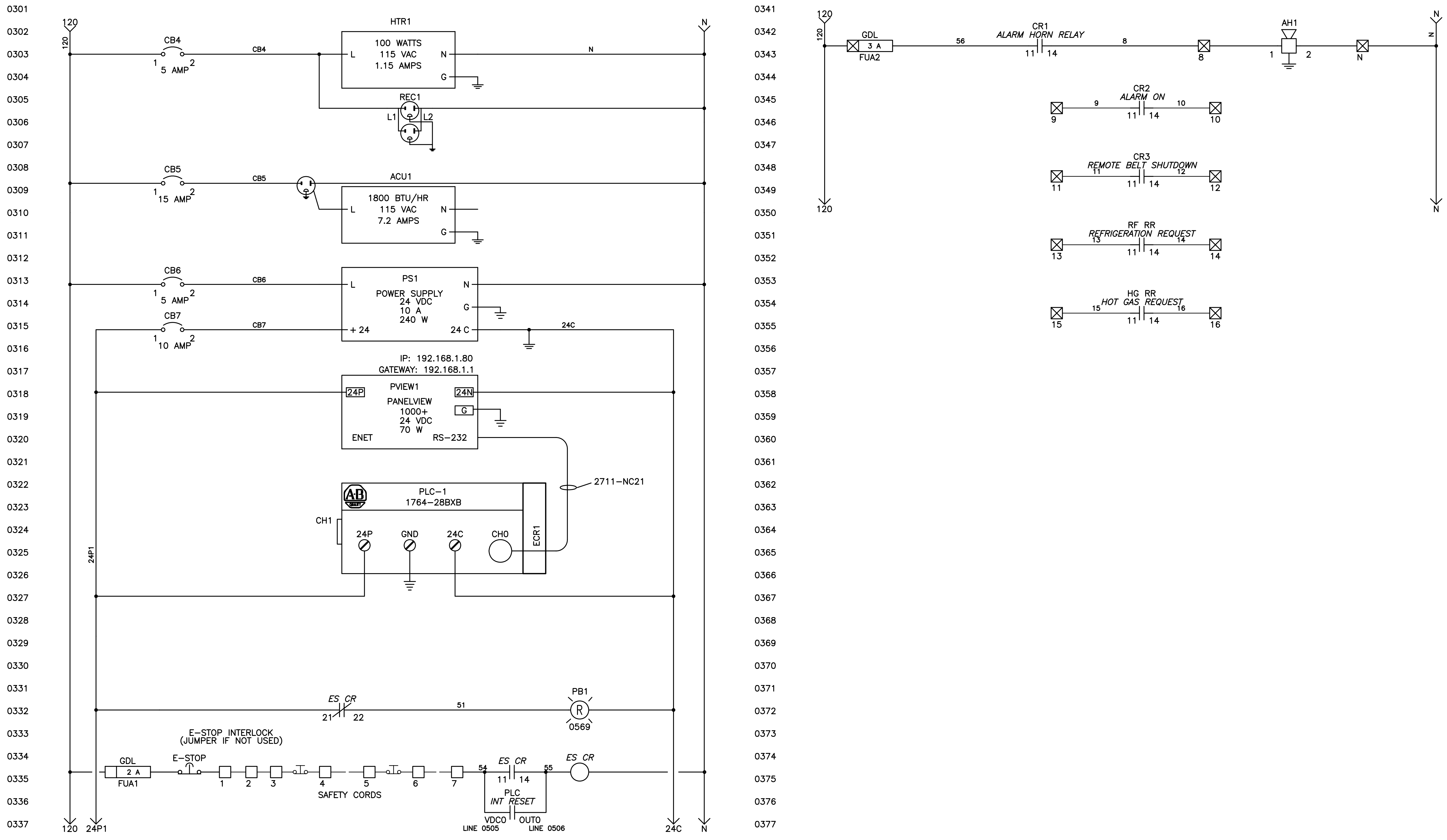
DRAWN BY	GDL	12/1/06
CHECKED BY	GDL	12/1/06
APPROVED BY		

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE
CONTROL WIRING
SPIRAL FREEZER - 0619-064S

DWG NO.	NO. REQD.
DRAWING NO.	REV
0619D1004	D
D	SCALE NONE
	L2-061108



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT

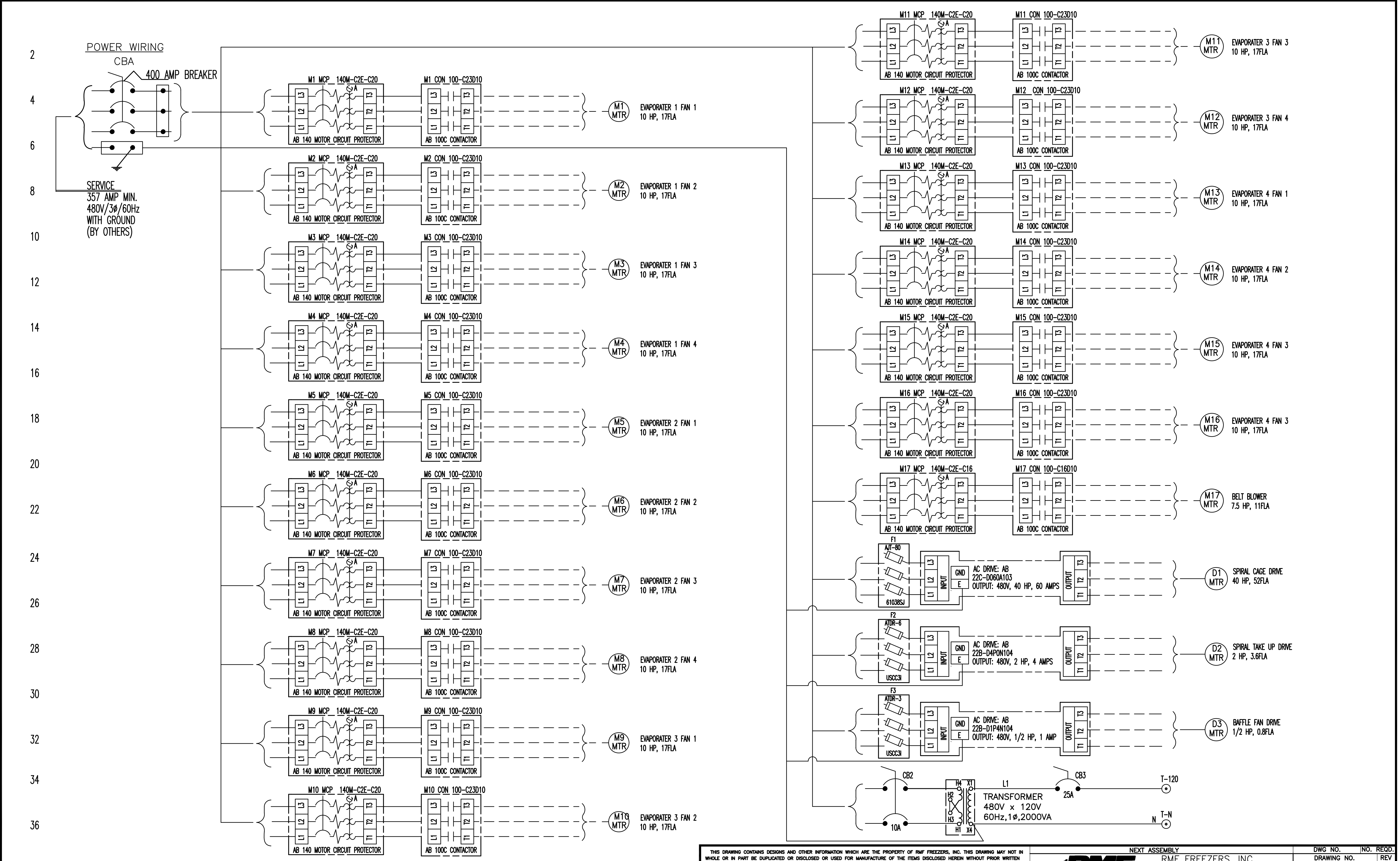
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE
POWER WIRING
SPIRAL FREEZER - 0619-064S

DWG NO. | NO. REQD.
DRAWING NO. 0619D1003
REV D
D
SCALE NONE
L2-061108



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
C	GDL	5/3/07	UPDATE SAFETY PINOUTS				
B	GDL	2/13/07	SHOP ASBUILT	D	GDL	6/5/07	ADD BELT BLOWER

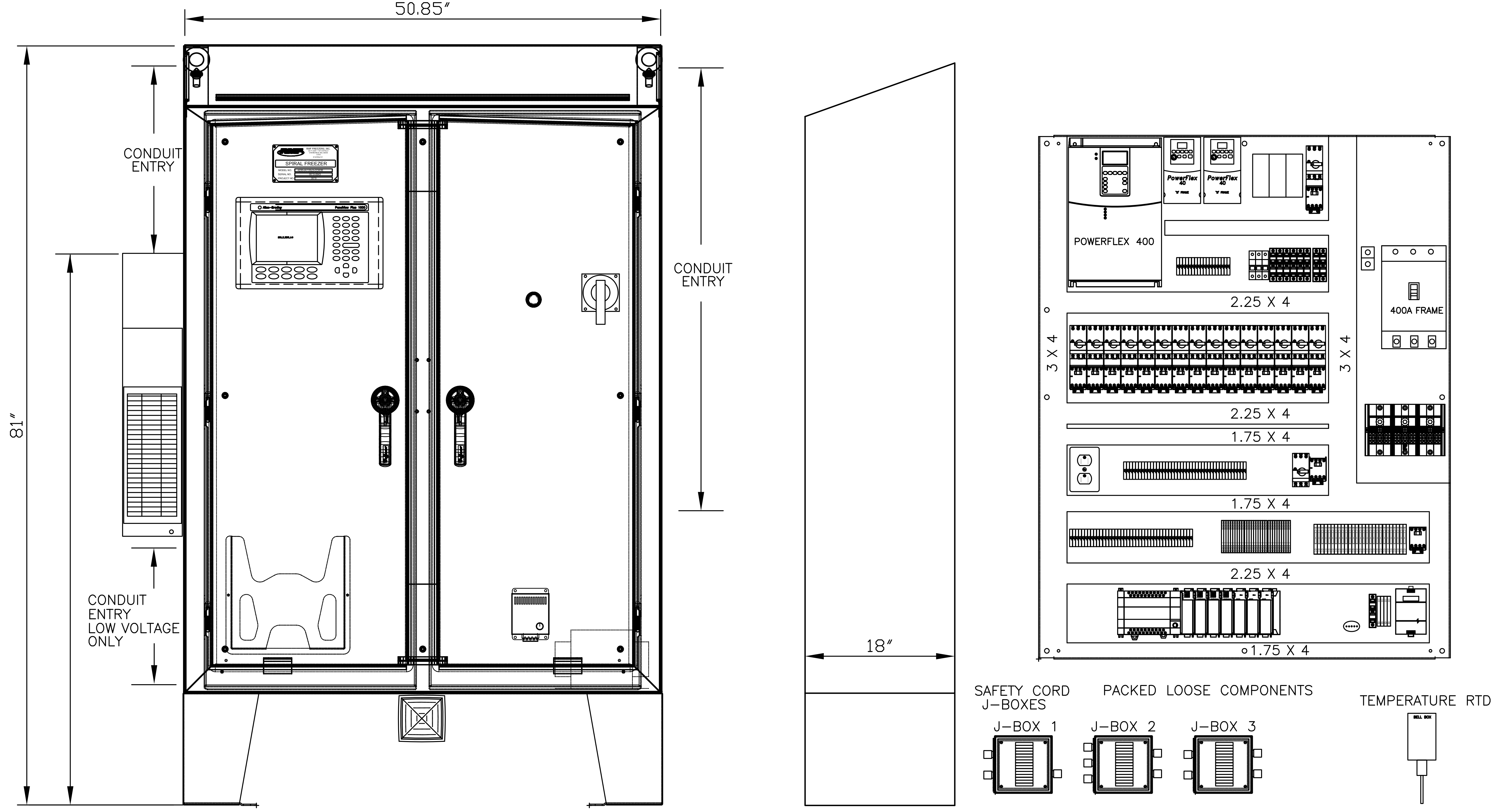
PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT
DRAWN BY GDL 12/18/06
CHECKED BY GDL 12/18/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE
POWER WIRING
SPIRAL FREEZER - 0619-064S

DWG NO.
NO. REQD.
DRAWING NO. 0619D1002
REV D
D
SCALE NONE
L2-061108



REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
B	GDL	2/13/07	SHOP ASBUILT	C	GDL	5/3/07	UPDATE SAFETY PINOUTS
A1	GDL	1/12/07	PRELIMINARY – UPGRADE MAIN DRIVE & ADD BAFFLE FAN	D	GDL	6/5/07	ADD BELT BLOWER
A	GDL	12/18/06	PRELIMINARY NOT FOR CONSTRUCTION				

PROJECT: WEST LIBERTY FOODS
LOCATION: TREMONTON, UT
DRAWN BY GDL 12/1/06
CHECKED BY GDL 12/1/06
APPROVED BY

NEXT ASSEMBLY

RMF FREEZERS, INC.
4417 EAST 119TH STREET
GRANDVIEW, MO. 64030
U.S.A.

TITLE
PANEL LAYOUT
SPIRAL FREEZER - 0619-064S

DWG NO. | NO. REQD.
DRAWING NO. 0619D1001
REV D
D
SCALE 1 = 9.65
L2-061108

www.abpowerflex.com

Allen-Bradley

PowerFlex® 40

Adjustable Frequency AC Drive

FRN 2.xx

22B-D4P0N104
22B-D1P4N104

ITEM # 20 & 21

User Manual

Revision "C" February '04
Approved 2/24/04

Revision "D" Next

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. "*Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls*" (Publication SGI-1.1 available from your local Rockwell Automation Sales Office or online at **http://www.ab.com/manuals/gi**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc. is prohibited.

Throughout this manual we use notes to make you aware of safety considerations.

⚠ **ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

Important: Identifies information that is especially important for successful application and understanding of the product.

Shock Hazard labels may be located on or inside the drive to alert people that dangerous voltage may be present.

Summary of Changes

The information below summarizes the changes to the PowerFlex 40 *User Manual* since the June 2003 release.

Description of New or Updated Information	**See Page(s)**
600 Volt ratings added to product line.	Throughout
480 Volt, 11 kW (15 HP) rating added to product line.	Throughout
Position 12 of the Catalog Number now indicates drive type.	P-4
Flange Mount drive enclosure added.	P-4, B-9
Remote HIM Menu Structure added.	2-5
The following parameters have been added: d029 [Torque Current] P042 [Voltage Class] A109 [Anlg out Setpt] A115 [Process Time Lo] A116 [Process Time Hi] A117 [Bus Reg Mode] A160 [EM Brk Off Delay] A161 [EM Brk On Delay] A162 [MOP Reset Sel]	 3-8 3-13 3-32 3-33 3-33 3-33 3-41 3-41 3-41
Options have been added to the following parameters: P036 [Start Source] P037 [Stop Mode] P038 [Speed Reference] A051-A054 [Dig Inx Sel] A055 [Relay Out Sel] A058 & A061 [Opto Outx Sel] A065 [Analog Out Sel]	 3-10 3-11 3-12 3-14 3-15 3-17 3-20
All drive ratings now support dynamic braking.	B-2
Remote Small HIM, Cat. No. 22-HIM-C2S, dimensions added.	B-17

The information below summarizes the changes to the PowerFlex 40 *User Manual* since the January 2003 release.

Description of New or Updated Information	See Page(s)
Fusing and circuit breaker information updated.	1-6
Requirements for motor cable types expanded.	1-8
I/O wring examples clarified.	1-16
Parameter A136 [PID Diff Rate] default value is 0.00.	3-38
Minimum resistance values for Dynamic Brake Modules added.	B-2
Inductance rating for 480 Volt, 2.2 kW (3.0 HP) Bulletin 1321-3R Series Line Reactor corrected.	B-3
Dimensions for NEMA Type 1 Bezel kit corrected.	B-18
Appendix E: Step Logic, Basic Logic and Timer/Counter Functions added	E-1
Appendix F: PID Setup added	F-1

Table of Contents

Overview

The purpose of this manual is to provide you with the basic information needed to install, start-up and troubleshoot the PowerFlex 40 Adjustable Frequency AC Drive.

Who Should Use this Manual?

This manual is intended for qualified personnel. You must be able to program and operate Adjustable Frequency AC Drive devices. In addition, you must have an understanding of the parameter settings and functions.

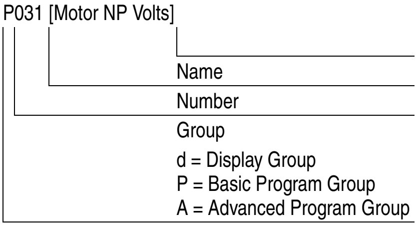
Reference Materials

The following manuals are recommended for general drive information:

Title	Publication	Available Online at …
Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives	DRIVES-IN001…	**www.ab.com/manuals/dr**
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001…	**www.ab.com/manuals/dr**
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1	**www.ab.com/manuals/gi**
A Global Reference Guide for Reading Schematic Diagrams	100-2.10	**www.ab.com/manuals/gi**
Guarding Against Electrostatic Damage	8000-4.5.2	**www.ab.com/manuals/dr**

Manual Conventions

- In this manual we refer to the PowerFlex 40 Adjustable Frequency AC Drive as; drive, PowerFlex 40 or PowerFlex 40 Drive.
- Parameter numbers and names are shown in this format:



- The following words are used throughout the manual to describe an action:

Word	Meaning
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Shall	Required and necessary
Should	Recommended
Should Not	Not Recommended

Drive Frame Sizes

Similar PowerFlex 40 drive sizes are grouped into frame sizes to simplify spare parts ordering, dimensioning, etc. A cross reference of drive catalog numbers and their respective frame sizes is provided in Appendix B.

General Precautions

ATTENTION: The drive contains high voltage capacitors which take time to discharge after removal of mains supply. Before working on drive, ensure isolation of mains supply from line inputs [R, S, T (L1, L2, L3)]. Wait three minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death.

Darkened display LEDs is not an indication that capacitors have discharged to safe voltage levels.

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, "Guarding Against Electrostatic Damage" or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

Catalog Number Explanation

1-3	4	5	6-8	9	10	11	12[1]	13-14
22B	**-**	**A**	**1P5**	**N**	**1**	**1**	**4**	**AA**
Drive	Dash	Voltage Rating	Rating	Enclosure	HIM	Emission Class	Type	Optional

Code	
22B	PowerFlex 40

Code	**Version**
4	Standard

Code	**Rating**
0	Not Filtered
1	Filtered

Code	**Voltage**	**Ph.**
V	120V AC	1
A	240V AC	1
B	240V AC	3
D	480V AC	3
E	600V AC	3

Code	**Interface Module**
1	Fixed Keypad

Code	**Purpose**
AA thru ZZ	Reserved for custom firmware

Code	**Enclosure**
N	Panel Mount - IP 20 (NEMA Type Open)
F	Flange Mount - IP 20 (NEMA Type Open)
H	Replacement Plate Drive - IP 20 (NEMA Type Open) *- Contact factory for ordering information.*

Output Current @ 100-120V Input

Code	**Amps**	**kW (HP)**
2P3	2.3	0.4 (0.5)
5P0	5.0	0.75 (1.0)
6P0	6.0	1.1 (1.5)

Output Current @ 200-240V Input

Code	**Amps**	**kW (HP)**
2P3	2.3	0.4 (0.5)
5P0	5.0	0.75 (1.0)
8P0	8.0	1.5 (2.0)
012	12	2.2 (3.0)
017	17.5	3.7 (5.0)
024	24	5.5 (7.5)
033	33	7.5 (10)

Output Current @ 380-480V Input

Code	**Amps**	**kW (HP)**
1P4	1.4	0.4 (0.5)
2P3	2.3	0.75 (1.0)
4P0	4.0	1.5 (2.0)
6P0	6.0	2.2 (3.0)
010	10.5	4.0 (5.0)
012	12	5.5 (7.5)
017	17	7.5 (10)
024	24	11 (15)

Output Current @ 500-600V Input

Code	**Amps**	**kW (HP)**
1P7	1.7	0.75 (1.0)
3P0	3.0	1.5 (2.0)
4P2	4.2	2.2 (3.0)
6P6	6.6	4.0 (5.0)
9P9	9.9	5.5 (7.5)
012	12.2	7.5 (10)
019	19	11 (15)

(1) Position 12 of the Catalog Number now indicates drive type. All PowerFlex 40 drives are equipped with RS485 communication.

Additional accessories, options and adapters are available. See Appendix B for details.

Chapter 1

Installation/Wiring

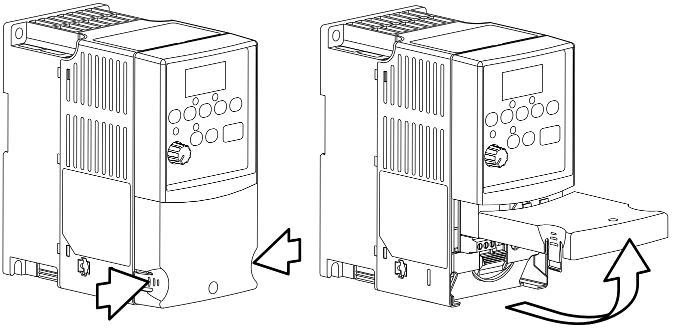
This chapter provides information on mounting and wiring the PowerFlex 40 Drive.

Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.

ATTENTION: The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

Opening the Cover

1. Press and hold in the tabs on each side of the cover.
2. Pull the cover out and up to release.



Mounting Considerations

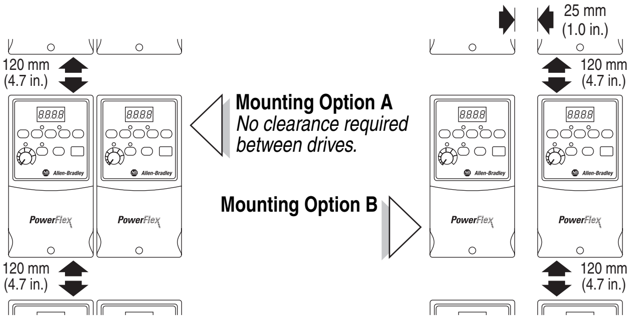
- Mount the drive upright on a flat, vertical and level surface.

Frame	Screw Size	Screw Torque	DIN Rail
B	M4 (#8-32)	1.56-1.96 N-m (14-17 lb.-in.)	35 mm
C	M5 (#10-24)	2.45-2.94 N-m (22-26 lb.-in.)	–

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

Minimum Mounting Clearances

Refer to Appendix B for mounting dimensions.



Ambient Operating Temperatures

Table 1.A Enclosure and Clearance Requirements

Ambient Temperature		Enclosure Rating	Minimum Mounting Clearances
Minimum	Maximum		
-10°C (14°F)	40°C (104°F)	IP 20/Open Type	Use Mounting Option A
		IP 30/NEMA 1/UL Type 1(1)	Use Mounting Option B
	50°C (122°F)	IP 20/Open Type	Use Mounting Option B

(1) Rating requires installation of the PowerFlex 40 IP 30/NEMA 1/UL Type 1 option kit.

Debris Protection

A plastic top panel is included with the drive. Install the panel to prevent debris from falling through the vents of the drive housing during installation. Remove the panel for IP 20/Open Type applications.

Storage

- Store within an ambient temperature range of -40° to +85°C.
- Store within a relative humidity range of 0% to 95%, non-condensing.
- Do not expose to a corrosive atmosphere.

AC Supply Source Considerations

Ungrounded Distribution Systems

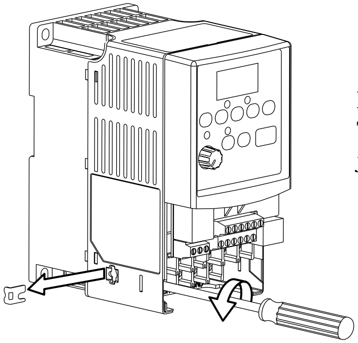
ATTENTION: PowerFlex 40 drives contain protective MOVs that are referenced to ground. These devices should be disconnected if the drive is installed on an ungrounded distribution system.

Disconnecting MOVs

To prevent drive damage, the MOVs connected to ground shall be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. To disconnect these devices, remove the jumper shown in the Figures 1.1 and 1.2.

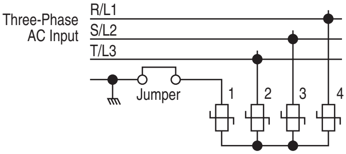
1. Turn the screw counterclockwise to loosen.
2. Pull the jumper completely out of the drive chassis.
3. Tighten the screw to keep it in place.

Figure 1.1 Jumper Location (Typical)



Important:
Tighten screw after jumper removal.

Figure 1.2 Phase to Ground MOV Removal



Input Power Conditioning

The drive is suitable for direct connection to input power within the rated voltage of the drive (see Appendix A). Listed in Table 1.B are certain input power conditions which may cause component damage or reduction in product life. If any of the conditions exist, as described in Table 1.B, install one of the devices listed under the heading *Corrective Action* on the line side of the drive.

Important: Only one device per branch circuit is required. It should be mounted closest to the branch and sized to handle the total current of the branch circuit.

Table 1.B Input Power Conditions

Input Power Condition	Corrective Action
Low Line Impedance (less than 1% line reactance)	• Install Line Reactor(2) • or Isolation Transformer • or Bus Inductor – 5.5 & 11 kW (7.5 & 15 HP) drives only
Greater than 120 kVA supply transformer	
Line has power factor correction capacitors	• Install Line Reactor • or Isolation Transformer
Line has frequent power interruptions	
Line has intermittent noise spikes in excess of 6000V (lightning)	
Phase to ground voltage exceeds 125% of normal line to line voltage	• Remove MOV jumper to ground. • or Install Isolation Transformer with grounded secondary if necessary.
Ungrounded distribution system	
240V open delta configuration (stinger leg)(1)	• Install Line Reactor

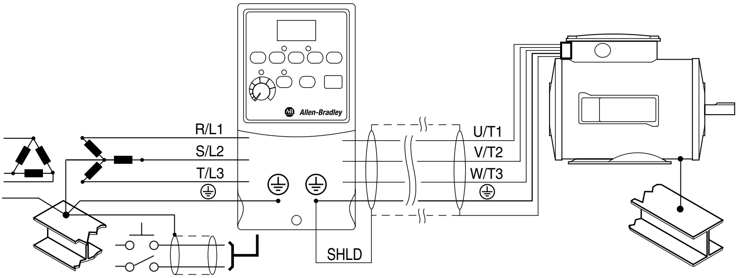
(1) For drives applied on an open delta with a middle phase grounded neutral system, the phase opposite the phase that is tapped in the middle to the neutral or earth is referred to as the “stinger leg,” “high leg,” “red leg,” etc. This leg should be identified throughout the system with red or orange tape on the wire at each connection point. The stinger leg should be connected to the center Phase B on the reactor. Refer to Table B.D for specific line reactor part numbers.

(2) Refer to Appendix B for accessory ordering information.

General Grounding Requirements

The drive Safety Ground - ⏚ (PE) must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

Figure 1.3 Typical Grounding



Ground Fault Monitoring

If a system ground fault monitor (RCD) is to be used, only Type B (adjustable) devices should be used to avoid nuisance tripping.

Safety Ground - ⏚ (PE)

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

Shield Termination - SHLD

Either of the safety ground terminals located on the power terminal block provides a grounding point for the motor cable shield. The **motor cable** shield connected to one of these terminals (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal. The conduit box option may be used with a cable clamp for a grounding point for the cable shield.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

RFI Filter Grounding

Using single phase drives with integral filter, or an external filter with any drive rating, may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked.

Fuses and Circuit Breakers

The PowerFlex 40 does not provide branch short circuit protection. This product should be installed with either input fuses or an input circuit breaker. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations.

ATTENTION: To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in this section.

Fusing

The PowerFlex 40 has been UL tested and approved for use with input fuses. The ratings in the table that follows are the minimum recommended values for use with each drive rating. The devices listed in this table are provided to serve as a guide.

Bulletin 140M (Self-Protected Combination Controller)/UL489 Circuit Breakers

When using Bulletin 140M or UL489 rated circuit breakers, the guidelines listed below must be followed in order to meet the NEC requirements for branch circuit protection.

- Bulletin 140M can be used in single and group motor applications.
- Bulletin 140M can be used up stream from the drive **without** the need for fuses.

Table 1.C Minimum Recommended Branch Circuit Protective Devices

Voltage Rating	Drive Rating *kW (HP)*	Fuse Rating(1) *Amps*	140M Motor Protectors(2) *Catalog No.*	Recommended MCS Contactors *Catalog No.*
120V AC – 1-Phase	0.4 (0.5)	15	140M-C2E-C16	100-C12
	0.75 (1.0)	35	140M-D8E-C20	100-C23
	1.1 (1.5)	40	140M-F8E-C32	100-C37
240V AC – 1-Phase	0.4 (0.5)	10	140M-C2E-B63	100-C09
	0.75 (1.0)	20	140M-C2E-C16	100-C12
	1.5 (2.0)	30	140M-D8E-C20	100-C23
	2.2 (3.0)	40	140M-F8E-C32	100-C37
240V AC – 3-Phase	0.4 (0.5)	6	140M-C2E-B40	100-C07
	0.75 (1.0)	10	140M-C2E-C10	100-C09
	1.5 (2.0)	15	140M-C2E-C16	100-C12
	2.2 (3.0)	25	140M-C2E-C16	100-C23
	3.7 (5.0)	35	140M-F8E-C25	100-C23
	5.5 (7.5)	40	140M-F8E-C32	100-C37
	7.5 (10.0)	60	140M-G8E-C45	100-C60
480V AC – 3-Phase	0.4 (0.5)	3	140M-C2E-B25	100-C07
	0.75 (1.0)	6	140M-C2E-B40	100-C07
	1.5 (2.0)	10	140M-C2E-B63	100-C09
	2.2 (3.0)	15	140M-C2E-C10	100-C09
	4.0 (5.0)	20	140M-C2E-C16	100-C23
	5.5 (7.5)	25	140M-D8E-C20	100-C23
	7.5 (10.0)	30	140M-D8E-C20	100-C23
	11 (15)	50	140M-F8E-C32	100-C43
600V AC – 3-Phase	0.75 (1.0)	6	140M-C2E-B25	100-C09
	1.5 (2.0)	6	140M-C2E-B40	100-C09
	2.2 (3.0)	10	140M-C2E-B63	100-C09
	4.0 (5.0)	15	140M-C2E-C10	100-C09
	5.5 (7.5)	20	140M-C2E-C16	100-C16
	7.5 (10.0)	25	140M-C2E-C16	100-C23
	11 (15)	40	140M-D8E-C25	100-C30

(1) Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.

(2) Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001… to determine the frame and breaking capacity required for your application.

Power Wiring

ATTENTION: National Codes and standards (NEC, VDE, BSI, etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from "cross coupled" power leads.

Motor Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than 15 mils (0.4 mm/0.015 in.). Do not route more than three sets of motor leads in a single conduit to minimize "cross talk". If more than three drive/motor connections per conduit are required, shielded cable must be used.
UL installations in 50°C ambient must use 600V, 75°C or 90°C wire.
UL installations in 40°C ambient should use 600V, 75°C or 90°C wire.
Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas**. Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations or a high degree of communications / networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks. Refer to Reflected Wave in "Wiring and Grounding Guidelines for PWM AC Drives," publication DRIVES-IN001A-EN-P.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden® 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.
Standard (Option 2)	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	• Three tinned copper conductors with XLPE insulation. • 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield. • PVC jacket.
Class I & II; Division I & II	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	• Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor. • Black sunlight resistant PVC jacket overall. • Three copper grounds on #10 AWG and smaller.

Reflected Wave Protection

The drive should be installed as close to the motor as possible. Installations with long motor cables may require the addition of external devices to limit voltage reflections at the motor (reflected wave phenomena). See Table 1.D for recommendations.

The reflected wave data applies to all frequencies 2 to 16 kHz.

For 240V ratings, reflected wave effects do not need to be considered.

Table 1.D Maximum Cable Length Recommendations

Reflected Wave		
380-480V Ratings	**Motor Insulation Rating**	**Motor Cable Only**[1]
	1000 Vp-p	15 meters (49 feet)
	1200 Vp-p	40 meters (131 feet)
	1600 Vp-p	170 meters (558 feet)

[1] Longer cable lengths can be achieved by installing devices on the output of the drive. Consult factory for recommendations.

Output Disconnect

The drive is intended to be commanded by control input signals that will start and stop the motor. A device that routinely disconnects then reapplies output power to the motor for the purpose of starting and stopping the motor should not be used. If it is necessary to disconnect power to the motor with the drive outputting power, an auxiliary contact should be used to simultaneously disable drive control run commands.

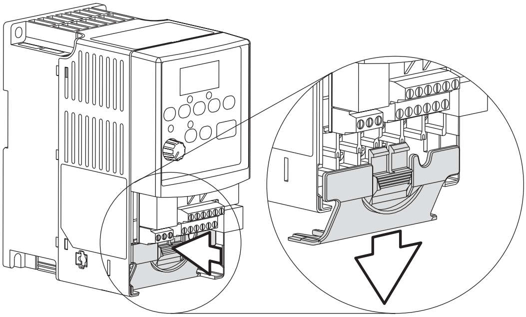
Power Terminal Block

The drive utilizes a finger guard over the power wiring terminals. To remove:

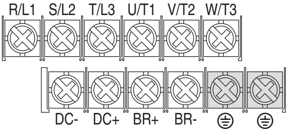
1. Press in and hold the locking tab.
2. Slide finger guard down and out.

Replace the finger guard when wiring is complete.

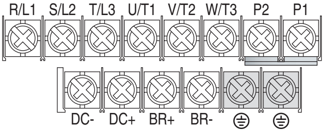
Figure 1.4 Power Terminal Block (Typical)

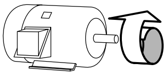
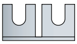


B Frame



C Frame



Terminal (1)	Description
R/L1, S/L2	1-Phase Input
R/L1, S/L2, T/L3	3-Phase Input
U/T1	To Motor U/T1 =  Switch any two motor leads to change forward direction.
V/T2	To Motor V/T2
W/T3	To Motor W/T3
P2, P1	DC Bus Inductor Connection (C Frame drives only.) The C Frame drive is shipped with a jumper between Terminals P2 and P1. Remove this jumper only when a DC Bus Inductor will be connected. Drive will not power up without a jumper or inductor connected. 
DC+, DC-	DC Bus Connection
BR+, BR-	Dynamic Brake Resistor Connection
⏚	Safety Ground - PE

(1) **Important:** Terminal screws may become loose during shipment. Ensure that all terminal screws are tightened to the recommended torque before applying power to the drive.

Table 1.E Power Terminal Block Specifications

Frame	Maximum Wire Size (1)	Minimum Wire Size (1)	Torque
B	5.3 mm^2 (10 AWG)	1.3 mm^2 (16 AWG)	1.7-2.2 N-m (16-19 lb.-in.)
C	8.4 mm^2 (8 AWG)	1.3 mm^2 (16 AWG)	2.9-3.7 N-m (26-33 lb.-in.)

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

I/O Wiring Recommendations

Motor Start/Stop Precautions

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If used, the input device must not exceed one operation per minute or drive damage can occur.

ATTENTION: The drive start/stop control circuitry includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. When the AC line is removed, there will be a loss of any inherent regenerative braking effect that might be present - the motor will coast to a stop. An auxiliary braking method may be required.

Important points to remember about I/O wiring:

- Always use copper wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled “Common” are not referenced to the safety ground (PE) terminal and are designed to greatly reduce common mode interference.

ATTENTION: Driving the 4-20mA analog input from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

Control Wire Types

Table 1.F Recommended Control and Signal Wire(1)

Wire Type(s)	Description	Minimum Insulation Rating
Belden 8760/9460 (or equiv.)	0.8 mm^2 (18 AWG), twisted pair, 100% shield with drain.	300V 60 degrees C (140 degrees F)
Belden 8770 (or equiv.)	0.8 mm^2 (18 AWG), 3 conductor, shielded for remote pot only.	

(1) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

I/O Terminal Block

Table 1.G I/O Terminal Block Specifications

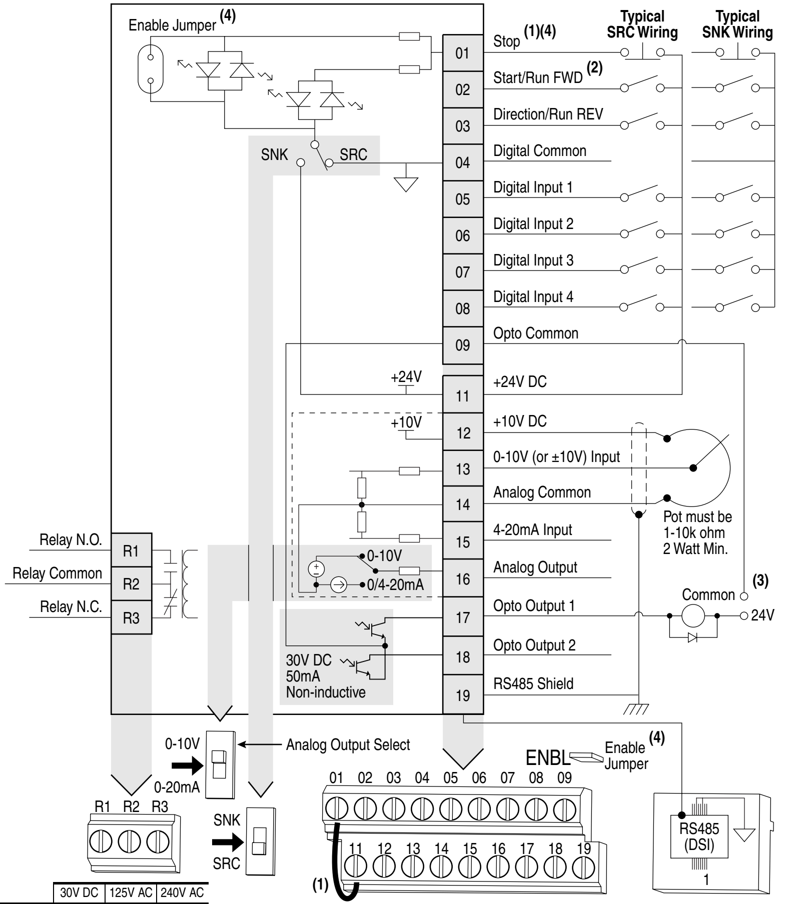
Frame	Maximum Wire Size (2)	Minimum Wire Size (2)	Torque
B & C	1.3 mm^2 (16 AWG)	0.13 mm^2 (26 AWG)	0.5-0.8 N-m (4.4-7 lb.-in.)

(2) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

Maximum Control Wire Recommendations

Do not exceed control wiring length of 30 meters (100 feet). Control signal cable length is highly dependent on electrical environment and installation practices. To improve noise immunity, the I/O terminal block Common must be connected to ground terminal/protective earth. If using the RS485 (DSI) port, I/O Terminal 16 should also be connected to ground terminal/protective earth.

Figure 1.5 Control Wiring Block Diagram



	30V DC	125V AC	240V AC
Resistive	3.0A	3.0A	3.0A
Inductive	0.5A	0.5A	0.5A

P036 [Start Source]	Stop	I/O Terminal 01 Stop
Keypad	Per P037	Coast
3-Wire	Per P037	Per P037(4)
2-Wire	Per P037	Coast
Momt FWD/REV	Per P037	Per P037(4)
RS485 Port	Per P037	Coast

(1) **Important:** I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set to "3-Wire" or "Momt FWD/REV" control. In three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. All other stop sources are controlled by P037 [Stop Mode].

Important: The drive is shipped with a jumper installed between I/O Terminals 01 and 11. Remove this jumper when using I/O Terminal 01 as a stop or enable input.

(2) Two wire control shown. For three wire control use a momentary input ⊥ on I/O Terminal 02 to command a start. Use a maintained input ○⁄○ for I/O Terminal 03 to change direction.

(3) When using an opto output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown, to prevent damage to the output.

(4) When the ENBL enable jumper is removed, I/O Terminal 01 will always act as a hardware enable, causing a coast to stop without software interpretation.

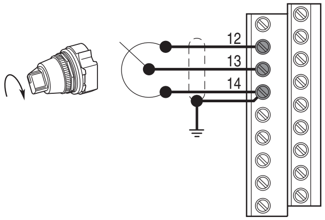
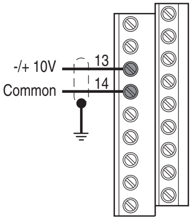
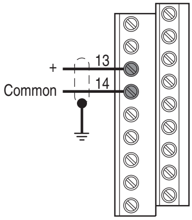
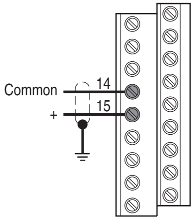
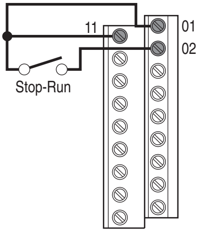
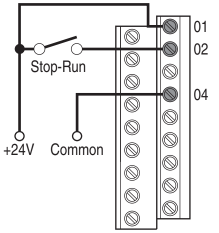
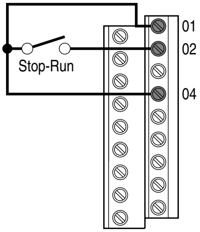
Table 1.H Control I/O Terminal Designations

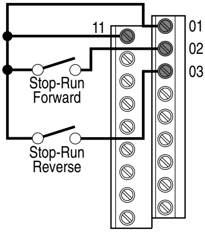
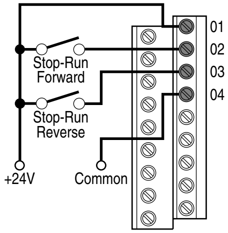
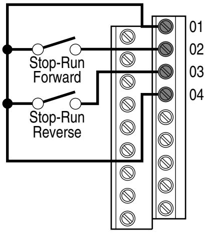
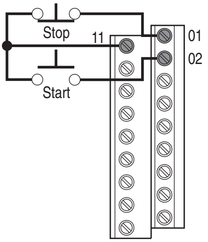
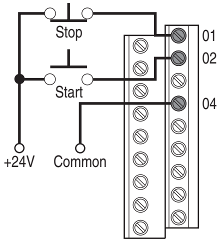
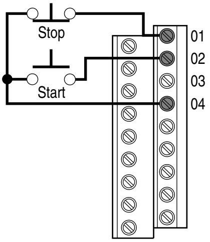
No.	Signal	Default	Description	Param.
R1	Relay N.O.	Fault	Normally open contact for output relay.	A055
R2	Relay Common	–	Common for output relay.	
R3	Relay N.C.	Fault	Normally closed contact for output relay.	A055
Analog Output Select DIP Switch		0-10V	Sets analog output to either voltage or current. Setting must match A065 [Analog Out Sel].	
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.	
01	Stop (1)	Coast	The factory installed jumper or a normally closed input must be present for the drive to start.	P036 (1)
02	Start/Run FWD	Not Active	Command comes from the integral keypad by default. To disable reverse operation, see A095 [Reverse Disable].	P036, P037
03	Direction/Run REV	Not Active		P036, P037, A095
04	Digital Common	–	For digital inputs. Electronically isolated with digital inputs from analog I/O and opto outputs.	
05	Digital Input 1	Preset Freq	Program with A051 [Digital In1 Sel].	A051
06	Digital Input 2	Preset Freq	Program with A052 [Digital In2 Sel].	A052
07	Digital Input 3	Local	Program with A053 [Digital In3 Sel].	A053
08	Digital Input 4	Jog Forward	Program with A054 [Digital In4 Sel].	A054
09	Opto Common	–	For opto-coupled outputs. Electronically isolated with opto outputs from analog I/O and digital inputs.	
11	+24V DC	–	Referenced to Digital Common. Drive supplied power for digital inputs. Maximum output current is 100mA.	
12	+10V DC	–	Referenced to Analog Common. Drive supplied power for 0-10V external potentiometer. Maximum output current is 15mA.	P038
13	±10V In (2)	Not Active	For external 0-10V (unipolar) or ±10V (bipolar) input supply (input impedance = 100k ohm) or potentiometer wiper.	P038, A051-A054, A123, A132
14	Analog Common	–	For 0-10V In or 4-20mA In. Electronically isolated with analog inputs and outputs from digital I/O and opto outputs.	
15	4-20mA In (2)	Not Active	For external 4-20mA input supply (input impedance = 250 ohm).	P038, A051-A054, A132
16	Analog Output	OutFreq 0-10	The default analog output is 0-10V. To covert to a current value, change the Analog Output Select DIP Switch to 0-20mA. Program with A065 [Analog Out Sel]. Max analog value can be scaled with A066 [Analog Out High]. Maximum Load: 4-20mA = 525 ohm (10.5V) 0-10V = 1k ohm (10mA)	A065, A066
17	Opto Output 1	MotorRunning	Program with A058 [Opto Out1 Sel]	A058, A059, A064
18	Opto Output 2	At Frequency	Program with A061 [Opto Out2 Sel]	A061, A062, A064
19	RS485 (DSI) Shield	–	Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port.	

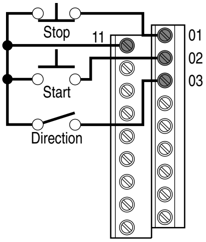
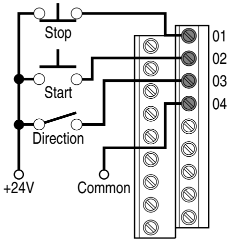
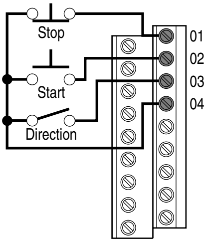
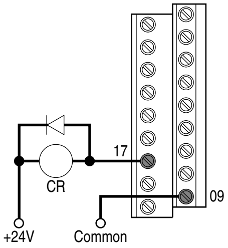
(1) See Footnotes (1) and (4) on page 1-14.

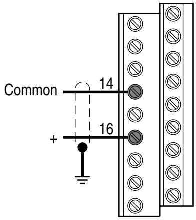
(2) 0-10V In and 4-20mA In are distinct input channels and may be connected simultaneously. Inputs may be used independently for speed control or jointly when operating in PID mode.

I/O Wiring Examples

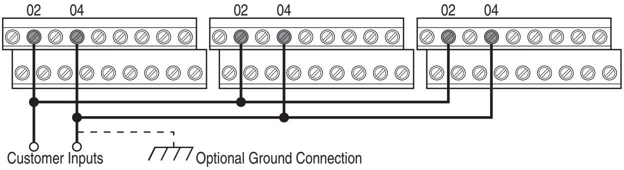
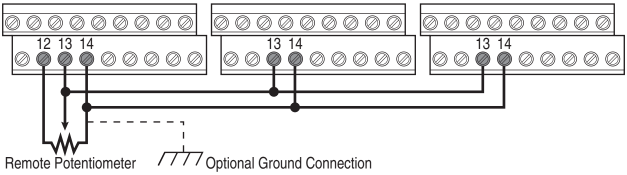
<table>
<tr><th>Input/Output</th><th colspan="6">Connection Example</th></tr>
<tr><td>Potentiometer
1-10k Ohm Pot.
Recommended
(2 Watt minimum)</td><td colspan="6">P038 [Speed Reference] = 2 “0-10V Input”
 </td></tr>
<tr><td>Analog Input
0 to +10V, 100k ohm impedance
4-20 mA, 250 ohm impedance</td><td colspan="2">Bipolar
P038 [Speed Reference] = 2 “0-10V Input” and A123 [10V Bipolar Enbl] = 1 “Bi-Polar In”
 </td><td colspan="2">Unipolar (Voltage)
P038 [Speed Reference] = 2 “0-10V Input”
 </td><td colspan="2">Unipolar (Current)
P038 [Speed Reference] = 3 “4-20mA Input”
 </td></tr>
<tr><td>2 Wire SRC Control - Non-Reversing
P036 [Start Source] = 2, 3 or 4
Input must be active for the drive to run. When input is opened, the drive will stop as specified by P037 [Stop Mode].
If desired, a User Supplied 24V DC power source can be used. Refer to the “External Supply (SRC)” example.</td><td colspan="3">Internal Supply (SRC)
 </td><td colspan="3">External Supply (SRC)

Each digital input draws 6 mA.</td></tr>
<tr><td>2 Wire SNK Control - Non-Reversing</td><td colspan="6">Internal Supply (SNK)
 </td></tr>
</table>

Input/Output	Connection Example	
2 Wire SRC Control - Run FWD/Run REV P036 [Start Source] = 2, 3 or 4 Input must be active for the drive to run. When input is opened, the drive will stop as specified by P037 [Stop Mode]. If both Run Forward and Run Reverse inputs are closed at the same time, an undetermined state could occur.	Internal Supply (SRC) 	External Supply (SRC)  Each digital input draws 6 mA.
2 Wire SNK Control - Run FWD/Run REV	Internal Supply (SNK) 	
3 Wire SRC Control - Non-Reversing P036 [Start Source] = 1 A momentary input will start the drive. A stop input to I/O Terminal 01 will stop the drive as specified by P037 [Stop Mode].	Internal Supply (SRC) 	External Supply (SRC)  Each digital input draws 6 mA.
3 Wire SNK Control - Non-Reversing	Internal Supply (SNK) 	

Input/Output	Connection Example	
3 Wire SRC Control - Reversing P036 [Start Source] = 1 A momentary input will start the drive. A stop input to I/O Terminal 01 will stop the drive as specified by P037 [Stop Mode]. I/O Terminal 03 determines direction.	Internal Supply (SRC) 	External Supply (SRC)  Each digital input draws 6 mA.
3 Wire SNK Control - Reversing	Internal Supply (SNK) 	
Opto Output (1 & 2) A058 [Opto Out1 Sel] determines Opto-Output 1 (I/O Terminal 17) operation. A061 [Opto Out2 Sel] determines Opto-Output 2 (I/O Terminal 18) operation. When using Opto-Output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown, to prevent damage to the output.	Opto-Output 1  Each Opto-Output is rated 30V DC 50 mA (Non-inductive).	

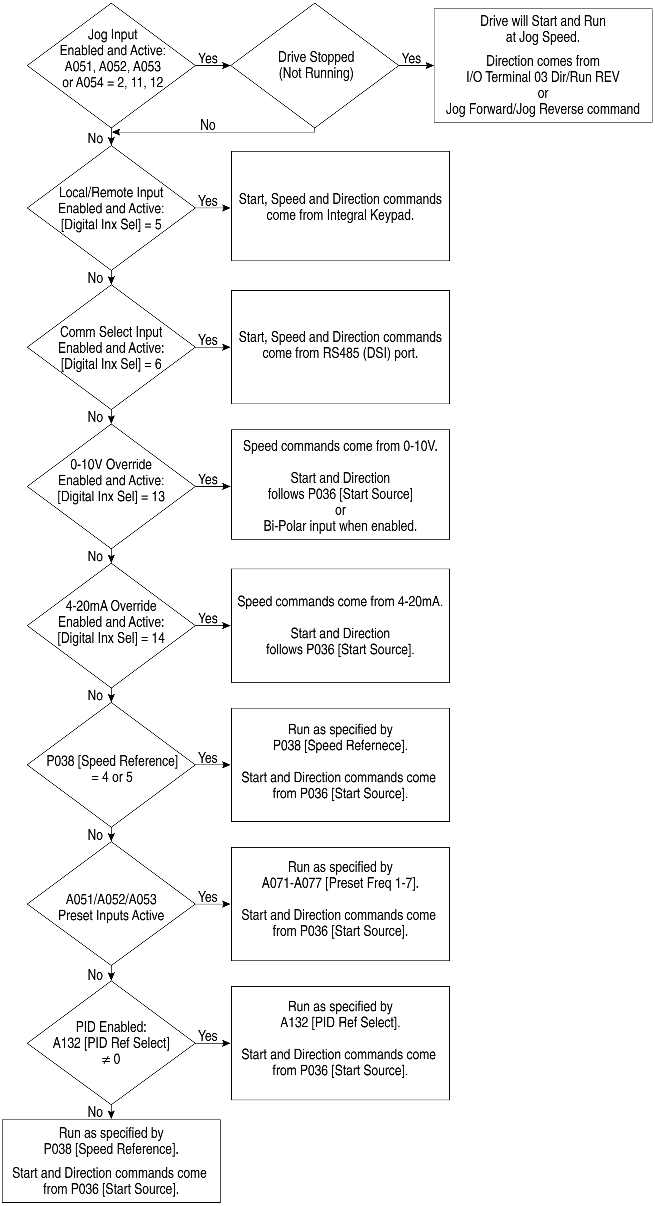
Input/Output	Connection Example
Analog Output A065 [Analog Out Sel] determines analog output type and drive conditions. 0-10V, 1k ohm minimum 0-20mA/4-20mA, 525 ohm maximum	A065 [Analog Out Sel] = 0 through 14 The Analog Output Select DIP Switch must be set to match the analog output signal mode set in A065 [Analog Out Sel]. 

Typical Multiple Drive Connection Examples

Input/Output	Connection Example
Multiple Digital Input Connections Customer Inputs can be wired per External Supply (SRC).	 When connecting a single input such as Run, Stop, Reverse or Preset Speeds to multiple drives, it is important to connect I/O Terminal 04 common together for all drives. If they are to be tied into another common (such as earth ground or separate apparatus ground) only one point of the daisy chain of I/O Terminal 04 should be connected. **ATTENTION:** I/O Common terminals should **not** be tied together when using SNK (Internal Supply) mode. In SNK mode, if power is removed from one drive, inadvertent operation of other drives that share the same I/O Common connection may occur.
Multiple Analog Connections	 When connecting a single potentiometer to multiple drives it is important to connect I/O Terminal 14 common together for all drives. I/O Terminal 14 common and I/O Terminal 13 (potentiometer wiper) should be daisy-chained to each drive. All drives must be powered up for the analog signal to be read correctly.

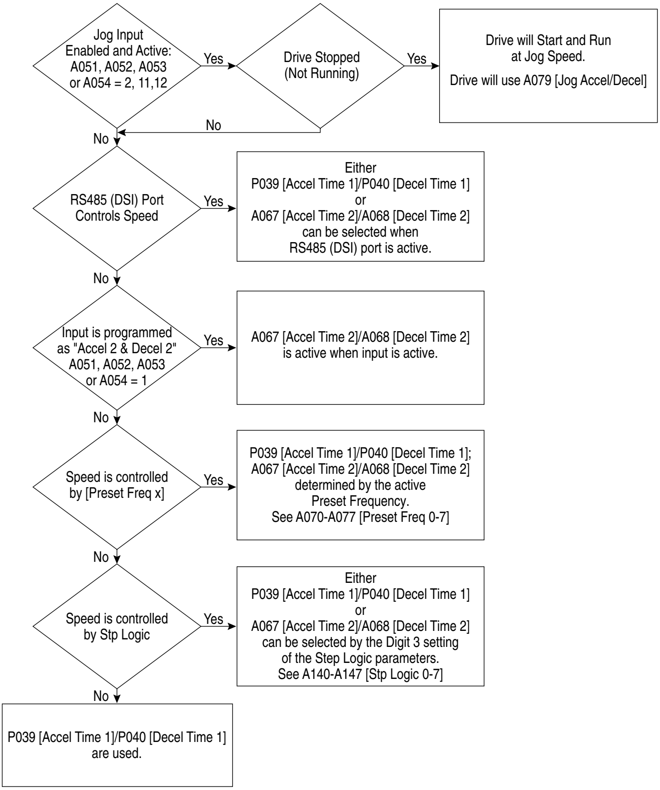
Start and Speed Reference Control

The drive speed command can be obtained from a number of different sources. The source is normally determined by P038 [Speed Reference]. However, when A051 - A054 [Digital Inx Sel] is set to option 2, 4, 5, 6, 11, 12, 13, 14, 15 and the digital input is active, or if A132 is not set to option 0, the speed reference commanded by P038 [Speed Reference] will be overridden. See the chart below for the override priority.



Accel/Decel Selection

The Accel/Decel rate can be obtained by a variety of methods. The default rate is determined by P039 [Accel Time 1] and P040 [Decel Time 1]. Alternative Accel/Decel rates can be made through digital inputs, RS485 (DSI) communications and/or parameters. See the chart below for the override priority.



EMC Instructions

CE Conformity

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. PowerFlex Drives comply with the EN standards listed below when installed according to the User Manual.

CE Declarations of Conformity are available online at:
http://www.ab.com/certification/ce/docs.

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

EMC Directive (89/336/EEC)

- EN61800-3 Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods.

General Notes

- If the plastic top panel is removed or the optional conduit box is not installed, the drive must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.
- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.
- Use of line filters in ungrounded systems is not recommended.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.

Essential Requirements for CE Compliance

Conditions 1-3 listed below **must be** satisfied for PowerFlex drives to meet the requirements of **EN61800-3**.

1. Grounding as described in Figure 1.6. Refer to page 1-6 for additional grounding recommendations.
2. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
3. Allowable cable length in Table 1.I is not exceeded.

Table 1.I Allowable Cable Length

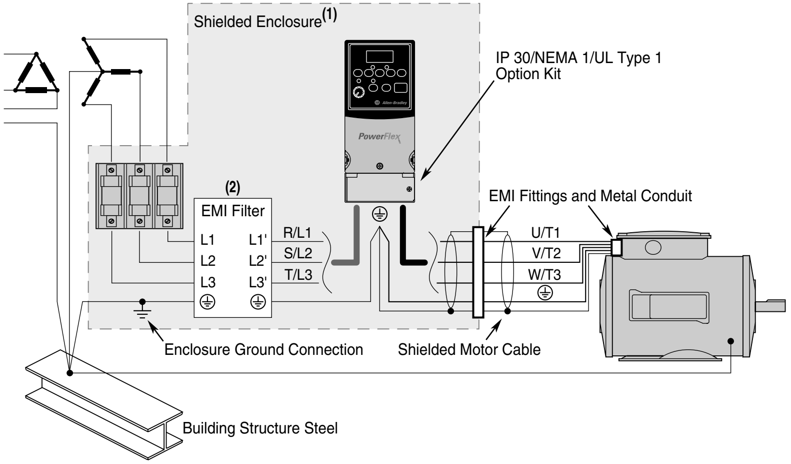
Filter Type	EN61800-3 First Environment Restricted Distribution or Second Environment (2)	EN61800-3 First Environment Unrestricted Distribution (3)
Integral	10 meters (33 feet)	1 meter (3 feet)
External - S Type(1)	10 meters (33 feet)	1 meter (3 feet)
External - L Type(1)	100 meters (328 feet)	5 meters (16 feet)

(1) Refer to Appendix B for details on optional external filters.

(2) Equivalent to EN55011 Class A.

(3) Equivalent to EN55011 Class B.

Figure 1.6 Connections and Grounding



(1) First Environment Unrestricted Distribution installations require a shielded enclosure. Keep wire length as short as possible between the enclosure entry point and the EMI filter.

(2) Integral EMI filters are available on 240V, 1-Phase drives.

EN61000-3-2

- 0.75 kW (1 HP) 240V 1-Phase and 3-Phase drives and 0.37 kW (0.5 HP) 240V 1-Phase drives are suitable for installation on a private low voltage power network. Installations on a public low voltage power network may require additional external harmonic mitigation.
- Other drive ratings meet the current harmonic requirements of EN61000-3-2 without additional external mitigation.

Start Up

This chapter describes how to start up the PowerFlex 40 Drive. To simplify drive setup, the most commonly programmed parameters are organized in a single Basic Program Group.

Important: Read the *General Precautions* section before proceeding.

ATTENTION: Power must be applied to the drive to perform the following start-up procedures. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed**. **Remove All Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

Prepare For Drive Start-Up

Before Applying Power to the Drive

☐ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

☐ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

☐ **3.** Verify that any digital control power is 24 volts.

☐ **4.** Verify that the Sink (SNK)/Source (SRC) Setup DIP Switch is set to match your control wiring scheme. See Figure 1.5 on page 1-14 for location.

Important: The default control scheme is Source (SRC). The Stop terminal is jumpered (I/O Terminals 01 and 11) to allow starting from the keypad. If the control scheme is changed to Sink (SNK), the jumper must be removed from I/O Terminals 01 and 11 and installed between I/O Terminals 01 and 04.

☐ **5.** Verify that the Stop input is present or the drive will not start.

Important: If I/O Terminal 01 is used as a stop input, the jumper between I/O Terminals 01 and 11 must be removed.

Applying Power to the Drive

☐ **6.** Apply AC power and control voltages to the drive.

☐ **7.** Familiarize yourself with the integral keypad features (see page 2-3) before setting any Program Group parameters.

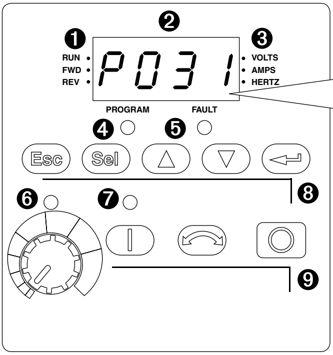
Start, Stop, Direction and Speed Control

Factory default parameter values allow the drive to be controlled from the integral keypad. No programming is required to start, stop, change direction and control speed directly from the integral keypad.

Important: To disable reverse operation, see A095 [Reverse Disable].

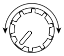
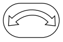
If a fault appears on power up, refer to Fault Descriptions on page 4-3 for an explanation of the fault code.

Integral Keypad



Menu	Description
d	**Display Group (View Only)** Consists of commonly viewed drive operating conditions.
P	**Basic Program Group** Consists of most commonly used programmable functions.
A	**Advanced Program Group** Consists of remaining programmable functions.
F	**Fault Designator** Consists of list of codes for specific fault conditions. Displayed only when fault is present.

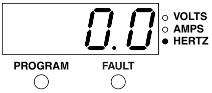
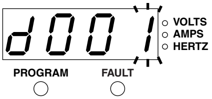
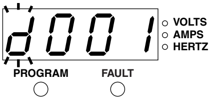
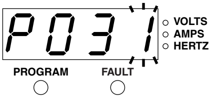
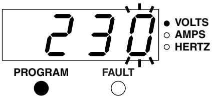
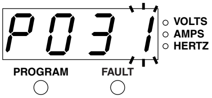
No.	LED	LED State	Description
❶	Run/Direction Status	Steady Red	Indicates drive is running and commanded motor direction.
		Flashing Red	Drive has been commanded to change direction. Indicates actual motor direction while decelerating to zero.
❷	Alphanumeric Display	Steady Red	Indicates parameter number, parameter value, or fault code.
		Flashing Red	Single digit flashing indicates that digit can be edited. All digits flashing indicates a fault condition.
❸	Displayed Units	Steady Red	Indicates the units of the parameter value being displayed.
❹	Program Status	Steady Red	Indicates parameter value can be changed.
❺	Fault Status	Flashing Red	Indicates drive is faulted.
❻	Pot Status	Steady Green	Indicates potentiometer on Integral Keypad is active.
❼	Start Key Status	Steady Green	Indicates Start key on Integral Keypad is active. The Reverse key is also active unless disabled by A095 [Reverse Disable].

No.	Key	Name	Description
❽	Esc	Escape	Back one step in programming menu. Cancel a change to a parameter value and exit Program Mode.
	Sel	Select	Advance one step in programming menu. Select a digit when viewing parameter value.
	△ ▽	Up Arrow Down Arrow	Scroll through groups and parameters. Increase/decrease the value of a flashing digit.
	↵	Enter	Advance one step in programming menu. Save a change to a parameter value.
❾		Potentiometer	Used to control speed of drive. Default is active. Controlled by parameter P038 [Speed Reference].
	|	Start	Used to start the drive. Default is active. Controlled by parameter P036 [Start Source].
		Reverse	Used to reverse direction of the drive. Default is active. Controlled by parameters P036 [Start Source] and A095 [Reverse Disable].
	◎	Stop	Used to stop the drive or clear a fault. This key is always active. Controlled by parameter P037 [Stop Mode].

Viewing and Editing Parameters

The last user-selected Display Group parameter is saved when power is removed and is displayed by default when power is reapplied.

The following is an example of basic integral keypad and display functions. This example provides basic navigation instructions and illustrates how to program the first Program Group parameter.

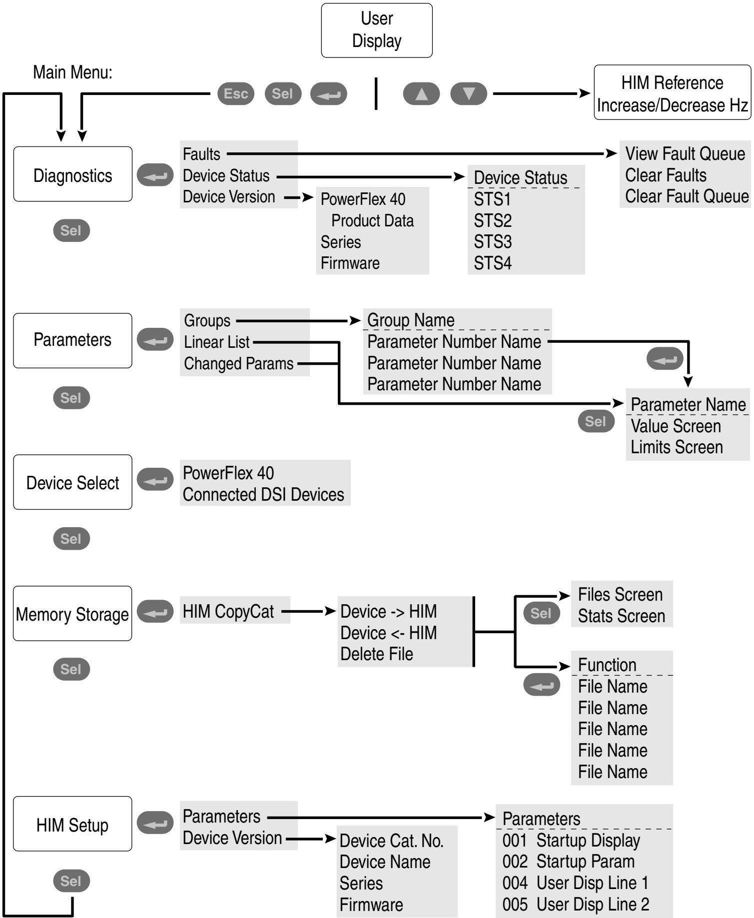
Step	Key(s)	Example Displays
1. When power is applied, the last user-selected Display Group parameter number is briefly displayed with flashing characters. The display then defaults to that parameter's current value. (Example shows the value of d001 [Output Freq] with the drive stopped.)		
2. Press Esc once to display the Display Group parameter number shown on power-up. The parameter number will flash.	Esc	
3. Press Esc again to enter the group menu. The group menu letter will flash.	Esc	
4. Press the Up Arrow or Down Arrow to scroll through the group menu (d, P and A).	△ or ▽	
5. Press Enter or Sel to enter a group. The right digit of the last viewed parameter in that group will flash.	↵ or Sel	
6. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the group.	△ or ▽	
7. Press Enter or Sel to view the value of a parameter. If you do not want to edit the value, press Esc to return to the parameter number.	↵ or Sel	
8. Press Enter or Sel to enter program mode to edit the parameter value. The right digit will flash and the Program LED will illuminate if the parameter can be edited.	↵ or Sel	
9. Press the Up Arrow or Down Arrow to change the parameter value. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash.	△ or ▽	
10. Press Esc to cancel a change. The digit will stop flashing, the previous value is restored and the Program LED will turn off. Or Press Enter to save a change. The digit will stop flashing and the Program LED will turn off.	Esc ↵	
11. Press Esc to return to the parameter list. Continue to press Esc to back out of the programming menu. If pressing Esc does not change the display, then d001 [Output Frequency] is displayed. Press Enter or Sel to enter the group menu.	Esc	

The Basic Program Group (page 3-9) contains the most commonly changed parameters.

Remote HIM Menu Structure

The Menu Structure below can be accessed through the following Human Interface Module options:

HIM Option	Catalog Number
Remote Panel Mount Small, LCD Display	22-HIM-C2S
Remote Panel Mount, LCD Display	22-HIM-C2
Remote Handheld, LCD Display	22-HIM-A3



Press Sel *to move between main menu tabs*

Press ↵ *to select a tab or menu item*

Press ▲ ▼ *to move between menu items*

Press Esc *to move 1 level back in the menu structure*

Diagnostics Menu

When a fault trips the drive, use this menu to access detailed data about the drive.

Option	Description
Faults	View fault queue or fault information, clear faults or clear fault queue.
Device Status	View status information about the drive or peripheral.
Device Version	View the firmware version and hardware series of components.

Parameters Menu

Use this menu to access drive parameters. Parameters can be displayed in groups, in a linear list, or only those changed from their defaults.

Device Select Menu

Use this menu to access the drive or peripheral that the drive is to access.

Memory Storage Menu

Drive data can be saved to, or recalled from HIM sets.
HIM sets are files stored in permanent nonvolatile HIM memory.

Option	Description
HIM Copycat Device -> HIM Device <- HIM	Save data to a HIM set or load data from a HIM set to active drive memory. A maximum of 5 HIM set can be stored.
Delete File	Delete a HIM set.

HIM Setup Menu

The HIM and drive have features that you can customize.

Option	Description
Parameters	Access parameters in HIM to set display options.
Device Version	View HIM version, hardware series and firmware version

Chapter 3

Programming and Parameters

Chapter 3 provides a complete listing and description of the PowerFlex 40 parameters. Parameters are programmed (viewed/edited) using the integral keypad. As an alternative, programming can also be performed using DriveExplorer™ or DriveExecutive™ software, a personal computer and a serial converter module. Refer to Appendix B for catalog numbers.

About Parameters

To configure a drive to operate in a specific way, drive parameters may have to be set. Three types of parameters exist:

- **ENUM**
  ENUM parameters allow a selection from 2 or more items. Each item is represented by a number.
- **Numeric Parameters**
  These parameters have a single numerical value (i.e. 0.1 Volts).
- **Bit Parameters**
  Bit parameters have four individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.

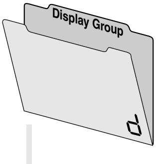
Some parameters are marked as follows.

○ = Stop drive before changing this parameter.

▽32 = 32 bit parameter. Parameters marked 32 bit will have two parameter numbers when using RS485 communications and programming software.

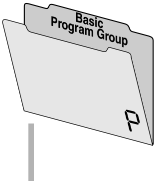
Parameter Organization

Refer to page 3-43 for an alphabetical listing of parameters.



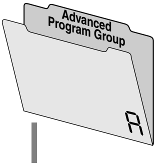
See page 3-3

Output Freq	d001
Commanded Freq	d002
Output Current	d003
Output Voltage	d004
DC Bus Voltage	d005
Drive Status	d006
Fault 1 Code	d007
Fault 2 Code	d008
Fault 3 Code	d009
Process Display	d010
Control Source	d012
Contrl In Status	d013
Dig In Status	d014
Comm Status	d015
Control SW Ver	d016
Drive Type	d017
Elapsed Run Time	d018
Testpoint Data	d019
Analog In 0-10V	d020
Analog In 4-20mA	d021
Output Power	d022
Output Power Fctr	d023
Drive Temp	d024
Counter Status	d025
Timer Status	d026
Stp Logic Status	d028
Torque Current	d029



See page 3-9

Motor NP Volts	P031
Motor NP Hertz	P032
Motor OL Current	P033
Minimum Freq	P034
Maximum Freq	P035
Start Source	P036
Stop Mode	P037
Speed Reference	P038
Accel Time 1	P039
Decel Time 1	P040
Reset To Defalts	P041
Voltage Class	P042



See page 3-14

Digital In1 Sel	A051
Digital In2 Sel	A052
Digital In3 Sel	A053
Digital In4 Sel	A054
Relay Out Sel	A055
Relay Out Level	A056
Opto Out1 Sel	A058
Opto Out1 Level	A059
Opto Out2 Sel	A061
Opto Out2 Level	A062
Opto Out Logic	A064
Analog Out Sel	A065
Analog Out High	A066
Accel Time 2	A067
Decel Time 2	A068
Internal Freq	A069
Preset Freq 0	A070
Preset Freq 1	A071
Preset Freq 2	A072
Preset Freq 3	A073
Preset Freq 4	A074
Preset Freq 5	A075
Preset Freq 6	A076
Preset Freq 7	A077
Jog Frequency	A078
Jog Accel/Decel	A079
DC Brake Time	A080
DC Brake Level	A081
DB Resistor Sel	A082
S Curve %	A083
Boost Select	A084
Start Boost	A085
Break Voltage	A086
Break Frequency	A087
Maximum Voltage	A088
Current Limit 1	A089
Motor OL Select	A090
PWM Frequency	A091
Auto Rstrt Tries	A092
Auto Rstrt Delay	A093
Start At PowerUp	A094
Reverse Disable	A095
Flying Start En	A096
Compensation	A097
SW Current Trip	A098
Process Factor	A099
Fault Clear	A100
Program Lock	A101
Testpoint Sel	A102
Comm Data Rate	A103
Comm Node Addr	A104
Comm Loss Action	A105

See page 3-14

Comm Loss Time	A106
Comm Format	A107
Language	A108
Anlg Out Setpnt	A109
Anlg In 0-10V Lo	A110
Anlg In 0-10V Hi	A111
Anlg In4-20mA Lo	A112
Anlg In4-20mA Hi	A113
Slip Hertz @ FLA	A114
Process Time Lo	A115
Process Time Hi	A116
Bus Reg Mode	A117
Current Limit 2	A118
Skip Frequency	A119
Skip Freq Band	A120
Stall Fault Time	A121
Analog In Loss	A122
10V Bipolar Enbl	A123
Var PWM Disable	A124
Torque Perf Mode	A125
Motor NP FLA	A126
Autotune	A127
IR Voltage Drop	A128
Flux Current Ref	A129
PID Trim Hi	A130
PID Trim Lo	A131
PID Ref Sel	A132
PID Feedback Sel	A133
PID Prop Gain	A134
PID Integ Time	A135
PID Diff Rate	A136
PID Setpoint	A137
PID Deadband	A138
PID Preload	A139
Stp Logic 0	A140
Stp Logic 1	A141
Stp Logic 2	A142
Stp Logic 3	A143
Stp Logic 4	A144
Stp Logic 5	A145
Stp Logic 6	A146
Stp Logic 7	A147
Stp Logic Time 0	A150
Stp Logic Time 1	A151
Stp Logic Time 2	A152
Stp Logic Time 3	A153
Stp Logic Time 4	A154
Stp Logic Time 5	A155
Stp Logic Time 6	A156
Stp Logic Time 7	A157
EM Brk Off Delay	A160
EM Brk On Delay	A161
MOP Reset Sel	A162

Display Group

d001 [Output Freq]

Related Parameter(s): d002, d010, P034, P035, P038

Output frequency present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.0/P035 [Maximum Freq]
	Display:	0.1 Hz

d002 [Commanded Freq]

Related Parameter(s): d001, d013, P034, P035, P038

Value of the active frequency command. Displays the commanded frequency even if the drive is not running.

Important: The frequency command can come from a number of sources. Refer to Start and Speed Reference Control on page 1-20 for details.

Values	Default:	Read Only
	Min/Max:	0.0/P035 [Maximum Freq]
	Display:	0.1 Hz

d003 [Output Current]

The output current present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Amps × 2)
	Display:	0.01 Amps

d004 [Output Voltage]

Related Parameter(s): P031, A084, A088

Output voltage present at terminals T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0/Drive Rated Volts
	Display:	1 VAC

d005 [DC Bus Voltage]

Present DC bus voltage level.

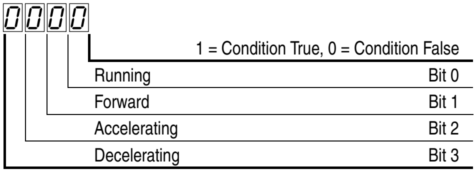
Values	Default:	Read Only
	Min/Max:	Based on Drive Rating
	Display:	1 VDC

Display Group *(continued)*

d006 [Drive Status]

Related Parameter(s): A095

Present operating condition of the drive.



1 = Condition True, 0 = Condition False	
Running	Bit 0
Forward	Bit 1
Accelerating	Bit 2
Decelerating	Bit 3

Values		
	Default:	Read Only
	Min/Max:	0/1
	Display:	1

d007 [Fault 1 Code]
d008 [Fault 2 Code]
d009 [Fault 3 Code]

A code that represents a drive fault. The codes will appear in these parameters in the order they occur (d007 [Fault 1 Code] = the most recent fault). Repetitive faults will only be recorded once.

Refer to Chapter 4 for fault code descriptions.

Values		
	Default:	Read Only
	Min/Max:	F2/F122
	Display:	F1

d010 [Process Display]

Related Parameter(s): d001, A099

32 32 bit parameter.

The output frequency scaled by A099 [Process Factor].

Output Freq x Process Factor = Process Display

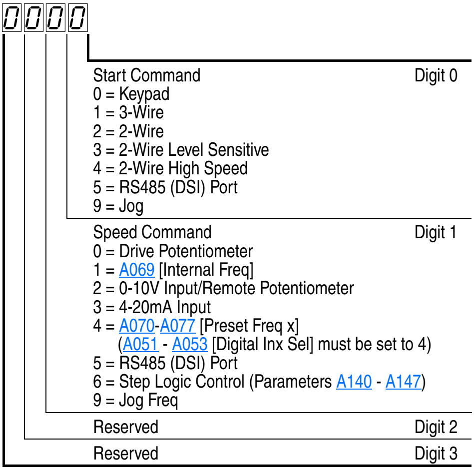
Values		
	Default:	Read Only
	Min/Max:	0.00/9999
	Display:	0.01 – 1

Display Group *(continued)*

d012 [Control Source]

Related Parameter(s): P036, P038, A051-A054

Displays the active source of the Start Command and Speed Command which are normally defined by the settings of P036 [Start Source] and P038 [Speed Reference] but may be overridden by digital inputs. Refer to the flowcharts on pages 1-20 and 1-21 for details.



Start Command — Digit 0
0 = Keypad
1 = 3-Wire
2 = 2-Wire
3 = 2-Wire Level Sensitive
4 = 2-Wire High Speed
5 = RS485 (DSI) Port
9 = Jog

Speed Command — Digit 1
0 = Drive Potentiometer
1 = A069 [Internal Freq]
2 = 0-10V Input/Remote Potentiometer
3 = 4-20mA Input
4 = A070-A077 [Preset Freq x]
(A051 - A053 [Digital Inx Sel] must be set to 4)
5 = RS485 (DSI) Port
6 = Step Logic Control (Parameters A140 - A147)
9 = Jog Freq

Reserved — Digit 2

Reserved — Digit 3

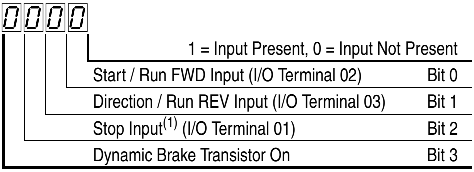
Values	Default:	Read Only
	Min/Max:	0/9
	Display:	1

d013 [Contrl In Status]

Related Parameter(s): d002, P034, P035

Status of the control terminal block control inputs.

Important: Actual control commands may come from a source other than the control terminal block.



1 = Input Present, 0 = Input Not Present

Start / Run FWD Input (I/O Terminal 02)	Bit 0
Direction / Run REV Input (I/O Terminal 03)	Bit 1
Stop Input(1) (I/O Terminal 01)	Bit 2
Dynamic Brake Transistor On	Bit 3

(1) The stop input must be present in order to start the drive.
When this bit is a 1 the drive can be started.
When this bit is a 0 the drive will stop.

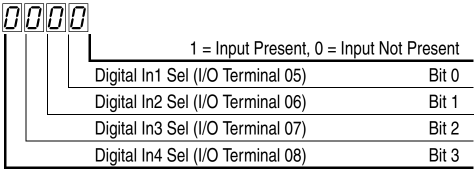
Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

Display Group *(continued)*

d014 [Dig In Status]

Related Parameter(s): A051-A054

Status of the control terminal block digital inputs.



1 = Input Present, 0 = Input Not Present

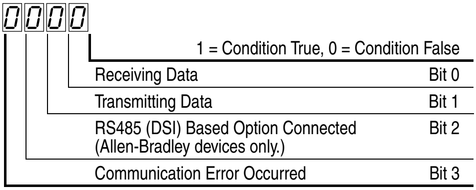
Digital In1 Sel (I/O Terminal 05)	Bit 0
Digital In2 Sel (I/O Terminal 06)	Bit 1
Digital In3 Sel (I/O Terminal 07)	Bit 2
Digital In4 Sel (I/O Terminal 08)	Bit 3

Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

d015 [Comm Status]

Related Parameter(s): A103-A107

Status of the communications ports.



1 = Condition True, 0 = Condition False

Receiving Data	Bit 0
Transmitting Data	Bit 1
RS485 (DSI) Based Option Connected (Allen-Bradley devices only.)	Bit 2
Communication Error Occurred	Bit 3

Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

d016 [Control SW Ver]

Main Control Board software version.

Values	Default:	Read Only
	Min/Max:	1.00/99.99
	Display:	0.01

d017 [Drive Type]

Used by Rockwell Automation field service personnel.

Values	Default:	Read Only
	Min/Max:	1001/9999
	Display:	1

Display Group *(continued)*

d018 [Elapsed Run Time]

Accumulated time drive is outputting power. Time is displayed in 10 hour increments.

Values	Default:	Read Only
	Min/Max:	0/9999 Hrs
	Display:	1 = 10 Hrs

d019 [Testpoint Data]

Related Parameter(s): A102

The present value of the function selected in A102 [Testpoint Sel].

Values	Default:	Read Only
	Min/Max:	0/FFFF
	Display:	1 Hex

d020 [Analog In 0-10V]

Related Parameter(s): A110, A111

The present value of the voltage at I/O Terminal 13 (100.0% = 10 volts).

Values	Default:	Read Only
	Min/Max:	0.0/100.0%
	Display:	0.1%

d021 [Analog In 4-20mA]

Related Parameter(s): A112, A113

The present value of the current at I/O Terminal 15 (0.0% = 4mA, 100.0% = 20mA).

Values	Default:	Read Only
	Min/Max:	0.0/100.0%
	Display:	0.1%

d022 [Output Power]

Output power present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Power × 2)
	Display:	0.01 kW

d023 [Output Powr Fctr]

The angle in electrical degrees between motor voltage and motor current.

Values	Default:	Read Only
	Min/Max:	0.0/180.0 deg
	Display:	0.1 deg

Display Group *(continued)*

d024 [Drive Temp]

Present operating temperature of the drive power section.

Values	Default:	Read Only
	Min/Max:	0/120 degC
	Display:	1 degC

d025 [Counter Status]

The current value of the counter when counter is enabled.

Values	Default:	Read only
	Min/Max:	0/9999
	Display:	1

d026 [Timer Status]

32 32 bit parameter.

The current value of the timer when timer is enabled.

Values	Default:	Read Only
	Min/Max:	0.0/9999 Secs
	Display:	0.1 Secs

d028 [Stp Logic Status]

When P038 [Speed Reference] is set to 6 “Stp Logic”, this parameter will display the current step of the step logic profile as defined by parameters A140-A147 [Stp Logic x].

Values	Default:	Read Only
	Min/Max:	0/7
	Display:	1

d029 [Torque Current]

The current value of the motor torque current.

Values	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Amps × 2)
	Display:	0.01 Amps

Basic Program Group

P031 [Motor NP Volts]

Related Parameter(s): d004, A084, A085, A086, A087

Stop drive before changing this parameter.

Set to the motor nameplate rated volts.

Values	Default:	Based on Drive Rating
	Min/Max:	20/Drive Rated Volts
	Display:	1 VAC

P032 [Motor NP Hertz]

Related Parameter(s): A084, A085, A086, A087, A090

Stop drive before changing this parameter.

Set to the motor nameplate rated frequency.

Values	Default:	60 Hz
	Min/Max:	15/400 Hz
	Display:	1 Hz

P033 [Motor OL Current]

Related Parameter(s): A055, A058, A061, A089, A090, A098, A114, A118

Set to the maximum allowable motor current.

The drive will fault on an F7 Motor Overload if the value of this parameter is exceeded by 150% for 60 seconds.

Values	Default:	Based on Drive Rating
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

P034 [Minimum Freq]

Related Parameter(s): d001, d002, d013, P035, A085, A086, A087, A110, A112

Sets the lowest frequency the drive will output continuously.

Values	Default:	0.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

P035 [Maximum Freq]

Related Parameter(s): d001, d002, d013, P034, A065, A078, A085, A086, A087, A111, A113

Stop drive before changing this parameter.

Sets the highest frequency the drive will output.

Values	Default:	60 Hz
	Min/Max:	0/400 Hz
	Display:	1 Hz

Basic Program Group *(continued)*

P036 [Start Source]

Related Parameter(s): d012, P037

Stop drive before changing this parameter.

Sets the control scheme used to start the drive.

Refer to Start and Speed Reference Control on page 1-20 for details about how other drive settings can override the setting of this parameter.

Important: For all settings except option 3, the drive must receive a leading edge from the start input for the drive to start after a stop input, loss of power or fault condition.

Options	**0**	"Keypad" (Default)	• Integral keypad controls drive operation. • I/O Terminal 1 "Stop" = coast to stop. • When active, the Reverse key is also active unless disabled by A095 [Reverse Disable].
	1	"3-Wire"	I/O Terminal 1 "Stop" = stop according to the value set in P037 [Stop Mode].
	2	"2-Wire"	I/O Terminal 1 "Stop" = coast to stop.
	3	"2-W Lvl Sens"	Drive will restart after a "Stop" command when: • Stop is removed and • Start is held active

ATTENTION: Hazard of injury exists due to unintended operation. When P036 [Start Source] is set to option 3, and the Run input is maintained, the Run inputs do not need to be toggled after a Stop input for the drive to run again. A Stop function is provided only when the Stop input is active (open).

	4	"2-W Hi Speed"	**Important:** There is greater potential voltage on the output terminals when using this option. • Outputs are kept in a ready-to-run state. The drive will respond to a "Start" command within 10 ms. • I/O Terminal 1 "Stop" = coast to stop.
	5	"Comm Port"	• Remote communications. Refer to Appendix C for details. • I/O Terminal 1 "Stop" = coast to stop.
	6	"Momt FWD/REV"	• Drive will start after a momentary input from either the Run FWD Input (I/O Terminal 02) or the Run REV Input (I/O Terminal 03). • I/O Terminal 1 "Stop" = stop according to the value set in P037 [Stop Mode].

Basic Program Group *(continued)*

P037 [Stop Mode]

Related Parameter(s): P036, A080, A081, A082, A105, A160

Active stop mode for all stop sources [e.g. keypad, run forward (I/O Terminal 02), run reverse (I/O Terminal 03), RS485 port] except as noted below.

Important: I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set for "3-Wire" control. When in three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode].

Hardware Enable Circuitry

By default, I/O Terminal 01 is a coast to stop input. The status of the input is interpreted by drive software. If the application requires the drive to be disabled without software interpretation, a "dedicated" hardware enable configuration can be utilized. This is accomplished by removing the ENBL enable jumper on the control board. In this case, the drive will always coast to a stop regardless of the settings of P036 [Start Source] and P037 [Stop Mode].

Options	**0**	"Ramp, CF"(1) (Default)	Ramp to Stop. "Stop" command clears active fault.
	1	"Coast, CF"(1)	Coast to Stop. "Stop" command clears active fault.
	2	"DC Brake, CF"(1)	DC Injection Braking Stop. "Stop" command clears active fault.
	3	"DCBrkAuto,CF"(1)	DC Injection Braking Stop with Auto Shutoff. • Standard DC Injection Braking for value set in A080 [DC Brake Time]. OR • Drive shuts off if the drive detects that the motor is stopped. "Stop" command clears active fault.
	4	"Ramp"	Ramp to Stop.
	5	"Coast"	Coast to Stop.
	6	"DC Brake"	DC Injection Braking Stop.
	7	"DC BrakeAuto"	DC Injection Braking Stop with Auto Shutoff. • Standard DC Injection Braking for value set in A080 [DC Brake Time]. OR • Drive shuts off if current limit is exceeded.
	8	"Ramp+EM B,CF"	Ramp to Stop with EM Brake Control. "Stop" Command clears active fault.
	9	"Ramp+EM Brk"	Ramp to Stop with EM Brake Control.

(1) Stop input also clears active fault.

Basic Program Group *(continued)*

P038 [Speed Reference]

Related Parameter(s): d001, d002, d012, d020, d021, P039,P040, A051-A054, A069, A070-A077, A110, A111, A112, A113, A123, A132, A140-A147, A150-A157

Sets the source of the speed reference to the drive.

The drive speed command can be obtained from a number of different sources. The source is normally determined by P038 [Speed Reference]. However, when A051 - A054 [Digital Inx Sel] is set to option 2, 4, 5, 6, 11, 12, 13, 14, 15 and the digital input is active, or if A132 [PID Ref Sel] is not set to option 0, the speed reference commanded by P038 [Speed Reference] will be overridden. Refer to the flowchart on page 1-20 for more information on speed reference control priority.

Options	**0**	“Drive Pot” (Default)	Internal frequency command from the potentiometer on the integral keypad.
	1	“InternalFreq”	Internal frequency command from A069 [Internal Freq]. Must be set when using MOP function.
	2	“0-10V Input”	External frequency command from the 0-10V or ±10V analog input or remote potentiometer.
	3	“4-20mA Input”	External frequency command from the 4-20mA analog input.
	4	“Preset Freq”	External frequency command as defined by A070 - A077 [Preset Freq x] when A051 - A054 [Digital Inx Sel] are programmed as “Preset Frequencies” and the digital inputs are active.
	5	“Comm Port”	External frequency command from the communications port. Refer to Appendix C for details.
	6	“Stp Logic”	External frequency command as defined by A070 - A077 [Preset Freq x] and A140 - A147 [Stp Logic x].
	7	“Anlg In Mult”	External frequency command as defined by the product of the analog inputs (shown in d020 [Analog In 0-10V] and d021 [Analog In 4-20mA]). [Analog In 0-10V] × [Analog In 4-20mA] = Speed Command Example: 100% × 50% = 50%

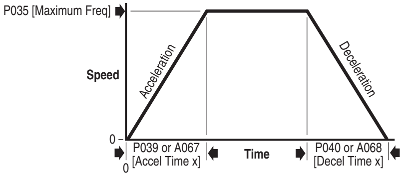
P039 [Accel Time 1]

Related Parameter(s): P038, P040, A051-A054, A067, A070-A077, A140-A147

Sets the rate of acceleration for all speed increases.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

Values	Default:	10.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs



Basic Program Group *(continued)*

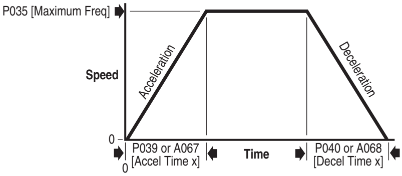
P040 [Decel Time 1]

Related Parameter(s): P038, P039, A051-A054, A068, A070-A077, A140-A147

Sets the rate of deceleration for all speed decreases.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

Values	Default:	10.0 Secs
	Min/Max:	0.1/600.0 Secs
	Display:	0.1 Secs



P041 [Reset To Defalts]

Stop drive before changing this parameter.

Resets all parameter values to factory defaults.

Options	**0**	"Ready/Idle" (Default)	
	1	"Factory Rset"	• After the reset function is complete, this parameter will set itself back to "0". • Causes an F48 Params Defaulted fault.

P042 [Voltage Class]

Stop drive before changing this parameter.

Sets the voltage class of 600V drives.

Options	**2**	"Low Voltage"	480V
	3	"High Voltage" (Default)	600V

Advanced Program Group

A051 [Digital In1 Sel]
(I/O Terminal 05)

A052 [Digital In2 Sel]
(I/O Terminal 06)

A053 [Digital In3 Sel]
(I/O Terminal 07)

A054 [Digital In4 Sel]
(I/O Terminal 08)

Related Parameter(s): d012, d014, P038, P039, P040, A067, A068, A070-A077, A078, A079, A118, A140-A147

Stop drive before changing this parameter.

Selects the function for the digital inputs. Refer to the flowchart on page 1-20 for more information on speed reference control priority.

Options	**0**	"Not Used"	Terminal has no function but can be read over network communications via d014 [Dig In Status].
	1	"Acc & Dec 2"	• When active, A067 [Accel Time 2] and A068 [Decel Time 2] are used for all ramp rates except Jog. • Can only be tied to one input. Refer to the flowchart on page 1-21 for more information on Accel/Decel selection.
	2	"Jog"	• When input is present, drive accelerates according to the value set in A079 [Jog Accel/Decel] and ramps to the value set in A078 [Jog Frequency]. • When input is removed, drive ramps to a stop according to the value set in A079 [Jog Accel/Decel]. • A valid "Start" command will override this input.
	3	"Aux Fault"	When enabled, an F2 Auxiliary Input fault will occur when the input is removed.
	4	"Preset Freq" (A051 & A052 Default)	Refer to A070 - A077 [Preset Freq x]. **Important:** Digital Inputs have priority for frequency control when programmed as Preset Speed and are active. Refer to the flowchart on page 1-20 for more information on speed reference control priority.
	5	"Local" (A053 Default)	When active, sets integral keypad as start source and potentiometer on the integral keypad as speed source.
	6	"Comm Port"	• When active, sets communications device as default start/speed command source. • Can only be tied to one input.
	7	"Clear Fault"	When active, clears an active fault.
	8	"RampStop,CF"	Causes drive to immediately ramp to a stop regardless of how P037 [Stop Mode] is set.
	9	"CoastStop,CF"	Causes drive to immediately coast to a stop regardless of how P037 [Stop Mode] is set.
	10	"DCInjStop,CF"	Causes drive to immediately begin a DC Injection stop regardless of how P037 [Stop Mode] is set.
	11	"Jog Forward" (A054 Default)	Drive accelerates to A078 [Jog Frequency] according to A079 [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command.
	12	"Jog Reverse"	Drive accelerates to A078 [Jog Frequency] according to A079 [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command.

A051 - A054 Options (Cont.)	**13**	“10V In Ctrl”	Selects 0-10V or ±10V control as the frequency reference. Start source is not changed.
	14	“20mA In Ctrl”	Selects 4-20mA control as the frequency reference. Start source is not changed.
	15	“PID Disable”	Disables PID function. Drive uses the next valid non-PID speed reference.
	16	“MOP Up”	Increases the value of A069 [Internal Freq] at a rate of 2 Hz per second. Default for A069 is 60 Hz.
	17	“MOP Down”	Decreases the value of A069 [Internal Freq] at a rate of 2 Hz per second. Default for A069 is 60 Hz.
	18	“Timer Start”	Clears and starts the timer function. May be used to control the relay or opto outputs.
	19	“Counter In”	Starts the counter function. May be used to control the relay or opto outputs.
	20	“Reset Timer”	Clears the active timer.
	21	“Reset Countr”	Clears the active counter.
	22	“Rset Tim&Cnt”	Clears the active timer and counter.
	23	“Logic In1”	Logic function input number 1. May be used to control the relay or opto outputs (see parameters A055, A058, A061 Options 11-14). May be used in conjunction with Step Logic parameters A140 - A147 [Stp Logic x].
	24	“Logic In2”	Logic function input number 2. May be used to control the relay or opto outputs (see parameters A055, A058, A061 Options 11-14). May be used in conjunction with Step Logic parameters A140 - A147 [Stp Logic x].
	25	“Current Lmt2”	When active, A118 [Current Limit 2] determines the drive current limit level.
	26	“Anlg Invert”	Inverts the scaling of the analog input levels set in A110 [Anlg In 0-10V Lo] and A111 [Anlg In 0-10V Hi] or A112 [Anlg In4-20mA Lo] and A113 [Anlg In4-20mA Hi].

A055 [Relay Out Sel]

Related Parameter(s): P033, A056, A092, A140-A147, A150-A157, A160, A161

Sets the condition that changes the state of the output relay contacts.

Options	**0**	“Ready/Fault” (Default)	Relay changes state when power is applied. This indicates that the drive is ready for operation. Relay returns drive to shelf state when power is removed or a fault occurs.
	1	“At Frequency”	Drive reaches commanded frequency.
	2	“MotorRunning”	Motor is receiving power from the drive.
	3	“Reverse”	Drive is commanded to run in reverse direction.
	4	“Motor Overld”	Motor overload condition exists.
	5	“Ramp Reg”	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	6	“Above Freq”	• Drive exceeds the frequency (Hz) value set in A056 [Relay Out Level]. • Use A056 to set threshold.

A055 Options (Cont.)	**7**	“Above Cur”	• Drive exceeds the current (% Amps) value set in A056 [Relay Out Level]. • Use A056 to set threshold. **Important:** Value for A056 [Relay Out Level] must be entered in percent of drive rated output current.
	8	“Above DCVolt”	• Drive exceeds the DC bus voltage value set in A056 [Relay Out Level]. • Use A056 to set threshold.
	9	“Retries Exst”	Value set in A092 [Auto Rstrt Tries] is exceeded.
	10	“Above Anlg V”	• Analog input voltage (I/O Terminal 13) exceeds the value set in A056 [Relay Out Level]. • Do not use if A123 [10V Bipolar Enbl] is set to 1 “Bi-Polar In”. • This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 13) is wired to a PTC and external resistor. • Use A056 to set threshold.
	11	“Logic In 1”	An input is programmed as “Logic In 1” and is active.
	12	“Logic In 2”	An input is programmed as “Logic In 2” and is active.
	13	“Logic 1 & 2”	Both Logic inputs are programmed and active.
	14	“Logic 1 or 2”	One or both Logic inputs are programmed and one or both is active.
	15	“StpLogic Out”	Drive enters Step Logic step with Digit 3 of Command Word (A140 - A147) set to enable Step Logic output.
	16	“Timer Out”	• Timer has reached value set in A056 [Relay Out Level]. • Use A056 to set threshold.
	17	“Counter Out”	• Counter has reached value set in A056 [Relay Out Level]. • Use A056 to set threshold.
	18	“Above PF Ang”	• Power Factor angle has exceeded the value set in A056 [Relay Out Level]. • Use A056 to set threshold.
	19	“Anlg In Loss”	Analog input loss has occurred. Program A122 [Analog In Loss] for desired action when input loss occurs.
	20	“ParamControl”	Enables the output to be controlled over network communications by writing to A056 [Relay Out Level]. (0 = Off, 1 = On.)
	21	“NonRec Fault”	• Value set in A092 [Auto Rstrt Tries] is exceeded. • A092 [Auto Rstrt Tries] in not enabled. • A Non-resettable fault has occurred.
	22	“EM Brk Cntrl”	EM brake is energized. Program A160 [EM Brk Off Delay] and A161 [EM Brk On Delay] for desired action.

Advanced Program Group *(continued)*

A056 [Relay Out Level]

Related Parameter(s): A055, A058, A061

32 32 bit parameter.

Sets the trip point for the digital output relay if the value of A055 [Relay Out Sel] is 6, 7, 8, 10, 16, 17, 18 or 20.

A055 Setting	A056 Min/Max
6	0/400 Hz
7	0/180%
8	0/815 Volts
10	0/100%
16	0.1/9999 Secs
17	1/9999 Counts
18	1/180 degs
20	0/1

Values	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

A058 [Opto Out1 Sel]
A061 [Opto Out2 Sel]

Related Parameter(s): P033, A056, A092, A140-A147, A150-A157

Determines the operation of the programmable opto outputs.

Options	**0**	"Ready/Fault"	Opto outputs are active when power is applied. This indicates that the drive is ready for operation. Opto outputs are inactive when power is removed or a fault occurs.
	1	"At Frequency" (A061 Default)	Drive reaches commanded frequency.
	2	"MotorRunning" (A058 Default)	Motor is receiving power from the drive.
	3	"Reverse"	Drive is commanded to run in reverse direction.
	4	"Motor Overld"	Motor overload condition exists.
	5	"Ramp Reg"	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	6	"Above Freq"	• Drive exceeds the frequency (Hz) value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	7	"Above Cur"	• Drive exceeds the current (% Amps) value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold. **Important:** Value for A059 or A062 [Opto Outx Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	• Drive exceeds the DC bus voltage value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	9	"Retries Exst"	Value set in A092 [Auto Rstrt Tries] is exceeded.

A058, A061 Options (Cont.)	**10** "Above Anlg V"	• Analog input voltage (I/O Terminal 13) exceeds the value set in A059 or A062 [Opto Outx Level]. • Do not use if A123 [10V Bipolar Enbl] is set to 1 "Bi-Polar In". • This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 13) is wired to a PTC and external resistor. • Use A059 or A062 to set threshold.
	11 "Logic In 1"	An input is programmed as "Logic In 1" and is active.
	12 "Logic In 2"	An input is programmed as "Logic In 2" and is active.
	13 "Logic 1 & 2"	Both Logic inputs are programmed and active.
	14 "Logic 1 or 2"	One or both Logic inputs are programmed and one or both is active.
	15 "StpLogic Out"	Drive enters Step Logic step with Digit 3 of Command Word (A140 - A147) set to enable Step Logic output.
	16 "Timer Out"	• Timer has reached value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	17 "Counter Out"	• Counter has reached value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	18 "Above PF Ang"	• Power Factor angle has exceeded the value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	19 "Anlg In Loss"	Analog input loss has occurred. Program A122 [Analog In Loss] for desired action when input loss occurs.
	20 "ParamControl"	Enables the output to be controlled over network communications by writing to A059 or A062 [Opto Outx Level]. (0 = Off, 1 = On.)
	21 "NonRec Fault"	• Value set in A092 [Auto Rstrt Tries] is exceeded. • A092 [Auto Rstrt Tries] in not enabled. • A Non-resettable fault has occurred.
	22 "EM Brk Cntrl"	EM brake is energized. Program A160 [EM Brk Off Delay] and A161 [EM Brk On Delay] for desired action.

Advanced Program Group *(continued)*

A059 [Opto Out1 Level]
A062 [Opto Out2 Level]

32 32 bit parameter.

Determines the on/off point for the opto outputs when A058 or A061 [Opto Outx Sel] is set to option 6, 7, 8, 10, 16, 17, 18 or 20.

A058 & A061 Setting	A059 & A062 Min/Max
6	0/400 Hz
7	0/180%
8	0/815 Volts
10	0/100%
16	0.1/9999 Secs
17	1/9999 Counts
18	1/180 degs
20	0/1

Values	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

A064 [Opto Out Logic]

Determines the logic (Normally Open/NO or Normally Closed/NC) of the opto outputs.

A064 Option	Opto Out1 Logic	Opto Out2 Logic
0	NO (Normally Open)	NO (Normally Open)
1	NC (Normally Closed)	NO (Normally Open)
2	NO (Normally Open)	NC (Normally Closed)
3	NC (Normally Closed)	NC (Normally Closed)

Values	Default:	0
	Min/Max:	0/3
	Display:	1

Advanced Program Group *(continued)*

A065 [Analog Out Sel]

Related Parameter(s): P035, A066

Sets the analog output signal mode (0-10V, 0-20mA, or 4-20mA). The output is used to provide a signal that is proportional to several drive conditions.

Option	Output Range	Minimum Output Value	Maximum Output Value A066 [Analog Out High]	DIP Switch Position	Related Parameter
0 “OutFreq 0-10”	0-10V	0V = 0 Hz	P035 [Maximum Freq]	0-10V	d001
1 “OutCurr 0-10”	0-10V	0V = 0 Amps	200% Drive Rated Output Current	0-10V	d003
2 “OutVolt 0-10”	0-10V	0V = 0 Volts	120% Drive Rated Output Volts	0-10V	d004
3 “OutPowr 0-10”	0-10V	0V = 0 kW	200% Drive Rated Power	0-10V	d022
4 “TstData 0-10”	0-10V	0V = 0000	65535 (Hex FFFF)	0-10V	d019
5 “OutFreq 0-20”	0-20mA	0 mA = 0 Hz	P035 [Maximum Freq]	0-20mA	d001
6 “OutCurr 0-20”	0-20mA	0 mA = 0 Amps	200% Drive Rated Output Current	0-20mA	d003
7 “OutVolt 0-20”	0-20mA	0 mA = 0 Volts	120% Drive Rated Output Volts	0-20mA	d004
8 “OutPowr 0-20”	0-20mA	0 mA = 0 kW	200% Drive Rated Power	0-20mA	d022
9 “TstData 0-20”	0-20mA	0 mA = 0000	65535 (Hex FFFF)	0-20mA	d019
10 “OutFreq 4-20”	4-20mA	4 mA = 0 Hz	P035 [Maximum Freq]	0-20mA	d001
11 “OutCurr 4-20”	4-20mA	4 mA = 0 Amps	200% Drive Rated Output Current	0-20mA	d003
12 “OutVolt 4-20”	4-20mA	4 mA = 0 Volts	120% Drive Rated Output Volts	0-20mA	d004
13 “OutPowr 4-20”	4-20mA	4 mA = 0 kW	200% Drive Rated Power	0-20mA	d022
14 “TstData 4-20”	4-20mA	4 mA = 0000	65535 (Hex FFFF)	0-20mA	d019
15 “OutTorq 0-10”	0-10V	0V = 0 Amps	200% Drive Rated FLA	0-10V	d029
16 “OutTorq 0-20”	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	0-20 mA	d029
17 “OutTorq 4-20”	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	0-20 mA	d029
18 “Setpnt 0-10”	0-10V	0V = 0%	100.0% Setpoint Setting	0-10V	A109
19 “Setpnt 0-20”	0-20 mA	0 mA = 0%	100.0% Setpoint Setting	0-20 mA	A109
20 “Setpnt 4-20”	4-20 mA	4 mA = 0%	100.0% Setpoint Setting	0-20 mA	A109

Values	Default:	0
	Min/Max:	0/20
	Display:	1

A066 [Analog Out High]

Related Parameter(s): A065

Scales the Maximum Output Value for the A065 [Analog Out Sel] source setting.

Examples:

A066 Setting	A065 Setting	A065 Max. Output Value
50%	1 “OutCurr 0-10”	5V for 200% Drive Rated Output Current
90%	8 “OutPowr 0-20”	18mA for 200% Drive Rated Power

Values	Default:	100%
	Min/Max:	0/800%
	Display:	1%

Advanced Program Group *(continued)*

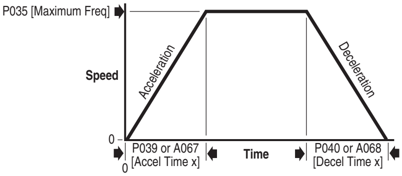
A067 [Accel Time 2]

Related Parameter(s): P039, A051-A054, A070-A077, A140-A147

When active, sets the rate of acceleration for all speed increases except jog. Refer to the flowchart on page 1-21 for details.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

Values	Default:	20.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs



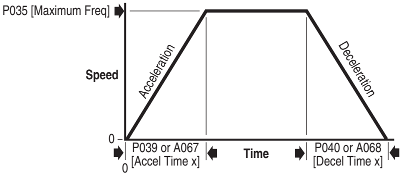
A068 [Decel Time 2]

Related Parameter(s): P040, A051-A054, A070-A077, A140-A147

When active, sets the rate of deceleration for all speed decreases except jog. Refer to the flowchart on page 1-21 for details.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

Values	Default:	20.0 Secs
	Min/Max:	0.1/600.0 Secs
	Display:	0.1 Secs



A069 [Internal Freq]

Related Parameter(s): P038, A162

Provides the frequency command to the drive when P038 [Speed Reference] is set to 1 “Internal Freq”. When enabled, this parameter will change the frequency command in “real time” using the integral keypad Up Arrow or Down Arrow when in program mode.

Important: Once the desired command frequency is reached, the Enter key must be pressed to store this value to EEPROM memory. If the ESC key is used before the Enter key, the frequency will return to the original value following the normal accel/decel curve.

If A051 - A054 [Digital Inx Sel] is set to 16 “MOP Up” or 17 “MOP Down” this parameter acts as the MOP frequency reference.

Values	Default:	60.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

Advanced Program Group *(continued)*

A070 [Preset Freq 0][1]
A071 [Preset Freq 1]
A072 [Preset Freq 2]
A073 [Preset Freq 3]
A074 [Preset Freq 4]
A075 [Preset Freq 5]
A076 [Preset Freq 6]
A077 [Preset Freq 7]

Related Parameter(s): P038, P039, P040, A051-A053, A067, A068, A140-A147, A150-A157

Values	A070 Default:[1]	0.0 Hz
	A071 Default:	5.0 Hz
	A072 Default:	10.0 Hz
	A073 Default:	20.0 Hz
	A074 Default:	30.0 Hz
	A075 Default:	40.0 Hz
	A076 Default:	50.0 Hz
	A077 Default:	60.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

Provides a fixed frequency command value when A051 - A053 [Digital Inx Sel] is set to 4 “Preset Frequencies”.

An active preset input will override speed command as shown in the flowchart on page 1-20.

[1] To activate A070 [Preset Freq 0] set P038 [Speed Reference] to option 4 “Preset Freq 0-3”.

Input State of Digital In 1 (I/O Terminal 05 when A051 = 4)	Input State of Digital In 2 (I/O Terminal 06 when A052 = 4)	Input State of Digital In 3 (I/O Terminal 07 when A053 = 4)	Frequency Source	Accel / Decel Parameter Used[2]
0	0	0	A070 [Preset Freq 0]	[Accel Time 1] / [Decel Time 1]
1	0	0	A071 [Preset Freq 1]	[Accel Time 1] / [Decel Time 1]
0	1	0	A072 [Preset Freq 2]	[Accel Time 2] / [Decel Time 2]
1	1	0	A073 [Preset Freq 3]	[Accel Time 2] / [Decel Time 2]
0	0	1	A074 [Preset Freq 4]	[Accel Time 1] / [Decel Time 1]
1	0	1	A075 [Preset Freq 5]	[Accel Time 1] / [Decel Time 1]
0	1	1	A076 [Preset Freq 6]	[Accel Time 2] / [Decel Time 2]
1	1	1	A077 [Preset Freq 7]	[Accel Time 2] / [Decel Time 2]

[2] When a Digital Input is set to “Accel 2 & Decel 2”, and the input is active, that input overrides the settings in this table.

A078 [Jog Frequency]

Related Parameter(s): P035, A051-A054, A079

Sets the output frequency when a jog command is issued.

Values	Default:	10.0 Hz
	Min/Max:	0.0/[Maximum Freq]
	Display:	0.1 Hz

Advanced Program Group *(continued)*

A079 [Jog Accel/Decel]

Related Parameter(s): A078, A051-A054

Sets the acceleration and deceleration time when a jog command is issued.

Values	Default:	10.0 Secs
	Min/Max:	0.1/600.0 Secs
	Display:	0.1 Secs

A080 [DC Brake Time]

Related Parameter(s): P037, A081

Sets the length of time that DC brake current is "injected" into the motor. Refer to parameter A081 [DC Brake Level].

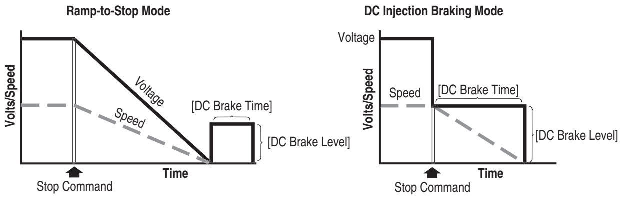
Values	Default:	0.0 Secs
	Min/Max:	0.0/99.9 Secs (A setting of 99.9 = Continuous)
	Display:	0.1 Secs

A081 [DC Brake Level]

Related Parameter(s): P037, A080

Defines the maximum DC brake current, in amps, applied to the motor when P037 [Stop Mode] is set to either "Ramp" or "DC Brake".

Values	Default:	Drive Rated Amps × 0.05
	Min/Max:	0.0/(Drive Rated Amps × 1.8)
	Display:	0.1 Amps



ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.

ATTENTION: This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking.

Advanced Program Group *(continued)*

A082 [DB Resistor Sel]

Related Parameter(s): P037

Stop drive before changing this parameter.

Enables/disables external dynamic braking.

Setting	Min/Max
0	"Disabled"
1	"Normal RA Res" (5% Duty Cycle) – Refer to Table B.C on page B-2.
2	"NoProtection" (100% Duty Cycle)
3-99	"x%Duty Cycle" Limited (3% – 99% of Duty Cycle)

Values	Default:	0
	Min/Max:	0/99
	Display:	1

A083 [S Curve %]

Sets the percentage of acceleration or deceleration time that is applied to the ramp as S Curve. Time is added, 1/2 at the beginning and 1/2 at the end of the ramp.

Values	Default:	0% (Disabled)
	Min/Max:	0/100%
	Display:	1%

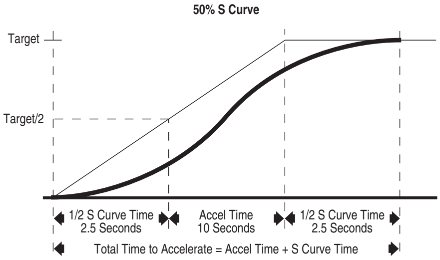
Example:

Accel Time = 10 Seconds

S Curve Setting = 50%

S Curve Time = 10 × 0.5 = 5 Seconds

Total Time = 10 + 5 = 15 Seconds



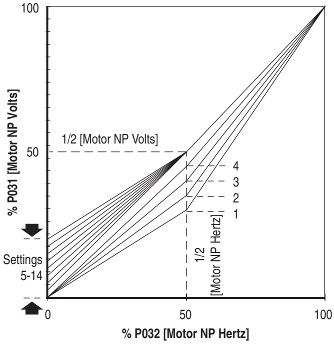
Advanced Program Group *(continued)*

A084 [Boost Select]

Related Parameter(s): d004, P031, P032, A085, A086, A087, A125

Sets the boost voltage (% of P031 [Motor NP Volts]) and redefines the Volts per Hz curve.
Active when A125 [Torque Perf Mode] = 0 "V/Hz".
Drive may add additional voltage unless Option 5 is selected.

Options	**0**	"Custom V/Hz"	
	1	"30.0, VT"	Variable Torque (Typical fan/pump curves.)
	2	"35.0, VT"	
	3	"40.0, VT"	
	4	"45.0, VT"	
	5	"0.0 no IR"	Constant Torque
	6	"0.0"	
	7	"2.5, CT" [Default for 4.0, 5.5, 7.5 & 11 kW (5.0, 7.5, 10 & 15 HP) Drives]	
	8	"5.0, CT" (Default)	
	9	"7.5, CT"	
	10	"10.0, CT"	
	11	"12.5, CT"	
	12	"15.0, CT"	
	13	"17.5, CT"	
	14	"20.0, CT"	



Advanced Program Group *(continued)*

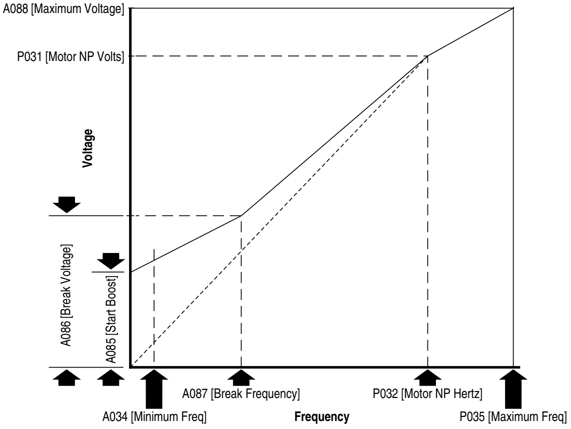
A085 [Start Boost]

Related Parameter(s): P031, P032, P034, P035, A084, A086, A087, A088, A125

Sets the boost voltage (% of P031 [Motor NP Volts]) and redefines the Volts per Hz curve when A084 [Boost Select] = 0 "Custom V/Hz" and A125 [Torque Perf Mode] = 0 "V/Hz".

Drive may add additional voltage unless Option 5 is selected.

Values	Default:	2.5%
	Min/Max:	0.0/25.0%
	Display:	0.1%



A086 [Break Voltage]

Related Parameter(s): P031, P032, P034, P035, A084, A085, A087, A088, A125

Sets the frequency where break voltage is applied when A084 [Boost Select] = 0 "Custom V/Hz" and A125 [Torque Perf Mode] = 0 "V/Hz"

Values	Default:	25.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A087 [Break Frequency]

Related Parameter(s): P031, P032, P034, P035, A084, A085, A086, A088, A125

Sets the frequency where break frequency is applied when A084 [Boost Select] = 0 "Custom V/Hz" and A125 [Torque Perf Mode] = 0 "V/Hz"

Values	Default:	15.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

Advanced Program Group *(continued)*

A088 [Maximum Voltage]

Related Parameter(s): d004, A085, A086, A087

Sets the highest voltage the drive will output.

Values	Default:	Drive Rated Volts
	Min/Max:	20/Drive Rated Volts
	Display:	1 VAC

A089 [Current Limit 1]

Related Parameter(s): P033, A118

Maximum output current allowed before current limiting occurs.

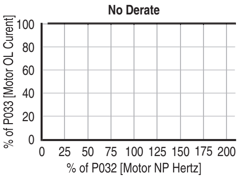
Values	Default:	Drive Rated Amps × 1.5
	Min/Max:	0.1/Drive Rated Amps × 1.8
	Display:	0.1 Amps

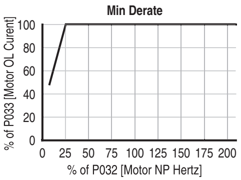
A090 [Motor OL Select]

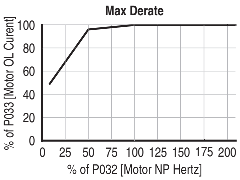
Related Parameter(s): P032, P033

Drive provides Class 10 motor overload protection. Settings 0-2 select the derating factor for the I^2t overload function.

Options	**0**	"No Derate" (Default)
	1	"Min Derate"
	2	"Max Derate"







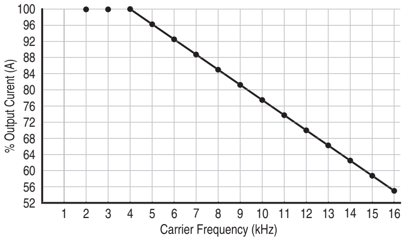
A091 [PWM Frequency]

Related Parameter(s): A124

Sets the carrier frequency for the PWM output waveform. The chart below provides derating guidelines based on the PWM frequency setting.

Important: Ignoring derating guidelines can cause reduced drive performance.

Values	Default:	4.0 kHz
	Min/Max:	2.0/16.0 kHz
	Display:	0.1 kHz



Advanced Program Group *(continued)*

A092 [Auto Rstrt Tries]

Related Parameter(s): A055, A058, A061, A093

Sets the maximum number of times the drive attempts to reset a fault and restart.

Clear a Type 1 fault and restart the drive.

1. Set A092 [Auto Rstrt Tries] to a value other than "0".
2. Set A093 [Auto Rstrt Delay] to a value other than "0".

Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.

1. Set A092 [Auto Rstrt Tries] to a value other than "0".
2. Set A093 [Auto Rstrt Delay] to "0".

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

Values	Default:	0
	Min/Max:	0/9
	Display:	1

A093 [Auto Rstrt Delay]

Related Parameter(s): A092

Sets the time between restart attempts when A092 [Auto Rstrt Tries] is set to a value other than zero.

Values	Default:	1.0 Secs
	Min/Max:	0.0/300.0 Secs
	Display:	0.1 Secs

A094 [Start At PowerUp]

Stop drive before changing this parameter.

Enables/disables a feature that allows a Start or Run command to automatically cause the drive to resume running at commanded speed after drive input power is restored. Requires a digital input configured for Run or Start and a valid start contact.

This parameter will not function if parameter P036 [Start Source] is set to 4 "2-W High Speed".

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

Advanced Program Group *(continued)*

A095 [Reverse Disable]

Related Parameter(s): d006

Stop drive before changing this parameter.

Enables/disables the function that allows the direction of motor rotation to be changed. The reverse command may come from a digital command, the keypad or a serial command. All reverse inputs including two-wire Run Reverse will be ignored with reverse disabled.

Options	**0**	"Rev Enabled" (Default)
	1	"Rev Disabled"

A096 [Flying Start En]

Sets the condition that allows the drive to reconnect to a spinning motor at actual RPM.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

A097 [Compensation]

Enables/disables correction options that may improve problems with motor instability.

Options	**0**	"Disabled"	
	1	"Electrical" (Default)	Some drive/motor combinations have inherent instabilities which are exhibited as non-sinusodial motor currents. This setting attempts to correct this condition.
	2	"Mechanical"	Some motor/load combinations have mechanical resonances which can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition.
	3	"Both"	

A098 [SW Current Trip]

Related Parameter(s): P033

Enables/disables a software instantaneous (within 100 ms) current trip.

Values	Default:	0.0 (Disabled)
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

A099 [Process Factor]

Related Parameter(s): d010

Scales the output frequency value displayed by d010 [Process Display].

Output Freq x Process Factor = Process Display

Values	Default:	30.0
	Min/Max:	0.1/999.9
	Display:	0.1

Advanced Program Group *(continued)*

A100 [Fault Clear]

Stop drive before changing this parameter.

Resets a fault and clears the fault queue. Used primarily to clear a fault over network communications.

Options	**0**	"Ready/Idle" (Default)	
	1	"Reset Fault"	
	2	"Clear Buffer"	(Parameters d007-d009 [Fault x Code])

A101 [Program Lock]

Protects parameters against change by unauthorized personnel.

Options	**0**	"Unlocked" (Default)
	1	"Locked"

A102 [Testpoint Sel]

Related Parameter(s): d019

Used by Rockwell Automation field service personnel.

Values	Default:	400
	Min/Max:	0/FFFF
	Display:	1 Hex

A103 [Comm Data Rate]

Related Parameter(s): d015

Sets the serial port rate for the RS485 (DSI) port.

Important: Power to drive must be cycled before any changes will affect drive operation.

Options	**0**	"1200"
	1	"2400"
	2	"4800"
	3	"9600" (Default)
	4	"19.2K"
	5	"38.4K"

A104 [Comm Node Addr]

Related Parameter(s): d015

Sets the drive node address for the RS485 (DSI) port if using a network connection.

Important: Power to drive must be cycled before any changes will affect drive operation.

Values	Default:	100
	Min/Max:	1/247
	Display:	1

Advanced Program Group *(continued)*

A105 [Comm Loss Action]

Related Parameter(s): d015, P037, A106

Selects the drive's response to a loss of the communication connection or excessive communication errors.

Options	**0**	"Fault" (Default)	Drive will fault on an F81 Comm Loss and coast to stop.
	1	"Coast Stop"	Stops drive via coast to stop.
	2	"Stop"	Stops drive via P037 [Stop Mode] setting.
	3	"Continu Last"	Drive continues operating at communication commanded speed saved in RAM.

A106 [Comm Loss Time]

Related Parameter(s): d015, A105

Sets the time that the drive will remain in communication loss before implementing the option selected in A105 [Comm Loss Action].

Values	Default:	5.0 Secs
	Min/Max:	0.1/60.0 Secs
	Display:	0.1 Secs

A107 [Comm Format]

Related Parameter(s): d015

Selects the protocol (RTU only), data bits (8 data bits only), parity (None, Even, Odd), and stop bits (1 stop bit only) used by the RS485 port on the drive.

Refer to Appendix C for details on using the drive communication features.

Important: Power to drive must be cycled before any changes will affect drive operation.

Options	**0**	"RTU 8-N-1" (Default)
	1	"RTU 8-E-1"
	2	"RTU 8-O-1"
	3	"RTU 8-N-2"
	4	"RTU 8-E-2"
	5	"RTU 8-O-2"

A108 [Language]

Selects the language displayed by the remote communications option.

Options	**1**	"English" (Default)
	2	"Français"
	3	"Español"
	4	"Italiano"
	5	"Deutsch"
	6	"Reserved"
	7	"Português"
	8	"Reserved"
	9	"Reserved"
	10	"Nederlands"

Advanced Program Group *(continued)*

A109 [Anlg Out Setpnt]

Related Parameter(s): A065

When A065 [Analog Out Sel] is set to option 18, 19 or 20, this parameter sets the percentage of analog output desired.

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A110 [Anlg In 0-10V Lo]

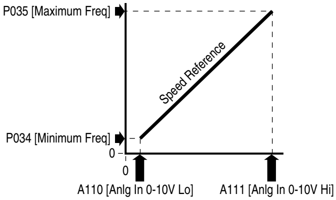
Related Parameter(s): d020, P034, P038, A122

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P034 [Minimum Freq] if a 0-10V input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value larger than A111 [Anlg In 0-10V Hi].

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%



A111 [Anlg In 0-10V Hi]

Related Parameter(s): d020, P035, P038, A122, A123

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P035 [Maximum Freq] if a 0-10V input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value smaller than A110 [Anlg In 0-10V Lo].

Values	Default:	100.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A112 [Anlg In4-20mA Lo]

Related Parameter(s): d021, P034, P038

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P034 [Minimum Freq] if a 4-20mA input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value larger than A113 [Anlg In4-20mA Hi].

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

Advanced Program Group *(continued)*

A113 [Anlg In4-20mA Hi]

Related Parameter(s): d021, P035, P038

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P035 [Maximum Freq] if a 4-20mA input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value smaller than A112 [Anlg In4-20mA Lo].

Values	Default:	100.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A114 [Slip Hertz @ FLA]

Related Parameter(s): P033

Compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency based on motor current.

Values	Default:	2.0 Hz
	Min/Max:	0.0/10.0 Hz
	Display:	0.1 Hz

A115 [Process Time Lo]

Related Parameter(s): d010, P034

Scales the time value when the drive is running at P034 [Minimum Freq]. When set to a value other than zero, d010 [Process Display] indicates the duration of the process.

Values	Default:	0.00
	Min/Max:	0.00/99.99
	Display:	0.01

A116 [Process Time Hi]

Related Parameter(s): d010, P035

Scales the time value when the drive is running at P035 [Maximum Freq]. When set to a value other than zero, d010 [Process Display] indicates the duration of the process.

Values	Default:	0.00
	Min/Max:	0.00/99.99
	Display:	0.01

A117 [Bus Reg Mode]

Disables the bus regulator.

Options	**0**	"Disabled"
	1	"Enabled" (Default)

A118 [Current Limit 2]

Related Parameter(s): P033, A051-A054, A089

Maximum output current allowed before current limiting occurs. This parameter is only active if A051 - A054 [Digital Inx Sel] is set to 25 "Current Lmt2" and is active.

Values	Default:	Drive Rated Amps × 1.5
	Min/Max:	0.1/(Drive Rated Amps × 1.8)
	Display:	0.1 Amps

Advanced Program Group *(continued)*

A119 [Skip Frequency]

Related Parameter(s): A120

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

Values	Default:	0 Hz
	Min/Max:	0/400 Hz
	Display:	1 Hz

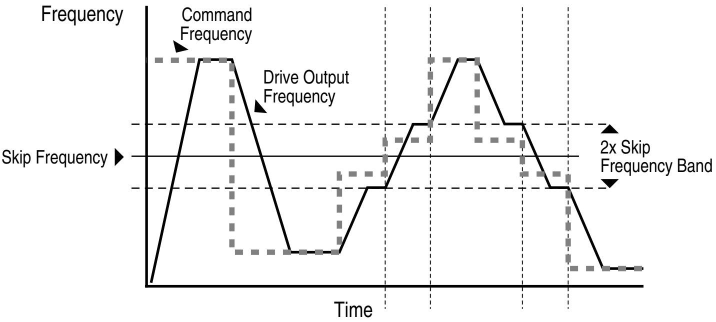
A120 [Skip Freq Band]

Related Parameter(s): A119

Determines the bandwidth around A119 [Skip Frequency]. A120 [Skip Frequency Band] is split applying 1/2 above and 1/2 below the actual skip frequency.

A setting of 0.0 disables this parameter.

Values	Default:	0.0 Hz
	Min/Max:	0.0/30.0 Hz
	Display:	0.1 Hz



A121 [Stall Fault Time]

Sets the time that the drive will remain in stall mode before a fault is issued.

Options	**0**	"60 Seconds" (Default)
	1	"120 Seconds"
	2	"240 Seconds"
	3	"360 Seconds"
	4	"480 Seconds"
	5	"Flt Disabled"

Advanced Program Group *(continued)*

A122 [Analog In Loss]

Related Parameter(s): A110, A111, A132

Selects drive action when an input signal loss is detected. Signal loss is defined as an analog signal less than 1V or 2mA. The signal loss event ends and normal operation resumes when the input signal level is greater than or equal to 1.5V or 3mA. If using a 0-10V analog input, set A110 [Anlg In 0-10V Lo] to a minimum of 20% (i.e. 2 volts).

Options	**0**	"Disabled" (Default)	
	1	"Fault (F29)"	F29 Analog Input Loss
	2	"Stop"	Uses P037 [Stop Mode]
	3	"Zero Ref"	Drive runs at zero speed reference.
	4	"Min Freq Ref"	Drive runs at minimum frequency.
	5	"Max Freq Ref"	Drive runs at maximum frequency.
	6	"Int Freq Ref"	Drive runs at internal frequency.

A123 [10V Bipolar Enbl]

Related Parameter(s): P038, A111

Enables/disables bipolar control. In bipolar mode direction is commanded by the sign of the reference.

Options	**0**	"Uni-Polar In" (Default)	0 to 10V only
	1	"Bi-Polar In"	±10V

A124 [Var PWM Disable]

Related Parameter(s): A091

Stop drive before changing this parameter.

Enables/disables a feature that varies the carrier frequency for the PWM output waveform defined by A091 [PWM Frequency].

Disabling this feature when low frequency conditions exist may result in IGBT stress and nuisance tripping.

Options	**0**	"Enabled" (Default)
	1	"Disabled"

A125 [Torque Perf Mode]

Related Parameter(s): A084, A085, A086, A087, A127

Stop drive before changing this parameter.

Enables/disables sensorless vector control operation.

Options	**0**	"V/Hz"
	1	"Sensrls Vect" (Default)

A126 [Motor NP FLA]

Related Parameter(s): A127

Set to the motor nameplate rated full load amps.

Values	Default:	Drive Rated Amps
	Min/Max:	0.1/(Drive Rated Amps × 2)
	Display:	0.1 Amps

Advanced Program Group *(continued)*

A127 [Autotune]

Related Parameter(s): A125, A126, A128, A129

Stop drive before changing this parameter.

Provides an automatic method for setting A128 [IR Voltage Drop] and A129 [Flux Current Ref], which affect sensorless vector performance. Parameter A126 [Motor NP FLA] must be set to the motor nameplate full load amps before running the Autotune procedure.

Options	**0**	“Ready/Idle” (Default)
	1	“Static Tune”
	2	“Rotate Tune”

“Ready” (0) = Parameter returns to this setting following a “Static Tune” or “Rotate Tune.”

“Static Tune” (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of A128 [IR Voltage Drop]. A start command is required following initiation of this setting. The parameter returns to “Ready” (0) following the test, at which time another start transition is required operate the drive in normal mode. Used when motor cannot be uncoupled from the load.

“Rotate Tune” (2) = A temporary command that initiates a “Static Tune” followed by a rotational test for the best possible automatic setting of A129 [Flux Current Ref]. A start command is required following initiation of this setting. The parameter returns to “Ready” (0) following the test, at which time another start transition is required to operate the drive in normal mode. **Important:** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure.

ATTENTION: Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding.

If the Autotune routine fails, an F80 SVC Autotune fault is displayed.

A128 [IR Voltage Drop]

Related Parameter(s): A127

Value of volts dropped across the resistance of the motor stator.

Values	Default:	Based on Drive Rating
	Min/Max:	0.0/230.0 VAC
	Display:	0.1 VAC

A129 [Flux Current Ref]

Related Parameter(s): A127

Value of amps for full motor flux.

Values	Default:	Based on Drive Rating
	Min/Max:	0.00/[Motor NP Volts]
	Display:	0.01 Amps

Advanced Program Group *(continued)*

A130 [PID Trim Hi]

Sets the maximum positive value that is added to a PID reference when PID trim is used.

Values	Default:	60.0
	Min/Max:	0.0/400.0
	Display:	0.1

A131 [PID Trim Lo]

Sets the minimum positive value that is added to a PID reference when PID trim is used.

Values	Default:	0.0
	Min/Max:	0.0/400.0
	Display:	0.1

A132 [PID Ref Select]

Related Parameter(s): P038, A122

Stop drive before changing this parameter.

Enables/disables PID mode and selects the source of the PID reference. Refer to Appendix F for details.

Options	**0**	"PID Disabled" (Default)
	1	"PID Setpoint"
	2	"0-10V Input"
	3	"4-20mA Input"
	4	"Comm Port"
	5	"Setpnt, Trim"
	6	"0-10V, Trim"
	7	"4-20mA, Trim"
	8	"Comm, Trim"

A133 [PID Feedback Sel]

Select the source of the PID feedback. Refer to Appendix F for details.

Options	**0**	"0-10V Input" (Default)	The PID will not function with a bipolar input. Negative voltages are treated as 0 volts.
	1	"4-20mA Input"	
	2	"Comm Port"	

A134 [PID Prop Gain]

Sets the value for the PID proportional component when the PID mode is enabled by A132 [PID Ref Sel].

Values	Default:	0.01
	Min/Max:	0.00/99.99
	Display:	0.01

Advanced Program Group *(continued)*

A135 [PID Integ Time]

Sets the value for the PID integral component when the PID mode is enabled by A132 [PID Ref Sel].

Values	Default:	0.1 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

A136 [PID Diff Rate]

Sets the value for the PID differential component when the PID mode is enabled by A132 [PID Ref Sel].

Values	Default:	0.01 (1/Secs)
	Min/Max:	0.00/99.99 (1/Secs)
	Display:	0.01 (1/Secs)

A137 [PID Setpoint]

Provides an internal fixed value for process setpoint when the PID mode is enabled by A132 [PID Ref Sel].

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A138 [PID Deadband]

Sets the lower limit of the PID output.

Values	Default:	0.0%
	Min/Max:	0.0/10.0%
	Display:	0.1%

A139 [PID Preload]

Sets the value used to preload the integral component on start or enable.

Values	Default:	0.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

Advanced Program Group *(continued)*

A140 [Stp Logic 0]
A141 [Stp Logic 1]
A142 [Stp Logic 2]
A143 [Stp Logic 3]
A144 [Stp Logic 4]
A145 [Stp Logic 5]
A146 [Stp Logic 6]
A147 [Stp Logic 7]

Related Parameter(s): P038, P039, P040, A051-A054, A055, A058, A061, A067, A068, A070-A077, A150-A157

Stop drive before changing this parameter.

Values	Default:	00F1
	Min/Max:	0001/bAFF
	Display:	4 Digits

Parameters A140-A147 are only active if P038 [Speed Reference] is set to 6 “Stp Logic”.

These parameters can be used to create a custom profile of frequency commands. Each “step” can be based on time, status of a Logic input or a combination of time and the status of a Logic input.

Digits 0-3 for each [Stp Logic x] parameter must be programmed according to the desired profile.

A Logic input is established by setting a digital input, parameters A051 - A054 [Digital Inx Sel], to 23 “Logic In1” and/or 24 “Logic In2”.

A time interval between steps can be programmed using parameters A150 - A157 [Stp Logic Time x]. See the table below for related parameters.

The speed for any step is programmed using parameters A070 - A077 [Preset Freq x].

Step Logic Parameter (Active when P038 = 6 “Stp Logic”)	Related Preset Frequency Parameter (Can be activated independent of Step Logic Parameters)	Related Step Logic Time Parameter (Active when A140-A147 Digit 0 or 1 are set to 1, b, C, d or E)
A140 [Stp Logic 0]	A070 [Preset Freq 0]	A150 [Stp Logic Time 0]
A141 [Stp Logic 1]	A071 [Preset Freq 1]	A151 [Stp Logic Time 1]
A142 [Stp Logic 2]	A072 [Preset Freq 2]	A152 [Stp Logic Time 2]
A143 [Stp Logic 3]	A073 [Preset Freq 3]	A153 [Stp Logic Time 3]
A144 [Stp Logic 4]	A074 [Preset Freq 4]	A154 [Stp Logic Time 4]
A145 [Stp Logic 5]	A075 [Preset Freq 5]	A155 [Stp Logic Time 5]
A146 [Stp Logic 6]	A076 [Preset Freq 6]	A156 [Stp Logic Time 6]
A147 [Stp Logic 7]	A077 [Preset Freq 7]	A157 [Stp Logic Time 7]

How Step Logic Works

The step logic sequence begins with a valid start command. A normal sequence always begins with A140 [Stp Logic 0].

Digit 0: Logic For Next Step

This digit defines the logic for the next step. When the condition is met the program advances to the next step. Step 0 follows Step 7. Example: Digit 0 is set 3. When “Logic In2” becomes active, the program advances to the next step.

Digit 1: Logic to Jump to a Different Step

For all settings other than F, when the condition is met, the program overrides Digit 0 and jumps to the step defined by Digit 2.

Digit 2: Different Step to Jump

When the condition for Digit 1 is met, the Digit 2 setting determines the next step or to end the program.

Digit 3: Step Settings

This digit defines what accel/decel profile the speed command will follow and the direction of the command for the current step. In addition, if a relay or opto output (parameters A055, A058 and A061) is set to 15 “StpLogic Out”, this parameter can control the status of that output.

Any Step Logic parameter can be programmed to control a relay or opto output, but you can not control different outputs based on the condition of different Step Logic commands.

Step Logic Settings

The logic for each function is determined by the four digits for each step logic parameter. The following is a listing of the available settings for each digit.

Refer to Appendix E for details.

0000

Logic For Next Step	Digit 0
Logic to Jump to a Different Step	Digit 1
Different Step to Jump	Digit 2
Step Settings	Digit 3

Digit 3 Settings

Required Setting	Accel/Decel Param. Used	Step Logic Output State	Commanded Direction
0	Accel/Decel 1	Off	FWD
1	Accel/Decel 1	Off	REV
2	Accel/Decel 1	Off	No Output
3	Accel/Decel 1	On	FWD
4	Accel/Decel 1	On	REV
5	Accel/Decel 1	On	No Output
6	Accel/Decel 2	Off	FWD
7	Accel/Decel 2	Off	REV
8	Accel/Decel 2	Off	No Output
9	Accel/Decel 2	On	FWD
A	Accel/Decel 2	On	REV
b	Accel/Decel 2	On	No Output

Digit 2 Settings

0 = Jump to Step 0
1 = Jump to Step 1
2 = Jump to Step 2
3 = Jump to Step 3
4 = Jump to Step 4
5 = Jump to Step 5
6 = Jump to Step 6
7 = Jump to Step 7
8 = End Program (Normal Stop)
9 = End Program (Coast to Stop)
A = End Program and Fault (F2)

Digit 1 and Digit 0 Settings

0 = Skip Step (Jump Immediately)
1 = Step Based on [Stp Logic Time x]
2 = Step if “Logic In1” is Active
3 = Step if “Logic In2” is Active
4 = Step if “Logic In1” is Not Active
5 = Step if “Logic In2” is Not Active
6 = Step if either “Logic In1” or “Logic In2” is Active
7 = Step if both “Logic In1” and “Logic In2” is Active
8 = Step if neither “Logic In1” or “Logic In2” is Active
9 = Step if “Logic In1” is Active and “Logic In2” is Not Active
A = Step if “Logic In2” is Active and “Logic In1” is Not Active
b = Step after [Stp Logic Time x] and “Logic In1” is Active
C = Step after [Stp Logic Time x] and “Logic In2” is Active
d = Step after [Stp Logic Time x] and “Logic In1” is Not Active
E = Step after [Stp Logic Time x] and “Logic In2” is Not Active
F = Do Not Step/Ignore Digit 2 Settings

Advanced Program Group *(continued)*

A150 [Stp Logic Time 0]
A151 [Stp Logic Time 1]
A152 [Stp Logic Time 2]
A153 [Stp Logic Time 3]
A154 [Stp Logic Time 4]
A155 [Stp Logic Time 5]
A156 [Stp Logic Time 6]
A157 [Stp Logic Time 7]

Related Parameter(s): P038, A055, A058, A061, A070-A077, A140-A147

Sets the time to remain in each step if the corresponding StpLogic command word is set to "Step after Time".

Values	Default:	30.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

A160 [EM Brk Off Delay]

Related Parameter(s): P037

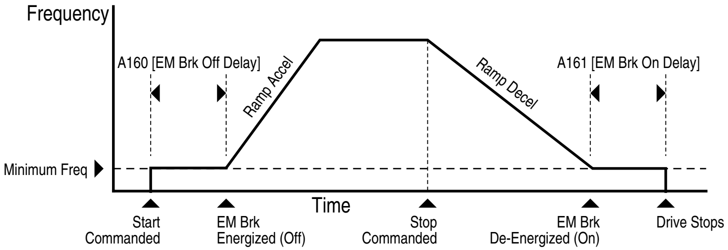
Sets the time the drive remains at minimum frequency before the relay or an opto output is energized and the drive ramps to the commanded frequency.

The relay or opto output is typically connected to a user-supplied electromechanical brake coil relay.

Set P037 [Stop Mode] to 8 "Ramp+EM B,CF" or 9 "Ramp+EM Brk" to enable the electromechanical brake option.

Set A055 [Relay Out Sel], A058 or A061 [Opto Outx Sel] to 22 "EM Brk Cntrl" to control brake operation.

Values	Default:	2.0 Secs
	Min/Max:	0.01/10.00 Secs
	Display:	0.01 Secs



A161 [EM Brk On Delay]

Related Parameter(s): P037

Sets the time the drive remains at minimum frequency before the relay or an opto output is de-energizing and the drive stops.

The relay or opto output is typically connected to a user-supplied electromechanical brake coil relay.

Set P037 [Stop Mode] to 8 “Ramp+EM B,CF” or 9 “Ramp+EM Brk” to enable the electromechanical brake option.

Set A055 [Relay Out Sel], A058 or A061 [Opto Outx Sel] to 22 “EM Brk Cntrl” to control brake operation.

Values	Default:	2.0 Secs
	Min/Max:	0.01/10.00 Secs
	Display:	0.01 Secs

A162 [MOP Reset Sel]

Related Parameter(s): A069

Set the drive to save the current MOP reference command.

Options	**0**	“Zero MOP Ref”	This option clamps A069 [Internal Freq] at 0.0 Hz when the drive is not running.
	1	“Save MOP Ref” (Default)	Reference is saved in A069 [Internal Freq].

Parameter Cross Reference – by Name

Parameter Name	No.	Group
10V Bipolar Enbl	A123	Advanced Program
Accel Time 1	P039	Basic Program
Accel Time 2	A067	Advanced Program
Analog In 0-10V	d020	Display
Analog In 0-20mA	d021	Display
Analog In Loss	A122	Advanced Program
Analog Out High	A066	Advanced Program
Analog Out Sel	A065	Advanced Program
Anlg In 0-10V Hi	A111	Advanced Program
Anlg In 4-10V Lo	A110	Advanced Program
Anlg In4-20mA Hi	A113	Advanced Program
Anlg In4-20mA Lo	A112	Advanced Program
Anlg Out Setpnt	A109	Advanced Program
Auto Rstrt Delay	A093	Advanced Program
Auto Rstrt Tries	A092	Advanced Program
Autotune	A127	Advanced Program
Boost Select	A084	Advanced Program
Break Frequency	A087	Advanced Program
Break Voltage	A086	Advanced Program
Bus Reg Mode	A117	Advanced Program
Comm Data Rate	A103	Advanced Program
Comm Format	A107	Advanced Program
Comm Loss Action	A105	Advanced Program
Comm Loss Time	A106	Advanced Program
Comm Node Addr	A104	Advanced Program
Comm Status	d015	Display
Commanded Freq	d002	Display
Compensation	A097	Advanced Program
Contrl In Status	d013	Display
Control Source	d012	Display
Control SW Ver	d016	Display
Counter Status	d025	Display
Current Limit x	A089, A118	Advanced Program
DB Resistor Sel	A082	Advanced Program
DC Brake Level	A081	Advanced Program
DC Brake Time	A080	Advanced Program
DC Bus Voltage	d005	Display
Decel Time 1	P040	Basic Program
Decel Time 2	A068	Advanced Program
Dig In Status	d014	Display
Digital Inx Sel	A051-A054	Advanced Program
Drive Status	d006	Display
Drive Temp	d024	Display
Drive Type	d017	Display
Elapsed Run Time	d018	Display
EM Brk Off Delay	A160	Advanced Program
EM Brk On Delay	A161	Advanced Program
Fault Clear	A100	Advanced Program
Fault x Code	d007-d009	Display
Flux Current Ref	A129	Advanced Program
Flying Start En	A096	Advanced Program
Internal Freq	A069	Advanced Program
IR Voltage Drop	A128	Advanced Program
Jog Accel/Decel	A079	Advanced Program
Jog Frequency	A078	Advanced Program
Language	A108	Advanced Program
Maximum Freq	P035	Basic Program

Parameter Name	No.	Group
Maximum Voltage	A088	Advanced Program
Minimum Freq	P034	Basic Program
MOP Reset Sel	A162	Advanced Program
Motor NP FLA	A126	Advanced Program
Motor NP Hertz	P032	Basic Program
Motor NP Volts	P031	Basic Program
Motor OL Current	P033	Basic Program
Motor OL Select	A090	Advanced Program
Opto Out Logic	A064	Advanced Program
Opto Outx Level	A059, A062	Advanced Program
Opto Outx Sel	A058, A061	Advanced Program
Output Current	d003	Display
Output Freq	d001	Display
Output Power	d022	Display
Output Powr Fctr	d023	Display
Output Voltage	d004	Display
PID Deadband	A138	Advanced Program
PID Diff Rate	A136	Advanced Program
PID Feedback Sel	A133	Advanced Program
PID Integ Time	A135	Advanced Program
PID Preload	A139	Advanced Program
PID Prop Gain	A134	Advanced Program
PID Ref Sel	A132	Advanced Program
PID Setpoint	A137	Advanced Program
PID Trim Hi	A130	Advanced Program
PID Trim Lo	A131	Advanced Program
Preset Freq x	A070-A077	Advanced Program
Process Display	d010	Display
Process Factor	A099	Advanced Program
Process Time Hi	A116	Advanced Program
Process Time Lo	A115	Advanced Program
Program Lock	A101	Advanced Program
PWM Frequency	A091	Advanced Program
Relay Out Level	A056	Advanced Program
Relay Out Sel	A055	Advanced Program
Reset To Defalts	P041	Basic Program
Reverse Disable	A095	Advanced Program
S Curve %	A083	Advanced Program
Skip Freq Band	A120	Advanced Program
Skip Frequency	A119	Advanced Program
Slip Hertz @ FLA	A114	Advanced Program
Stp Logic Status	d028	Display
Stp Logic Step x	A140-A147	Advanced Program
Stp Logic Time x	A150-A157	Advanced Program
Speed Reference	P038	Basic Program
Stall Fault Time	A121	Advanced Program
Start At PowerUp	A094	Advanced Program
Start Boost	A085	Advanced Program
Start Source	P036	Basic Program
Stop Mode	P037	Basic Program
SW Current Trip	A098	Advanced Program
Testpoint Data	d019	Display
Testpoint Sel	A102	Advanced Program
Timer Status	d026	Display
Torque Current	d029	Display
Torque Perf Mode	A125	Advanced Program
Var PWM Disable	A124	Advanced Program
Voltage Class	P042	Basic Program

Notes:

Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the PowerFlex 40 drive. Included is a listing and description of drive faults (with possible solutions, when applicable).

For information on…	See page…	For information on…	See page…
Drive Status	4-1	Fault Descriptions	4-3
Faults	4-1	Common Symptoms and Corrective Actions	4-5

Drive Status

The condition or state of your drive is constantly monitored. Any changes will be indicated through the integral keypad.

LED Indications

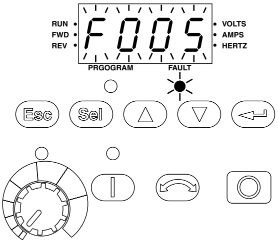
See page 2-3 for information on drive status indicators and controls.

Faults

A fault is a condition that stops the drive. There are two fault types.

Type	Fault Description	
①	Auto-Reset/Run	When this type of fault occurs, and A092 [Auto Rstrt Tries] is set to a value greater than "0," a user-configurable timer, A093 [Auto Rstrt Delay], begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
②	Non-Resetable	This type of fault may require drive or motor repair, or is caused by wiring or programing errors. The cause of the fault must be corrected before the fault can be cleared.

Fault Indication

Condition	Display
Drive is indicating a fault. The integral keypad provides visual notification of a fault condition by displaying the following. • Flashing fault number • Flashing fault indicator Press the Escape key to regain control of the integral keypad.	

Manually Clearing Faults

Step	Key(s)
1. Press Esc to acknowledge the fault. The fault information will be removed so that you can use the integral keypad. Access d007 [Fault 1 Code] to view the most recent fault information.	Esc
2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared. See Table 4.A.	
3. After corrective action has been taken, clear the fault by one of these methods.	
• Press Stop if P037 [Stop Mode] is set to a value between "0" and "3".	◎
• Cycle drive power.	
• Set A100 [Fault Clear] to "1" or "2".	
• Cycle digital input if A051-A054 [Digital Inx Sel] is set to option 7 "Clear Fault".	

Automatically Clearing Faults

Option / Step
Clear a Type 1 fault and restart the drive.
1. Set A092 [Auto Rstrt Tries] to a value other than "0".
2. Set A093 [Auto Rstrt Delay] to a value other than "0".
Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.
1. Set A092 [Auto Rstrt Tries] to a value other than "0".
2. Set A093 [Auto Rstrt Delay] to "0".

Auto Restart (Reset/Run)

The Auto Restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows remote or "unattended" operation. Only certain faults are allowed to be reset. Certain faults (Type 2) that indicate possible drive component malfunction are not resettable.

Caution should be used when enabling this feature, since the drive will attempt to issue its own start command based on user selected programming.

Fault Descriptions

Table 4.A Fault Types, Descriptions and Actions

No.	Fault	Type[1]	Description	Action
F2	Auxiliary Input	①	Auxiliary input interlock is open.	1. Check remote wiring. 2. Verify communications programming for intentional fault.
F3	Power Loss	②	DC bus voltage remained below 85% of nominal.	1. Monitor the incoming AC line for low voltage or line power interruption. 2. Check input fuses.
F4	UnderVoltage	①	DC bus voltage fell below the minimum value.	Monitor the incoming AC line for low voltage or line power interruption.
F5	OverVoltage	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
F6	Motor Stalled	①	Drive is unable to accelerate motor.	Increase P039 - A067 [Accel Time x] or reduce load so drive output current does not exceed the current set by parameter A089 [Current Limit 1].
F7	Motor Overload	①	Internal electronic overload trip.	1. An excessive motor load exists. Reduce load so drive output current does not exceed the current set by parameter P033 [Motor OL Current]. 2. Verify A084 [Boost Select] setting
F8	Heatsink OvrTmp	①	Heatsink temperature exceeds a predefined value.	1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) for IP 30/NEMA 1/UL Type 1 installations or 50°C (122°F) for IP20/Open type installations. 2. Check fan.
F12	HW OverCurrent	②	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper A084 [Boost Select] setting, DC brake volts set too high or other causes of excess current.
F13	Ground Fault	②	A current path to earth ground has been detected at one or more of the drive output terminals.	Check the motor and external wiring to the drive output terminals for a grounded condition.
F29	Analog Input Loss	①	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with A122 [Analog In Loss].	1. Check parameters. 2. Check for broken/loose connections at inputs.

(1) See page 4-1 for a description of fault types.

No.	Fault	Type(1)	Description	Action
F33	Auto Rstrt Tries	②	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of A092 [Auto Rstrt Tries].	Correct the cause of the fault and manually clear.
F38	Phase U to Gnd	②	A phase to ground fault has been detected between the drive and motor in this phase.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace drive if fault cannot be cleared.
F39	Phase V to Gnd			
F40	Phase W to Gnd			
F41	Phase UV Short	②	Excessive current has been detected between these two output terminals.	1. Check the motor and drive output terminal wiring for a shorted condition. 2. Replace drive if fault cannot be cleared.
F42	Phase UW Short			
F43	Phase VW Short			
F48	Params Defaulted		The drive was commanded to write default values to EEPROM.	1. Clear the fault or cycle power to the drive. 2. Program the drive parameters as needed.
F63	SW OverCurrent	①	Programmed A098 [SW Current Trip] has been exceeded.	Check load requirements and A098 [SW Current Trip] setting.
F64	Drive Overload	②	Drive rating of 150% for 1 minute or 200% for 3 seconds has been exceeded.	Reduce load or extend Accel Time.
F70	Power Unit	②	Failure has been detected in the drive power section.	1. Cycle power. 2. Replace drive if fault cannot be cleared.
F71	Net Loss		The communication network has faulted.	1. Cycle power. 2. Check communications cabling. 3. Check network adapter setting. 4. Check external network status.
F80	SVC Autotune		The autotune function was either cancelled by the user or failed.	Restart procedure.
F81	Comm Loss	②	RS485 (DSI) port stopped communicating.	1. If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters or complete drive as required. 2. Check connection. 3. An adapter was intentionally disconnected. 4. Turn off using A105 [Comm Loss Action].
F100	Parameter Checksum	②	The checksum read from the board does not match the checksum calculated.	Set P041 [Reset To Defalts] to option 1 “Reset Defaults”.
F122	I/O Board Fail	②	Failure has been detected in the drive control and I/O section.	1. Cycle power. 2. Replace drive if fault cannot be cleared.

(1) See page 4-1 for a description of fault types.

Common Symptoms and Corrective Actions

Motor does not Start.

Cause(s)	Indication	Corrective Action
No output voltage to the motor.	None	Check the power circuit. • Check the supply voltage. • Check all fuses and disconnects. Check the motor. • Verify that the motor is connected properly. Check the control input signals. • Verify that a Start signal is present. If 2-Wire control is used, verify that either the Run Forward or Run Reverse signal is active, but not both. • Verify that I/O Terminal 01 is active. • Verify that P036 [Start Source] matches your configuration. • Verify that A095 [Reverse Disable] is not prohibiting movement.
Drive is Faulted	Flashing red status light	Clear fault. • Press Stop • Cycle power • Set A100 [Fault Clear] to option 1 “Clear Faults”. • Cycle digital input if A051 - A054 [Digital Inx Sel] is set to option 7 “Clear Fault”.

Drive does not Start from Start or Run Inputs wired to the terminal block.

Cause(s)	Indication	Corrective Action
Drive is Faulted	Flashing red status light	Clear fault. • Press Stop • Cycle power • Set A100 [Fault Clear] to option 1 “Clear Faults”. • Cycle digital input if A051 - A054 [Digital Inx Sel] is set to option 7 “Clear Fault”.
Incorrect programming. • P036 [Start Source] is set to option 0 “Keypad” or option 5 “RS485 (DSI) Port”. • A051 - A054 [Digital Inx Sel] is set to option 5 “Local” and the input is active.	None	Check parameter settings.
Incorrect input wiring. See 1-16 for wiring examples. • 2 wire control requires Run Forward, Run Reverse or Jog input. • 3 wire control requires Start and Stop inputs • Stop input is always required.	None	Wire inputs correctly and/or install jumper.
Incorrect Sink/Source DIP switch setting.	None	Set switch to match wiring scheme.

Drive does not Start from Integral Keypad.

Cause(s)	Indication	Corrective Action
Integral keypad is not enabled.	Green LED above Start key is not illuminated.	• Set parameter P036 [Start Source] to option 0 “Keypad”. • Set parameter A051 - A054 [Digital Inx Sel] to option 5 “Local” and activate the input.
I/O Terminal 01 “Stop” input is not present.	None	Wire inputs correctly and/or install jumper.

Drive does not respond to changes in speed command.

Cause(s)	Indication	Corrective Action
No value is coming from the source of the command.	The drive “Run” indicator is lit and output is 0 Hz.	• Check d012 [Control Source] for correct source. • If the source is an analog input, check wiring and use a meter to check for presence of signal. • Check d002 [Commanded Freq] to verify correct command.
Incorrect reference source is being selected via remote device or digital inputs.	None	• Check d012 [Control Source] for correct source. • Check d014 [Dig In Status] to see if inputs are selecting an alternate source. Verify settings for A051 - A054 [Digital Inx Sel]. • Check P038 [Speed Reference] for the source of the speed reference. Reprogram as necessary. • Review the Speed Reference Control chart on page 1-20.

Motor and/or drive will not accelerate to commanded speed.

Cause(s)	Indication	Corrective Action
Acceleration time is excessive.	None	Reprogram P039 [Accel Time 1] or A067 [Accel Time 2].
Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration.	None	Compare d003 [Output Current] with A089 [Current Limit 1]. Remove excess load or reprogram P039 [Accel Time 1] or A067 [Accel Time 2]. Check for improper A084 [Boost Select] setting.
Speed command source or value is not as expected.	None	Verify d002 [Commanded Freq]. Check d012 [Control Source] for the proper Speed Command.
Programming is preventing the drive output from exceeding limiting values.	None	Check P035 [Maximum Freq] to insure that speed is not limited by programming.
Torque performance does not match motor characteristics.	None	Set motor nameplate full load amps in parameter A126 [Motor NP FLA]. Perform A127 [Autotune] “Static Tune” or “Rotate Tune” procedure. Set A125 [Torque Perf Mode] to option 0 “V/Hz”.

Motor operation is unstable.

Cause(s)	Indication	Corrective Action
Motor data was incorrectly entered.	None	1. Correctly enter motor nameplate data into P031, P032 and P033. 2. Enable A097 [Compensation]. 3. Use A084 [Boost Select] to reduce boost level.

Drive will not reverse motor direction.

Cause(s)	Indication	Corrective Action
Digital input is not selected for reversing control.	None	Check [Digital Inx Sel] (See page 3-14). Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring. (See page 1-15)
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
Reverse is disabled.	None	Check A095 [Reverse Disable].

Drive does not power up.

Cause(s)	Indication	Corrective Action
No input power to drive.	None	Check the power circuit. • Check the supply voltage. • Check all fuses and disconnects.
Jumper between I/O Terminals P2 and P1 not installed and/or DC Bus Inductor not connected.	None	Install jumper or connect DC Bus Inductor.

Supplemental Drive Information

Drive, Fuse & Circuit Breaker Ratings

The tables on the following pages provide drive ratings and recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 degree C and the U.S. N.E.C. Other country, state or local codes may require different ratings.

Fusing

If fuses are chosen as the desired protection method, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

- IEC – BS88 (British Standard) Parts 1 & 2 (1), EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T or J must be used. (2)

Circuit Breakers

Refer to listings in the following tables for recommended circuit breakers (inverse time or instantaneous trip) and 140M Self-Protecting Motor Starters.

---

(1) Typical designations include, but may not be limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

(2) Typical designations include; Type CC - KTK-R, FNQ-R
Type J - JKS, LPJ
Type T - JJS, JJN

Specifications

Drive Ratings

Catalog Number	Output Ratings		Input Ratings			Branch Circuit Protection			Power Dissipation
	kW (HP)	*Amps*	*Voltage Range*	*kVA*	*Amps*	*Fuses*	*140M Motor Protectors*(2)	*Contactors*	*IP20 Open Watts*
100 - 120V AC (±10%) – 1-Phase Input, 0 - 230V 3-Phase Output									
22B-V2P3N104	0.4 (0.5)	2.3	90-132	1.15	9.0	15	140M-C2E-C16	100-C12	30
22B-V5P0N104	0.75 (1.0)	5.0	90-132	2.45	20.3	35	140M-D8E-C20	100-C23	56
22B-V6P0N104	1.1 (1.5)	6.0	90-132	3.0	24.0	40	140M-F8E-C32	100-C37	70
200 - 240V AC (±10%) – 1-Phase(1) Input, 0 - 230V 3-Phase Output									
22B-A2P3N104	0.4 (0.5)	2.3	180-264	1.15	6.0	10	140M-C2E-B63	100-C09	30
22B-A5P0N104	0.75 (1.0)	5.0	180-264	2.45	12.0	20	140M-C2E-C16	100-C12	55
22B-A8P0N104	1.5 (2.0)	8.0	180-264	4.0	18.0	30	140M-D8E-C20	100-C23	80
22B-A012N104	2.2 (3.0)	12.0	180-264	5.5	25.0	40	140M-F8E-C32	100-C37	110
200 - 240V AC (±10%) – 3-Phase Input, 0 - 230V 3-Phase Output									
22B-B2P3N104	0.4 (0.5)	2.3	180-264	1.15	2.5	6	140M-C2E-B40	100-C07	30
22B-B5P0N104	0.75 (1.0)	5.0	180-264	2.45	5.7	10	140M-C2E-C10	100-C09	55
22B-B8P0N104	1.5 (2.0)	8.0	180-264	4.0	9.5	15	140M-C2E-C16	100-C12	80
22B-B012N104	2.2 (3.0)	12.0	180-264	5.5	15.5	25	140M-C2E-C16	100-C23	115
22B-B017N104	3.7 (5.0)	17.5	180-264	8.6	21.0	35	140M-F8E-C25	100-C23	165
22B-B024N104	5.5 (7.5)	24.0	180-264	11.8	26.1	40	140M-F8E-C32	100-C37	226
22B-B033N104	7.5 (10.0)	33.0	180-264	16.3	34.6	60	140M-G8E-C45	100-C60	290
380 - 480V AC (±10%) – 3-Phase Input, 0 - 460V 3-Phase Output									
22B-D1P4N104	0.4 (0.5)	1.4	342-528	1.4	1.8	3	140M-C2E-B25	100-C07	30
22B-D2P3N104	0.75 (1.0)	2.3	342-528	2.3	3.2	6	140M-C2E-B40	100-C07	40
22B-D4P0N104	1.5 (2.0)	4.0	342-528	4.0	5.7	10	140M-C2E-B63	100-C09	60
22B-D6P0N104	2.2 (3.0)	6.0	342-528	5.9	7.5	15	140M-C2E-C10	100-C09	90
22B-D010N104	4.0 (5.0)	10.5	342-528	10.3	13.0	20	140M-C2E-C16	100-C23	150
22B-D012N104	5.5 (7.5)	12.0	342-528	11.8	14.2	25	140M-D8E-C20	100-C23	160
22B-D017N104	7.5 (10.0)	17.0	342-528	16.8	18.4	30	140M-D8E-C20	100-C23	200
22B-D024N104	11.0 (15.0)	24.0	342-528	23.4	26.0	50	140M-F8E-C32	100-C43	285
460 - 600V AC (±10%) – 3-Phase Input, 0 - 575V 3-Phase Output									
22B-E1P7N104	0.75 (1.0)	1.7	414-660	2.1	2.3	6	140M-C2E-B25	100-C09	40
22B-E3P0N104	1.5 (2.0)	3.0	414-660	3.65	3.8	6	140M-C2E-B40	100-C09	60
22B-E4P2N104	2.2 (3.0)	4.2	414-660	5.2	5.3	10	140M-C2E-B63	100-C09	90
22B-E6P6N104	4.0 (5.0)	6.6	414-660	8.1	8.3	15	140M-C2E-C10	100-C09	150
22B-E9P9N104	5.5 (7.5)	9.9	414-660	12.1	11.2	20	140M-C2E-C16	100-C16	160
22B-E012N104	7.5 (10.0)	12.2	414-660	14.9	13.7	25	140M-C2E-C16	100-C23	200
22B-E019N104	11.0 (15.0)	19.0	414-660	23.1	24.1	40	140M-D8E-C25	100-C30	285

(1) 200-240V AC - 1-Phase drives are also available with an integral EMC filter. Catalog suffix changes from N104 to N114.

(2) Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001… to determine the frame and breaking capacity required for your application.

Input/Output Ratings

Output Frequency: 0-400 Hz (Programmable)

Efficiency: 97.5% (Typical)

Approvals

UL508C

CSA 22.2

EMC Directive 89/336
LV: EN 50178, EN 60204
EMC: EN 61800-3, EN 50081-1, EN 50082-2

Digital Control Inputs (Input Current = 6mA)

SRC (Source) Mode:	SNK (Sink) Mode:
18-24V = ON	0-6V = ON
0-6V = OFF	18-24V = OFF

Analog Control Inputs

4-20mA Analog: 250 ohm input impedance
0-10V DC Analog: 100k ohm input impedance
External Pot: 1-10k ohms, 2 Watt minimum

Control Output

Programmable Output (form C relay)	*Opto Outputs*	*Analog Outputs (10 bit)*
Resistive Rating: 3.0A at 30V DC, 3.0A at 125V AC, 3.0A at 240V AC	30V DC, 50mA	0-10V, 1k ohm Min.
Inductive Rating: 0.5A at 30V DC, 0.5A at 125V AC, 0.5A at 240V AC	Non-inductive	4-20mA, 525 ohm Max.

Fuses and Circuit Breakers

Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.
Recommended Circuit Breakers: HMCP circuit breakers or equivalent.

Protective Features

Motor Protection: I^2t overload protection - 150% for 60 Secs, 200% for 3 Secs (Provides Class 10 protection)

Overcurrent: 200% hardware limit, 300% instantaneous fault

Over Voltage:
100-120V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 150V AC incoming line)
200-240V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 290V AC incoming line)
380-460V AC Input – Trip occurs at 810V DC bus voltage (equivalent to 575V AC incoming line)
460-600V AC Input – Trip occurs at 1005V DC bus voltage (equivalent to 711V AC incoming line)

Under Voltage:
100-120V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 75V AC incoming line)
200-240V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 150V AC incoming line)
380-480V AC Input – Trip occurs at 390V DC bus voltage (equivalent to 275V AC incoming line)
460-600V AC Input – If P042 = 3 “High Voltage” trip occurs at 487V DC bus voltage (344V AC incoming line);
If P042 = 2 “Low Voltage” trip occurs at 390V DC bus voltage (275V AC incoming line)

Control Ride Through: Minimum ride through is 0.5 Secs - typical value 2 Secs

Faultless Power Ride Through: 100 milliseconds

Dynamic Braking

Internal brake IGBT included with all ratings. Refer to Appendix B for DB resistor ordering information.

Category	**Specification**	
Environment	Altitude:	1000 m (3300 ft) max. without derating
	Ambient Operating Temperature	
	Open Type, IP20:	–10 to 50 degrees C (14 to 122 degrees F)
	NEMA Type 1, IP30, UL Type 1:	–10 to 40 degrees C (14 to 104 degrees F)
	Cooling Method	
	Convection:	0.4 kW (0.5 HP) drives
	Fan:	All other drive ratings and 0.4 kW (0.5 HP) 1-Phase drives with Integral “S Type” EMC Filter
	Storage Temperature:	–40 to 85 degrees C (–40 to 185 degrees F)
	Atmosphere:	**Important:** Drive **must** **not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
	Relative Humidity:	0 to 95% non-condensing
	Shock (operating):	15G peak for 11ms duration (±1.0ms)
	Vibration (operating):	1G peak, 5 to 2000 Hz
Control	Carrier Frequency	2-16 kHz. Drive rating based on 4 kHz.
	Frequency Accuracy	
	Digital Input:	Within ±0.05% of set output frequency.
	Analog Input:	Within 0.5% of maximum output frequency, 10-Bit resolution
	Analog Output:	±2% of full scale, 10-Bit resolution
	Speed Regulation - Open Loop with Slip Compensation:	±1% of base speed across a 60:1 speed range.
	Stop Modes:	Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S Curve.
	Accel/Decel:	Two independently programmable accel and decel times. Each time may be programmed from 0 - 600 seconds in 0.1 second increments.
	Intermittent Overload:	150% Overload capability for up to 1 minute 200% Overload capability for up to 3 seconds
	Electronic Motor Overload Protection	Class 10 protection with speed sensitive response.

Appendix B

Accessories and Dimensions

Product Selection

Table B.A Catalog Number Description

22B	-	A	1P5	N	1	1	4
Drive		Voltage Rating	Rating	Enclosure	HIM	Emission Class	Type

Table B.B PowerFlex 40 Drives

Drive Ratings				IP20/NEMA Type Open		IP20 Flange Mount
Input Voltage	**kW**	**HP**	**Output Current**	**Catalog Number**	**Frame Size**	**Catalog Number**
120V 50/60 Hz 1-Phase No Filter	0.4	0.5	2.3A	22B-V2P3N104	B	22B-V2P3F104
	0.75	1.0	5.0A	22B-V5P0N104	B	22B-V5P0F104
	1.1	1.5	6.0A	22B-V6P0N104	B	22B-V6P0F104
240V 50/60 Hz 1-Phase With Integral “S Type” EMC Filter	0.4	0.5	2.3A	22B-A2P3N114	B	–
	0.75	1.0	5.0A	22B-A5P0N114	B	–
	1.5	2.0	8.0A	22B-A8P0N114	B	–
	2.2	3.0	12.0A	22B-A012N114	C	–
240V 50/60 Hz 1-Phase No Filter	0.4	0.5	2.3A	22B-A2P3N104	B	22B-A2P3F104
	0.75	1.0	5.0A	22B-A5P0N104	B	22B-A5P0F104
	1.5	2.0	8.0A	22B-A8P0N104	B	22B-A8P0F104
	2.2	3.0	12.0A	22B-A012N104	C	22B-A012F104
240V 50/60 Hz 3-Phase No Filter	0.4	0.5	2.3A	22B-B2P3N104	B	22B-B2P3F104
	0.75	1.0	5.0A	22B-B5P0N104	B	22B-B5P0F104
	1.5	2.0	8.0A	22B-B8P0N104	B	22B-B8P0F104
	2.2	3.0	12.0A	22B-B012N104	B	22B-B012F104
	3.7	5.0	17.5A	22B-B017N104	B	22B-B017F104
	5.5	7.5	24.0A	22B-B024N104	C	22B-B024F104
	7.5	10.0	33.0A	22B-B033N104	C	22B-B033F104
480V 50/60 Hz 3-Phase No Filter	0.4	0.5	1.4A	22B-D1P4N104	B	22B-D1P4F104
	0.75	1.0	2.3A	22B-D2P3N104	B	22B-D2P3F104
	1.5	2.0	4.0A	22B-D4P0N104	B	22B-D4P0F104
	2.2	3.0	6.0A	22B-D6P0N104	B	22B-D6P0F104
	4.0	5.0	10.5A	22B-D010N104	B	22B-D010F104
	5.5	7.5	12.0A	22B-D012N104	C	22B-D012F104
	7.5	10.0	17.0A	22B-D017N104	C	22B-D017F104
	11.0	15.0	24.0A	22B-D024N104	C	22B-D024F104
600V 50/60 Hz 3-Phase No Filter	0.75	1.0	1.7A	22B-E1P7N104	B	22B-E1P7F104
	1.5	2.0	3.0A	22B-E3P0N104	B	22B-E3P0F104
	2.2	3.0	4.2A	22B-E4P2N104	B	22B-E4P2F104
	4.0	5.0	6.6A	22B-E6P6N104	B	22B-E6P6F104
	5.5	7.5	9.9A	22B-E9P9N104	C	22B-E9P9F104
	7.5	10.0	12.0A	22B-E012N104	C	22B-E012F104
	11.0	15.0	19.0A	22B-E019N104	C	22B-E019F104

Table B.C Dynamic Brake Modules

Drive Ratings				
Input Voltage	**kW**	**HP**	**Minimum Resistance Ω**	**Catalog Number**[1]
120V 50/60 Hz 1-Phase	0.4	0.5	48	AK-R2-091P500
	0.75	1.0	48	AK-R2-091P500
	1.1	1.5	48	AK-R2-091P500
240V 50/60 Hz 1-Phase	0.4	0.5	48	AK-R2-091P500
	0.75	1.0	48	AK-R2-091P500
	1.5	2.0	48	AK-R2-091P500
	2.2	3.0	32	AK-R2-047P500
240V 50/60 Hz 3-Phase	0.4	0.5	48	AK-R2-091P500
	0.75	1.0	48	AK-R2-091P500
	1.5	2.0	48	AK-R2-091P500
	2.2	3.0	32	AK-R2-047P500
	3.7	5.0	19	AK-R2-047P500
	5.5	7.5	13	AK-R2-030P1K2
	7.5	10.0	10	AK-R2-030P1K2
480V 50/60 Hz 3-Phase	0.4	0.5	97	AK-R2-360P500
	0.75	1.0	97	AK-R2-360P500
	1.5	2.0	97	AK-R2-360P500
	2.2	3.0	97	AK-R2-120P1K2
	4.0	5.0	77	AK-R2-120P1K2
	5.5	7.5	55	AK-R2-120P1K2
	7.5	10.0	39	AK-R2-120P1K2
	11.0	15.0	24	AK-R2-120P1K2 (2)
600V 50/60 Hz 3-Phase	0.75	1.0	120	AK-R2-360P500
	1.5	2.0	120	AK-R2-360P500
	2.2	3.0	82	AK-R2-120P1K2
	4.0	5.0	82	AK-R2-120P1K2
	5.5	7.5	51	AK-R2-120P1K2
	7.5	10.0	51	AK-R2-120P1K2
	11.0	15.0	51	AK-R2-120P1K2 (2)

(1) The resistors listed in this tables are rated for 5% duty cycle.

(2) Requires two resistors wired in parallel.

Table B.D Bulletin 1321-3R Series Line Reactors

Input Voltage	kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance mh	Watts Loss	Catalog Number [1]
240V 50/60 Hz 3-Phase	0.4	0.5	4	6	12.0	21 W	1321-3R4-D
	0.75	1.0	8	12	3.0	29 W	1321-3R8-B
	1.5	2.0	8	12	1.5	19.5 W	1321-3R8-A
	2.2	3.0	12	18	1.25	26 W	1321-3R12-A
	3.7	5.0	18	27	0.8	36 W	1321-3R18-A
	5.5	7.5	25	37.5	0.5	48 W	1321-3R25-A
	7.5	10.0	35	52.5	0.4	49 W	1321-3R35-A
480V 50/60 Hz 3-Phase	0.4	0.5	2	3	20.0	11.3 W	1321-3R2-B
	0.75	1.0	4	6	9.0	20 W	1321-3R4-C
	1.5	2.0	4	6	6.5	20 W	1321-3R4-B
	2.2	3.0	8	12	5.0	25.3 W	1321-3R8-C
	4.0	5.0	12	18	2.5	31 W	1321-3R12-B
	5.5	7.5	12	18	2.5	31 W	1321-3R12-B
	7.5	10.0	18	27	1.5	43 W	1321-3R18-B
	11.0	15.0	25	37.5	1.2	52 W	1321-3R25-B
600V 50/60 Hz 3-Phase	0.75	1.0	2	3	20.0	11.3 W	1321-3R2-B
	1.5	2.0	4	6	6.5	20 W	1321-3R4-B
	2.2	3.0	4	6	6.5	20 W	1321-3R4-B
	4.0	5.0	8	12	5.0	25.3 W	1321-3R8-C
	5.5	7.5	12	18	2.5	31 W	1321-3R12-B
	7.5	10.0	12	18	2.5	31 W	1321-3R12-B
	11.0	15.0	18	27	1.5	43 W	1321-3R18-B

[1] Catalog numbers listed are for 3% impedance open style units. NEMA Type 1 and 5% impedance reactor types are also available. Refer to publication 1321-TD001….

Table B.E DC Bus Inductors

Input Voltage	kW	HP	Amps	Inductance mh	MTE Catalog Number [2]
240V 50/60 Hz 3-Phase	5.5	7.5	32	0.85	32RB001
	7.5	10.0	40	0.5	40RB001
480V 50/60 Hz 3-Phase	5.5	7.5	18	3.75	18RB004
	7.5	10.0	25	4.0	25RB005
	11.0	15.0	32	2.68	32RB003
600V 50/60 Hz 3-Phase	5.5	7.5	12	6.0	12RB004
	7.5	10.0	18	6.0	18RB005
	11.0	15.0	25	4.0	25RB005

[2] Use MTE RB Series or equivalent inductors.

Table B.F EMC Line Filters

Drive Ratings			S Type Filter Catalog Number (1)	L Type Filter Catalog Number (4)
Input Voltage	kW	HP		
120V 50/60 Hz 1-Phase	0.4	0.5	–	22-RF018-BL
	0.75	1.0	–	22-RF018-BL
	1.1	1.5	–	22-RF018-BL
240V 50/60 Hz 1-Phase	0.4	0.5	(2)	22-RF018-BL
	0.75	1.0	(2)	22-RF018-BL
	1.5	2.0	(2)	22-RF018-BL
	2.2	3.0	(2)	22-RF025-CL
240V 50/60 Hz 3-Phase	0.4	0.5	22-RF021-BS(3)	22-RF021-BL
	0.75	1.0	22-RF021-BS(3)	22-RF021-BL
	1.5	2.0	22-RF021-BS(3)	22-RF021-BL
	2.2	3.0	22-RF021-BS(3)	22-RF021-BL
	3.7	5.0	22-RF021-BS(3)	22-RF021-BL
	5.5	7.5	22-RF034-CS	22-RF034-CL
	7.5	10.0	22-RF034-CS	22-RF034-CL
480V 50/60 Hz 3-Phase	0.4	0.5	22-RF012-BS	22-RF012-BL
	0.75	1.0	22-RF012-BS	22-RF012-BL
	1.5	2.0	22-RF012-BS	22-RF012-BL
	2.2	3.0	22-RF012-BS	22-RF012-BL
	4.0	5.0	22-RF012-BS	22-RF012-BL
	5.5	7.5	22-RF018-CS	22-RF018-CL
	7.5	10.0	22-RF018-CS	22-RF018-CL
	11.0	15.0	22-RF026-BS	22-RF026-BL
600V 50/60 Hz 3-Phase	0.75	1.0	–	22-RF008-BL
	1.5	2.0	–	22-RF008-BL
	2.2	3.0	–	22-RF008-BL
	4.0	5.0	–	22-RF008-BL
	5.5	7.5	–	22-RF015-BL
	7.5	10.0	–	22-RF015-BL
	11.0	15.0	–	22-RF024-BL

(1) This filter is suitable for use with a cable length of at least 10 meters (33 feet) for Class A and 1 meter for Class B environments.

(2) These ratings can be ordered with internal “S Type” filters. Refer to the Catalog Number explanation on page P-4 and Table B.B for details.

(3) Filter must be Series B or later.

(4) This filter is suitable for use with a cable length of at least 100 meters for Class A and 5 meters for Class B environments.

Table B.G Human Interface Module (HIM) Option Kits and Accessories

Item	Description	Catalog Number
LCD Display, Remote Panel Mount	Digital speed control CopyCat capable IP66 (NEMA Type 4X/12) indoor use only Includes 2.9 meter cable	22-HIM-C2S
LCD Display, Remote Panel Mount	Digital speed control CopyCat capable IP66 (NEMA Type 4X/12) indoor use only Includes 2.9 meter cable	22-HIM-C2
LCD Display, Remote Handheld	Digital speed control Full numeric keypad CopyCat capable IP30 (NEMA Type 1) Includes 1.0 meter cable Panel mount with optional Bezel Kit	22-HIM-A3
Bezel Kit	Panel mount for LCD Display, Remote Handheld unit, IP30 (NEMA Type 1)	22-HIM-B1
DSI HIM Cable (DSI HIM to RJ45 cable)	1.0 Meter (3.3 Feet) 2.9 Meter (9.51 Feet)	22-HIM-H10 22-HIM-H30

Table B.H IP30/NEMA 1/UL Type 1 Kit

Item	Description	Drive Frame	Catalog Number
IP30/NEMA 1/UL Type 1 Kit	Field installed kit. Converts drive to IP30/ NEMA 1/UL Type 1 enclosure. Includes conduit box with mounting screws and plastic top panel.	B	22-JBAB
		C	22-JBAC
IP30/NEMA 1/UL Type 1 Kit for Communication Option	Field installed kit. Converts drive to IP30/ NEMA 1/UL Type 1 enclosure. Includes communication option conduit box with mounting screws and plastic top panel.	B	22-JBCB
		C	22-JBCC

Table B.I Communication Option Kits and Accessories

Item	Description	Catalog Number
Communication Adapters	Embedded communication options for use with the PowerFlex family of drives. Requires a Communication Adapter Cover (Ordered Separately). DeviceNet EtherNet	 22-COMM-D 22-COMM-E
Communication Adapter Cover	Cover that houses the DeviceNet Communication Adapter. B Frame Drive C Frame Drive	 22B-CCB 22B-CCC
Serial Converter Module (RS485 to RS232)	Provides serial communication via DF1 protocol for use with DriveExplorer and DriveExecutive software. Includes: DSI to RS232 serial converter (1) 1203-SFC serial cable (1) 22-RJ45CBL-C20 cable (1) DriveExplorer Lite CD (1)	22-SCM-232
DSI Cable	2.0 meter RJ45 to RJ45 cable, male to male connectors.	22-RJ45CBL-C20
Serial Cable	2.0 meter serial cable with a locking low profile connector to connect to the serial converter and a 9-pin sub-miniature D female connector to connect to a computer.	1203-SFC
Null Cable Converter	For use when connecting the serial converter to DriveExplorer on a handheld PC.	1203-SNM
Splitter Cable	RJ45 one to two port splitter cable	AK-U0-RJ45-SC1
Terminating Resistors	RJ45 120 Ohm resistors (2 pieces)	AK-U0-RJ45-TR1
Terminal Block	RJ45 Two position terminal block (5 pieces)	AK-U0-RJ45-TB2P
DriveExplorer Software (CD-ROM) Version 3.01 or later	Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online. Compatibility: Windows 95, 98, ME, NT 4.0 (Service Pack 3 or later), 2000, XP and CE(1)	9306-4EXP01ENE
DriveExecutive software (CD-ROM) Version 1.01 or later	Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online and offline. Compatibility: Windows 98, ME, NT 4.0 (Service Pack 3 or later), 2000 and XP	9303-4DTE01ENE

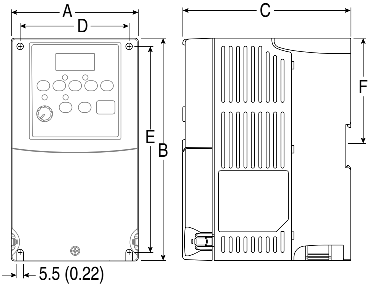
(1) See www.ab.com/drives/driveexplorer.htm for supported devices.

Product Dimensions

Table B.J PowerFlex 40 Frames – Ratings are in kW and (HP)

Frame	120V AC – 1-Phase	240V AC – 1-Phase	240V AC – 3-Phase		480V AC – 3-Phase		600V AC – 3-Phase	
B	0.4 (0.5) 0.75 (1.0) 1.1 (1.5)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	2.2 (3.0) 3.7 (5.0)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	2.2 (3.0) 4.0 (5.0)	0.75 (1.0) 1.5 (2.0)	2.2 (3.0) 4.0 (5.0)
C		2.2 (3.0)	5.5 (7.5) 7.5 (10.0)		5.5 (7.5) 7.5 (10.0)	11.0 (15.0)	5.5 (7.5) 7.5 (10.0)	11.0 (15.0)

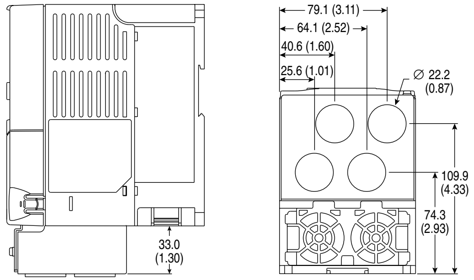
Figure B.1 PowerFlex 40 AC Drive



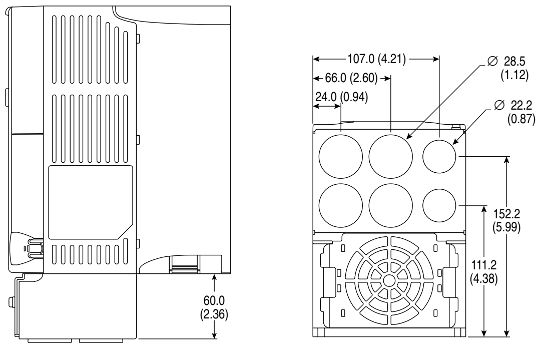
Dimensions are in millimeters and (inches).
Weights are in kilograms and (pounds).

Frame	A	B	C	D	E	F	Ship Weight
B	100 (3.94)	180 (7.09)	136 (5.35)	87 (3.43)	168 (6.61)	87.4 (3.44)	2.2 (4.9)
C	130 (5.1)	260 (10.2)	180 (7.1)	116 (4.57)	246 (9.7)	–	4.3 (9.5)

Figure B.2 IP 30/NEMA 1/UL Type 1 Option Kit without Communication Option

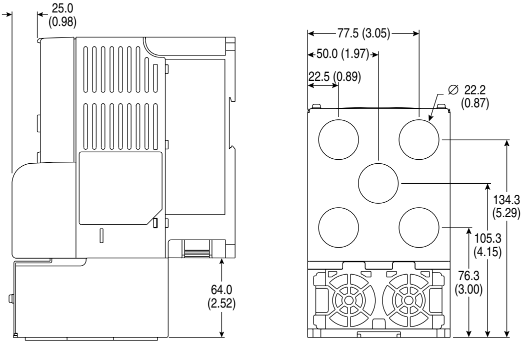


Frame B - 22-JBAB

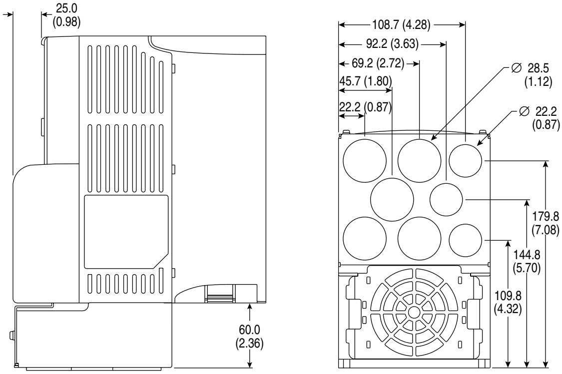


Frame C - 22-JBAC

Figure B.3 IP 30/NEMA 1/UL Type 1 Option Kit with Communication Option – Dimensions are in millimeters and (inches)

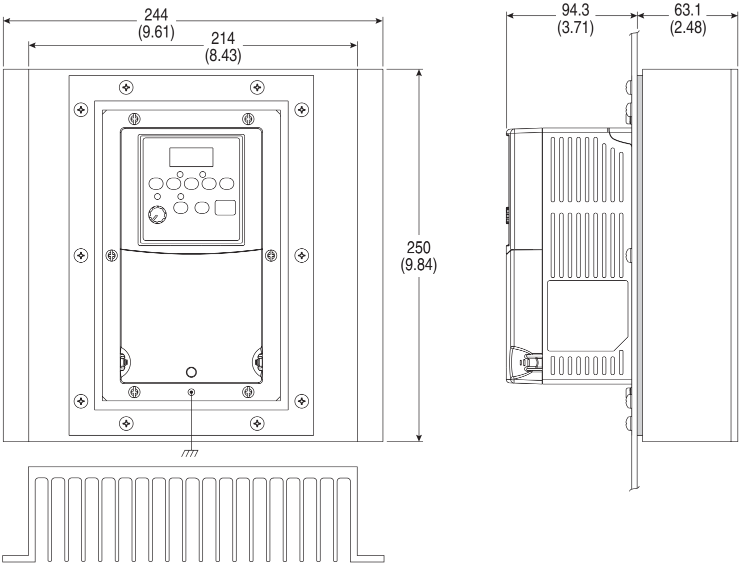


Frame B - 22-JBCB

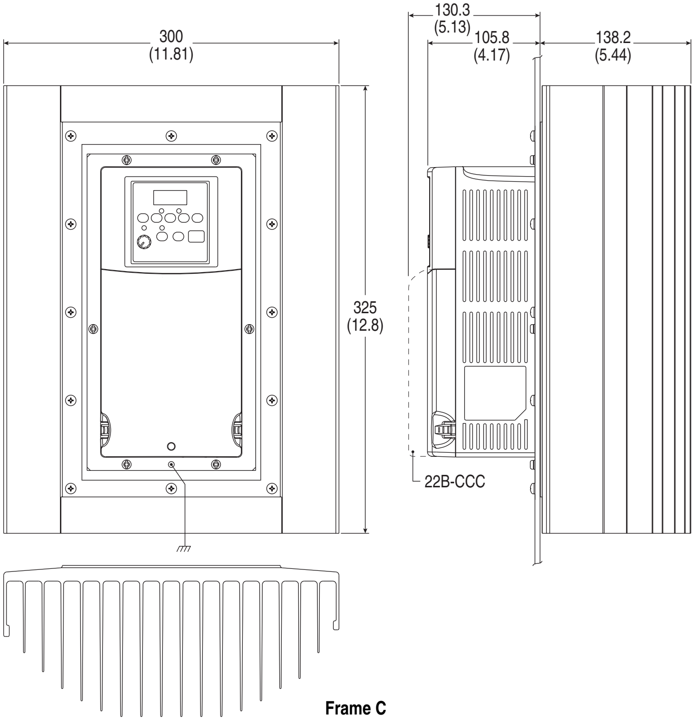


Frame C - 22-JBCC

Figure B.4 PowerFlex 40 Flange Mount Drives – Dimensions are in millimeters and (inches)

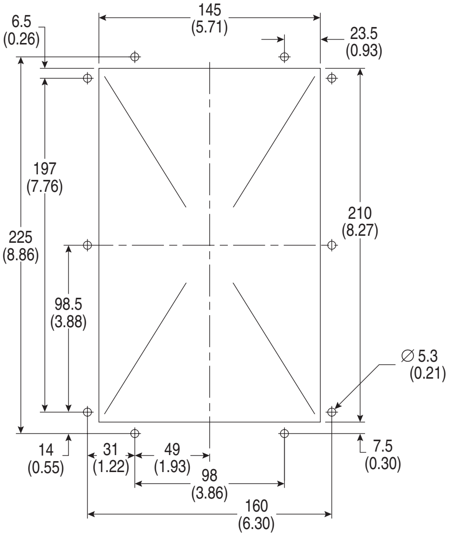


Frame B

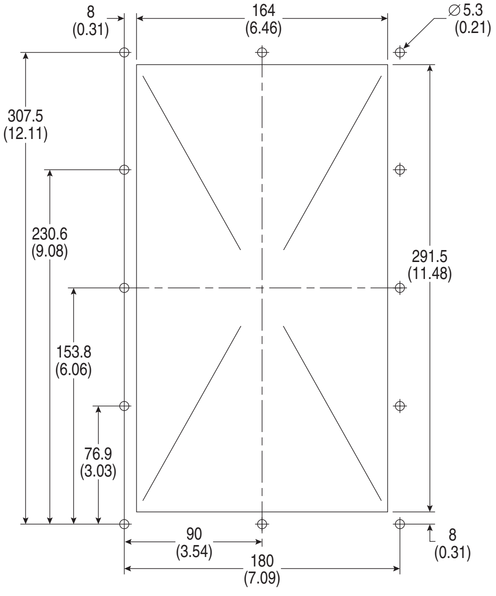


Frame C

Figure B.5 PowerFlex 40 Flange Mount Cutout Dimensions – Dimensions are in millimeters and (inches)

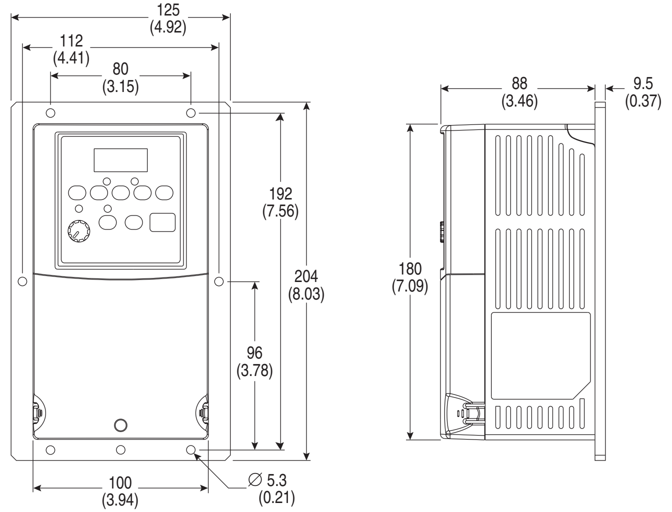


Frame B

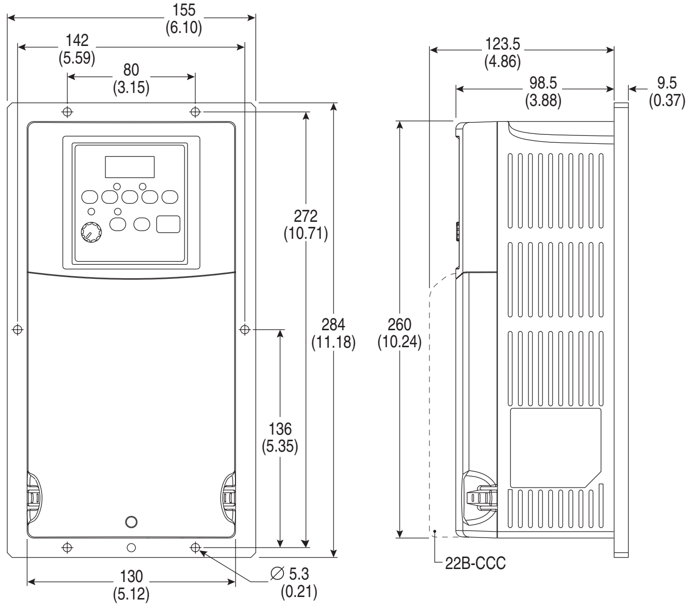


Frame C

Figure B.6 PowerFlex 40 Replacement Plate Drive Dimensions – Dimensions are in millimeters and (inches)

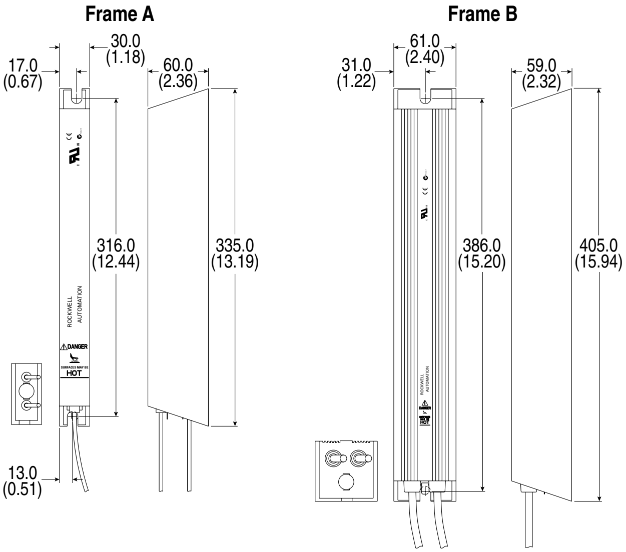


Frame B



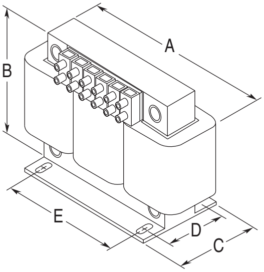
Frame C

Figure B.7 Dynamic Brake Modules – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).



Frame	Catalog Number	Weight
A	AK-R2-091P500, AK-R2-047P500, AK-R2-360P500	1.1 (2.5)
B	AK-R2-030P1K2, AK-R2-120P1K2	2.7 (6)

Figure B.8 Bulletin 1321-3R Series Line Reactors – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).



Catalog Number	A	B	C	D	E	Weight
1321-3R2-A	112 (4.40)	104 (4.10)	70 (2.75)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-B	112 (4.40)	104 (4.10)	70 (2.75)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-A	112 (4.40)	104 (4.10)	76 (3.00)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-B	112 (4.40)	104 (4.10)	76 (3.00)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-C	112 (4.40)	104 (4.10)	86 (3.38)	60 (2.35)	37 (1.44)	2.3 (5)
1321-3R4-D	112 (4.40)	104 (4.10)	92 (3.62)	66 (2.60)	37 (1.44)	2.7 (6)
1321-3R8-A	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	3.1 (7)
1321-3R8-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	3.6 (8)
1321-3R8-C	152 (6.00)	127 (5.00)	85 (3.35)	63 (2.48)	51 (2.00)	4.9 (11)
1321-3R12-A	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R12-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.5 (10)
1321-3R18-A	152 (6.00)	133 (5.25)	79 (3.10)	54 (2.13)	51 (2.00)	4.1 (9)
1321-3R18-B	152 (6.00)	133 (5.25)	86 (3.40)	63 (2.48)	51 (2.00)	5.4 (12)
1321-3R25-A	183 (7.20)	146 (5.76)	85 (3.35)	60 (2.35)	76 (3.00)	4.9 (11)
1321-3R35-A	193 (7.60)	146 (5.76)	91 (3.60)	66 (2.60)	76 (3.00)	6.3 (14)

Figure B.9 Frame B EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF012-BS, -BL; 22-RF018-BS; 22-RF021-BS, -BL

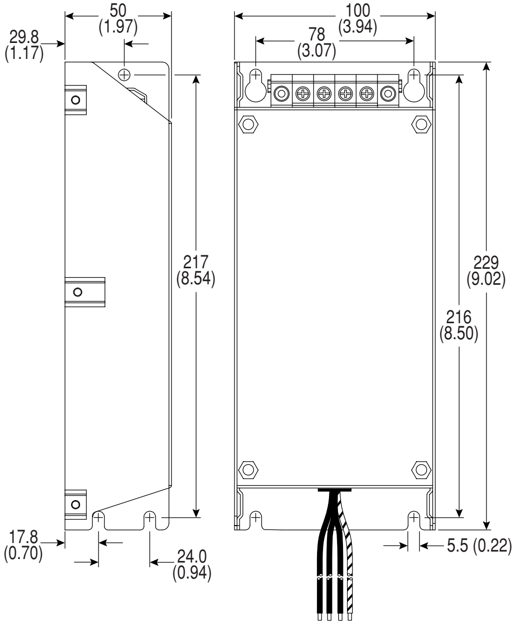


Figure B.10 Frame C EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF021-BL (Series B); 22-RF025-CL; 22-RF018-CS, -CL;
22-RF034-CS, -CL

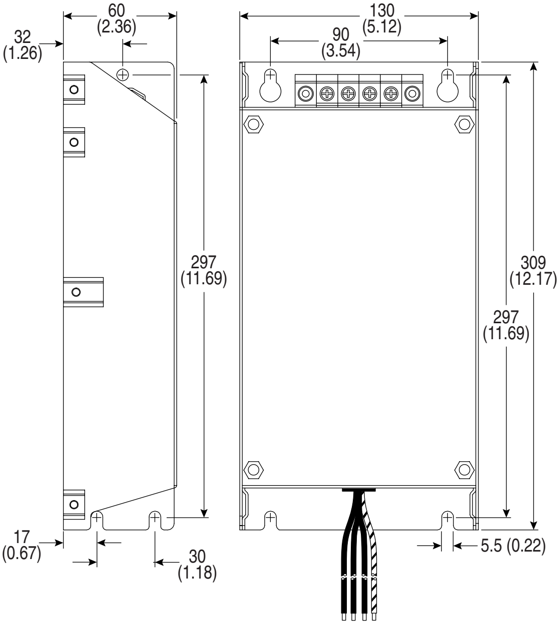


Figure B.11 Remote (Panel Mount) HIM – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-C2

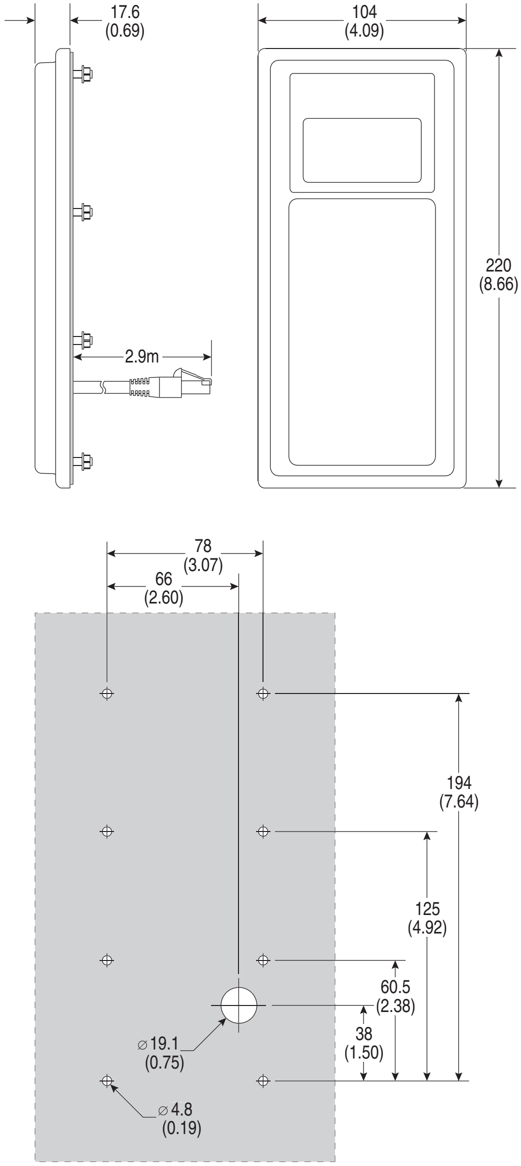
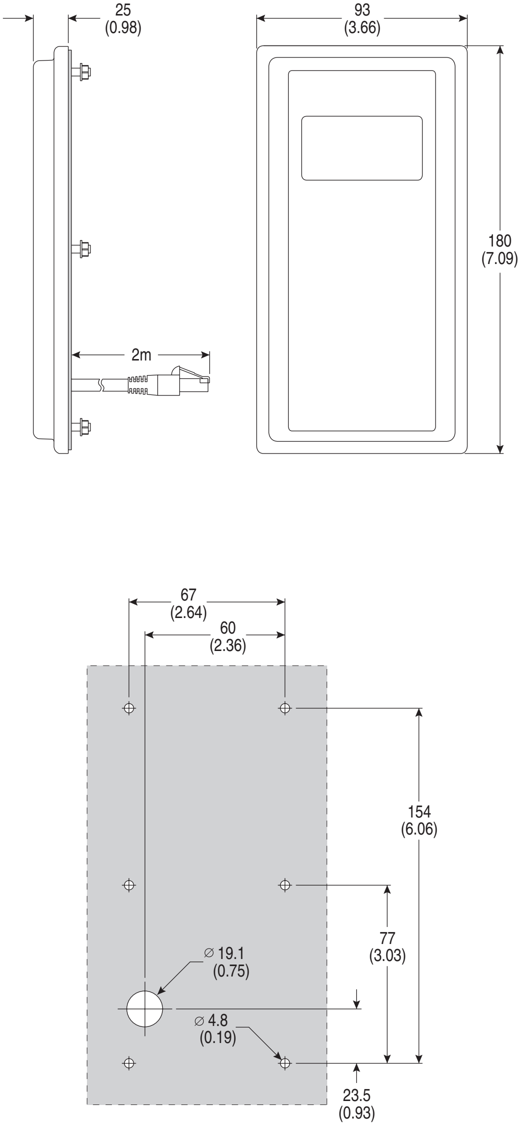
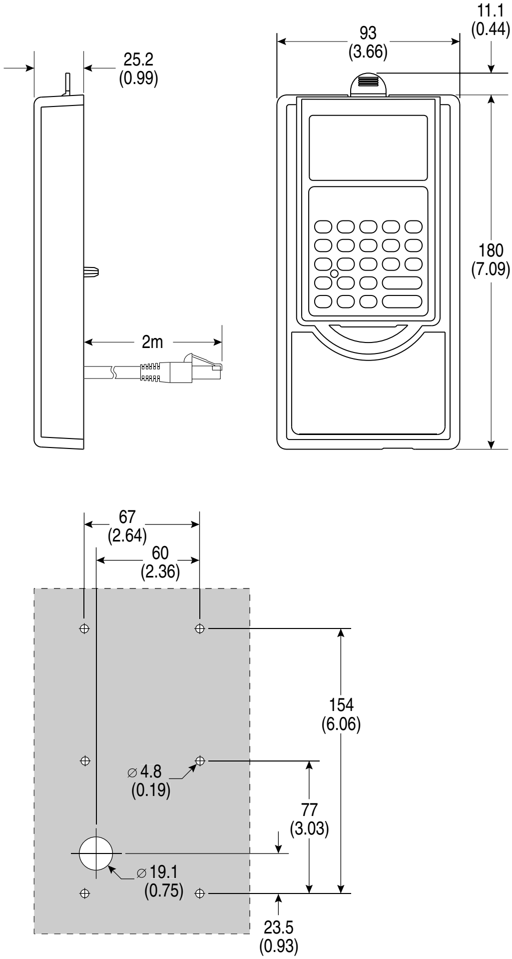


Figure B.12 Remote (Panel Mount) Small HIM – Dimensions are in millimeters and (inches) Catalog Number: 22-HIM-C2S



Important: The 22-HIM-C2S is smaller than the 22-HIM-C2 and cannot be used as a direct replacement.

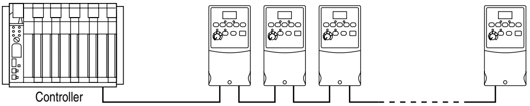
Figure B.13 NEMA Type 1 Bezel – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-B1



Appendix C

RS485 (DSI) Protocol

PowerFlex 40 drives support the RS485 (DSI) protocol to allow efficient operation with Rockwell Automation peripherals. In addition, some Modbus functions are supported to allow simple networking. PowerFlex 40 drives can be multi-dropped on an RS485 network using Modbus protocol in RTU mode.

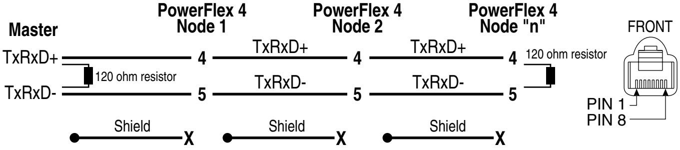


For information regarding DeviceNet or other communication protocols, refer to the appropriate user manual.

Network Wiring

Network wiring consists of a shielded 2-conductor cable that is daisy-chained from node to node.

Figure C.1 Network Wiring Diagram



NOTE: The shield is connected at ONLY ONE end of each cable segment.

Only pins 4 and 5 on the RJ45 plug should be wired. The other pins on the PowerFlex 40 RJ45 socket contain power, etc. for other Rockwell Automation peripheral devices and must not be connected.

Wiring terminations on the master controller will vary depending on the master controller used and "TxRxD+" and "TxRxD-" are shown for illustration purposes only. Refer to the master controller's user manual for network terminations. Note that there is no standard for the "+" and "-" wires, and consequently Modbus device manufacturers interpret them differently. If you have problems with initially establishing communications, try swapping the two network wires at the master controller.

Standard RS485 wiring practices apply. Termination resistors need to be applied at each end of the network cable. RS485 repeaters may need to be used for long cable runs, or if greater than 32 nodes are needed on the network.

Control Terminal 19 on the PowerFlex 40 must also be connected to PE ground (there are two PE terminals on the drive). See Table 1.H for more information.

Parameter Configuration

The following PowerFlex 40 parameters are used to configure the drive to operate on a network.

Parameter	Details	Reference
P036 [Start Source]	Set to 5 "RS485 (DSI) Port" if Start is controlled from the network.	Page 3-10
P038 [Speed Reference]	Set to 5 "RS485 (DSI) Port" if the Speed Reference is controlled from the network.	Page 3-12
A103 [Comm Data Rate]	Sets the data rate for the RS485 (DSI) Port. All nodes on the network must be set to the same data rate.	Page 3-30
A104 [Comm Node Addr]	Sets the node address for the drive on the network. Each device on the network requires a unique node address.	Page 3-30
A105 [Comm Loss Action]	Selects the drive's response to communication problems.	Page 3-31
A106 [Comm Loss Time]	Sets the time that the drive will remain in communication loss before the drive implements A105 [Comm Loss Action].	Page 3-31
A107 [Comm Format]	Sets the transmission mode, data bits, parity and stop bits for the RS485 (DSI) Port. All nodes on the network must be set to the same setting.	Page 3-31

Supported Modbus Function Codes

The peripheral interface (DSI) used on PowerFlex 40 drives supports some of the Modbus function codes.

Modbus Function Code	Command
03	Read Holding Registers
06	Preset (Write) Single Register

Important: Modbus devices can be 0-based (registers are numbered starting at 0) or 1-based (registers are numbered starting at 1). Depending on the Modbus Master used, the register addresses listed on the following pages may need to be offset by +1. For example, Logic Command may be register address 8192 for some master devices (e.g. ProSoft 3150-MCM SLC Modbus scanner) and 8193 for others (e.g. PanelViews).

Writing (06) Logic Command Data

The PowerFlex 40 drive can be controlled via the network by sending Function Code 06 writes to register address 8192 (Logic Command). P036 [Start Source] must be set to 5 "RS485 (DSI) Port" in order to accept the commands.

Logic Command

Address (Decimal)	Bit(s)	Description
8192	0	1 = Stop, 0 = Not Stop
	1	1 = Start, 0 = Not Start
	2	1 = Jog, 0 = No Jog
	3	1 = Clear Faults, 0 = Not Clear Faults
	5,4	00 = No Command
		01 = Forward Command
		10 = Reverse Command
		11 = No Command
	6	Not Used
	7	Not Used
	9,8	00 = No Command
		01 = Accel Rate 1 Enable
		10 = Accel Rate 2 Enable
		11 = Hold Accel Rate Selected
	11,10	00 = No Command
		01 = Decel Rate 1 Enable
		10 = Decel Rate 2 Enable
		11 = Hold Decel Rate Selected
	14,13,12	000 = No Command
		001 = Freq. Source = P036 [Start Source]
		010 = Freq. Source = A069 [Internal Freq]
		011 = Freq. Source = Comms (Addr 8193)
		100 = A070 [Preset Freq 0]
		101 = A071 [Preset Freq 1]
		110 = A072 [Preset Freq 2]
		111 = A073 [Preset Freq 3]
	15	Not Used

Writing (06) Reference

The Speed Reference to a PowerFlex 40 drive can be controlled via the network by sending Function Code 06 writes to register address 8193 (Reference). P038 [Speed Reference] must be set to 5 "RS485 (DSI) Port" in order to accept the Speed Reference.

Reference

Address (Decimal)	Description
8193	A decimal value entered as xxx.x where the decimal point is fixed. For example, a decimal "100" equals 10.0 Hz and "543" equals 54.3 Hz.

Reading (03) Logic Status Data

The PowerFlex 40 Logic Status data can be read via the network by sending Function Code 03 reads to register address 8448 (Logic Status).

Logic Status

Address (Decimal)	Bit(s)	Description
8448	0	1 = Ready, 0 = Not Ready
	1	1 = Active (Running), 0 = Not Active
	2	1 = Cmd Forward, 0 = Cmd Reverse
	3	1 = Rotating Forward, 0 = Rotating Reverse
	4	1 = Accelerating, 0 = Not Accelerating
	5	1 = Decelerating, 0 = Not Decelerating
	6	1 = Alarm, 0 = No Alarm
	7	1 = Faulted, 0 = Not Faulted
	8	1 = At Reference, 0 = Not At Reference
	9	1 = Reference Controlled by Comm
	10	1 = Operation Cmd Controlled by Comm
	11	1 = Parameters have been locked
	12	Digital Input 1 Status
	13	Digital Input 2 Status
	14	Digital Input 3 Status(1)
	15	Digital Input 4 Status(1)

(1) This status is available only with firmware revision FRN 2.xx and higher.

Reading (03) Feedback

The Feedback (Output Frequency) from the PowerFlex 40 drive can be read via the network by sending Function Code 03 reads to register address 8451 (Feedback).

Feedback(2)

Address (Decimal)	Description
8451	A xxx.x decimal value where the decimal point is fixed. For example, a decimal "123" equals 12.3 Hz and "300" equals 30.0 Hz.

(2) Returns the same data as Reading (03) Parameter d001 [Output Freq].

Reading (03) Drive Error Codes

The PowerFlex 40 Error Code data can be read via the network by sending Function Code 03 reads to register address 8449 (Drive Error Codes).

Logic Status		
Address (Decimal)	**Value (Decimal)**	**Description**
8449	0	No Fault
	2	Auxiliary Input
	3	Power Loss
	4	Undervoltage
	5	Overvoltage
	6	Motor Stalled
	7	Motor Overload
	8	Heatsink Overtemperature
	12	HW Overcurrent (300%)
	13	Ground Fault
	29	Analog Input Loss
	33	Auto Restart Tries
	38	Phase U to Ground Short
	39	Phase V to Ground Short
	40	Phase W to Ground Short
	41	Phase UV Short
	42	Phase UW Short
	43	Phase VW Short
	63	Software Overcurrent
	64	Drive Overload
	70	Power Unit Fail
	80	AutoTune Fail
	81	Communication Loss
	100	Parameter Checksum Error
	122	I/O Board Fail

Reading (03) and Writing (06) Drive Parameters

To access drive parameters, the Modbus register address equals the parameter number. For example, a decimal "1" is used to address Parameter d001 [Output Freq] and decimal "39" is used to address Parameter P039 [Accel Time 1].

Additional Information

Refer to **http://www.ab.com/drives/** for additional information.

Notes:

RJ45 DSI Splitter Cable

The PowerFlex 40 drive provides a RJ45 port to allow the connection of a single peripheral device. The RJ45 DSI Splitter Cable can be used to connect a second DSI peripheral device to the drive.

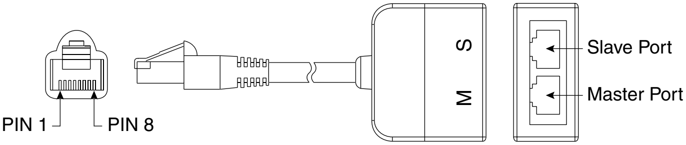
Connectivity Guidelines

ATTENTION: Risk of injury or equipment damage exists. The peripherals may not perform as intended if these Connectivity Guidelines are not followed. Precautions should be taken to follow these Connectivity Guidelines.

- Two peripherals maximum can be attached to a drive.
- If a single peripheral is used, it must be connected to the Master port (M) on the splitter and configured for “Auto” (default) or “Master.” Parameter 9 [Device Type] on the DSI / MDI keypads and Parameter 1 [Adapter Cfg] on the Serial Converter are used to select the type (Auto / Master / Slave).
- **Do not use the RJ45 Splitter Cable with a drive that has an internal network communication adapter installed.** Since only one additional peripheral can be added, the second peripheral can be connected directly to the RJ45 port on the drive. The internal Comm is always the Master, therefore the external peripheral must be configured as “Auto” (for temporary connections) or “Slave” (for permanent connections).
- If two peripherals will be powered up at the same time, one must be configured as the “Master” and connected to the Master port (M) and the other must be connected as the “Slave” and connected to the Slave port (S).

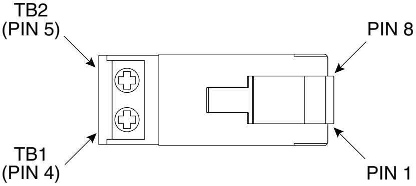
DSI Cable Accessories

RJ45 Splitter Cable – Catalog Number: AK-U0-RJ45-SC1



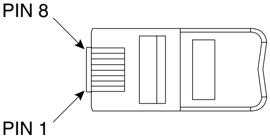
RJ45 Two-Position Terminal Block Adapter –

Catalog Number: AK-U0-RJ45-TB2P

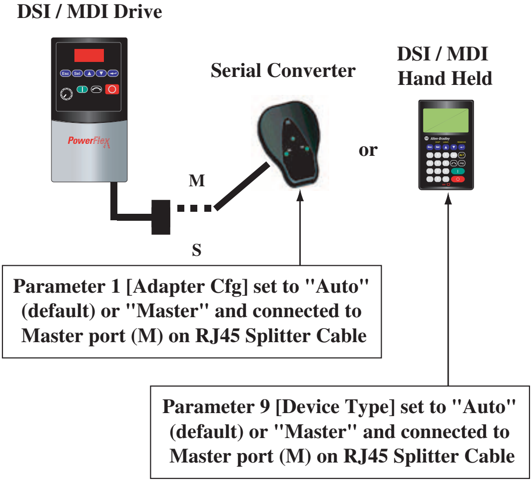


RJ45 Adapter with Integrated Termination Resistor –

Catalog Number: AK-U0-RJ45-TR1



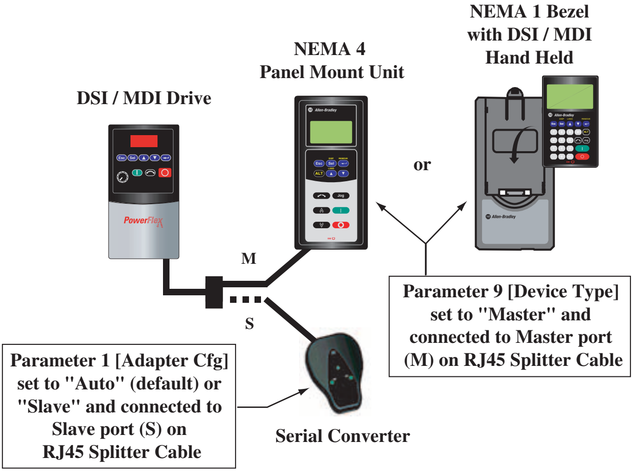
Connecting One Temporary Peripheral



Parameter 1 [Adapter Cfg] set to "Auto" (default) or "Master" and connected to Master port (M) on RJ45 Splitter Cable

Parameter 9 [Device Type] set to "Auto" (default) or "Master" and connected to Master port (M) on RJ45 Splitter Cable

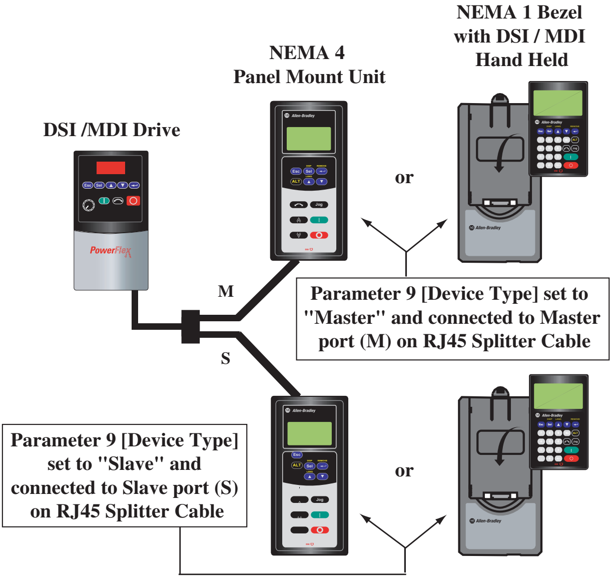
Connecting One Temporary Peripheral and One Permanent Peripheral



Parameter 9 [Device Type] set to "Master" and connected to Master port (M) on RJ45 Splitter Cable

Parameter 1 [Adapter Cfg] set to "Auto" (default) or "Slave" and connected to Slave port (S) on RJ45 Splitter Cable

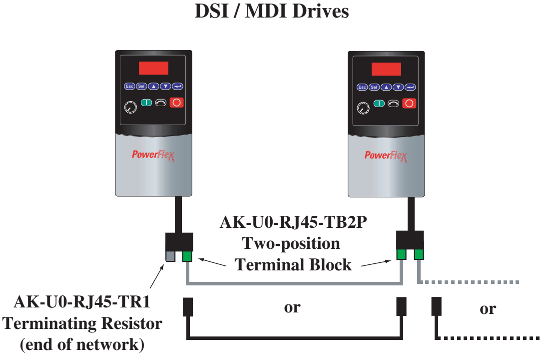
Connecting Two Permanent Peripherals



Parameter 9 [Device Type] set to "Master" and connected to Master port (M) on RJ45 Splitter Cable

Parameter 9 [Device Type] set to "Slave" and connected to Slave port (S) on RJ45 Splitter Cable

Connecting an RS-485 Network



Customer supplied RJ45 male-to-RJ45 male cables with wires connected at pins 4 and 5 only.

Both the Master (M) and Slave (S) ports on the RJ45 Splitter Cable operate as standard RS-485 ports in this configuration.

Step Logic, Basic Logic and Timer/Counter Functions

Four PowerFlex 40 logic functions provide the capability to program simple logic functions without a separate controller.

- Step Logic Function

  Steps through up to eight preset speeds based on programmed logic. Programmed logic can include conditions that need to be met from digital inputs programmed as “Logic In1” and “Logic In2” before stepping from one preset speed to the next. A timer is available for each of the eight steps and is used to program a time delay before stepping from one preset speed to the next. The status of a digital output can also be controlled based on the step being executed.

- Basic Logic Function

  Up to two digital inputs can be programmed as “Logic In1” and/or “Logic In2”. A digital output can be programmed to change state based on the condition of one or both inputs based on basic logic functions such as AND, OR, NOR. The basic logic functions can be used with or without step logic.

- Timer Function

  A digital input can be programmed for “Timer Start”. A digital output can be programmed as a “Timer Out” with an output level programmed to the desired time. When the timer reaches the time programmed into the output level the output will change state. The timer can be reset via a digital input programmed as “Reset Timer”.

- Counter Function

  A digital input can be programmed for “Counter In”. A digital output can be programmed as “Counter Out” with an output level programmed to the desired number of counts. When the counter reaches the count programmed into the output level the output will change state. The counter can be reset via a digital input programmed as “Reset Counter”.

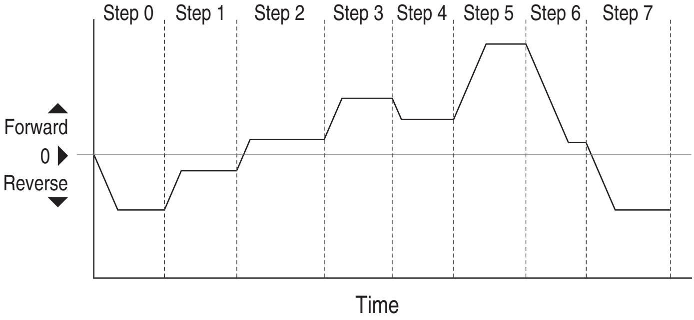
Step Logic Using Timed Steps

To activate this function, set parameter P038 [Speed Reference] to 6 "Stp Logic". Three parameters are used to configure the logic, speed reference and time for each step.

- Logic is defined using parameters A140-A147 [Stp Logic x].
- Preset Speeds are set with parameters A070-A077 [Preset Freq x].
- Time of operation for each step is set with parameters A150-A157 [Stp Logic Time x].

The direction of motor rotation can be forward or reverse.

Figure E.1 Using Timed Steps



Step Logic Sequence

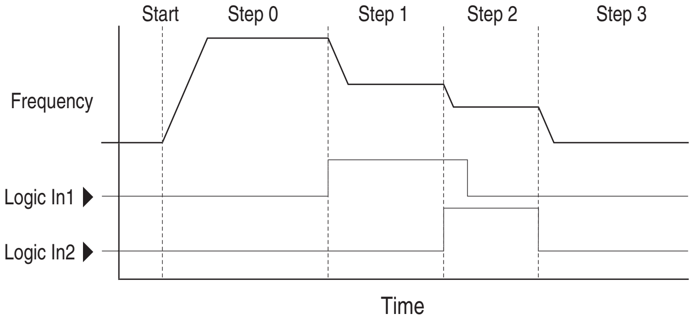
- Sequence begins with a valid start command.
- A normal sequence begins with Step 0 and transition to the next step when the corresponding step logic time has expired.
- Step 7 is followed by Step 0
- Sequence repeats until a stop is issued or a fault condition occurs.

Step Logic Using Basic Logic Functions

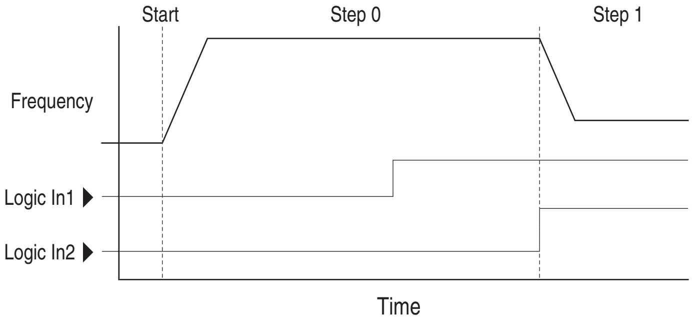
Digital input and digital output parameters can be configured to use logic to transition to the next step. Logic In1 and Logic In2 are defined by programming parameters A051-A054 [Digital Inx Sel] to option 23 "Logic In1" or option 24 "Logic In2".

Example

- Run at Step 0.
- Transition to Step 1 when Logic In1 is true.
  Logic senses the edge of Logic In1 when it transitions from off to on. Logic In1 is not required to remain "on".
- Transition to Step 2 when both Logic In1 and Logic In2 are true.
  The drive senses the level of both Logic In1 and Logic In2 and transitions to Step 2 when both are on.
- Transition to Step 3 when Logic In2 returns to a false or off state.
  Inputs are not required to remain in the "on" condition except under the logic conditions used for the transition from Step 2 to Step 3.



The step time value and the basic logic may be used together to satisfy machine conditions. For instance, the step may need to run for a minimum time period and then use the basic logic to trigger a transition to the next step.



Timer Function

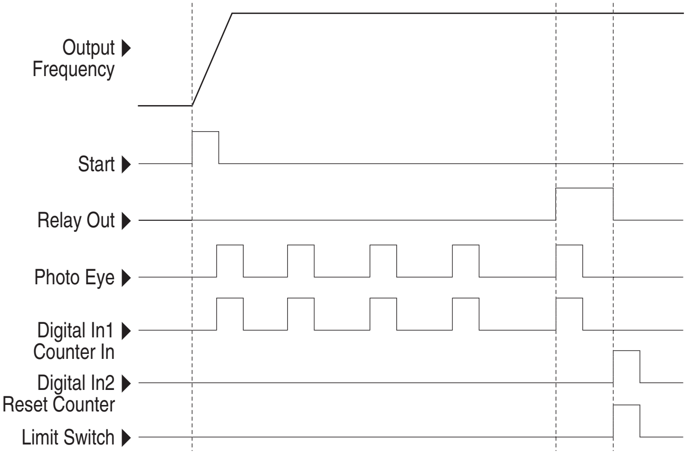
Digital inputs and outputs control the timer function and are configured with parameters A051-A054 [Digital Inx Sel] set to 18 “Timer Start” and 20 “Reset Timer”.

Digital outputs (relay and opto type) define a preset level and indicate when the level is reached. Level parameters A056 [Relay Out Level], A059 [Opto Out1 Level] and A062 [Opto Out2 Level] are used to set the desired time in seconds.

Parameters A055 [Relay Out Sel], A058 [Opto Out1 Sel] and A061 [Opto Out2 Sel] are set to option 16 “Timer Out” and causes the output to change state when the preset level is reached.

Example

- Drive starts up and accelerates to 30 Hz.
- After 30Hz has been maintained for 20 seconds, a 4-20mA analog input becomes the reference signal for speed control.
- The timer function is used to select a preset speed with a 20 second run time that overrides the speed reference while the digital input is active.
- Parameters are set to the following options:
  - P038 [Speed Reference] = 3 “4-20mA Input”
  - A051 [Digital In1 Sel] = 4 “Preset Freq”
  - A052 [Digital In2 Sel] = 18 “Timer Start”
  - A055 [Relay Out Sel] = 16 “Timer Out”
  - A056 [Relay Out Level] = 20.0 Secs
  - A071 [Preset Freq 1] = 30.0 Hz
- The control terminal block is wired such that a start command will also trigger the timer start.
- The relay output is wired to I/O Terminal 05 (Digital Input 1) so that it forces the input on when the timer starts.
- After the timer is complete, the output is turned off releasing the preset speed command. The drive defaults to following the analog input reference as programmed.



Note that a “Reset Timer” input is not required for this example since the “Timer Start” input both clears and starts the timer.

Counter Function

Digital inputs and outputs control the counter function and are configured with parameters A051-A054 [Digital Inx Sel] set to 19 “Counter In” and 21 “Reset Counter”.

Digital outputs (relay and opto type) define a preset level and indicate when the level is reached. Level parameters A056 [Relay Out Level], A059 [Opto Out1 Level] and A062 [Opto Out2 Level] are used to set the desired count value.

Parameters A055 [Relay Out Sel], A058 [Opto Out1 Sel] and A061 [Opto Out2 Sel] are set to 17 “Counter Out” which causes the output to change state when the level is reached.

Example

- A photo eye is used to count packages on a conveyor line.
- An accumulator holds the packages until 5 are collected.
- A diverter arm redirects the group of 5 packages to a bundling area.
- The diverter arm returns to its original position and triggers a limit switch that resets the counter.
- Parameters are set to the following options:
  - A051 [Digital In1 Sel] set to 19 to select “Counter In”
  - A052 [Digital In2 Sel] set to 21 to select “Reset Counter”
  - A055 [Relay Out Sel] set to 17 to select “Counter Out”
  - A056 [Relay Out Level] set to 5.0 (counts)

Step Logic Parameters

Table E.A Code Descriptions for Parameters A140-A147

Digit 3	Digit 2	Digit 1	Digit 0
0	0	F	1

Table E.B Digit 3 – Defines the action during the step currently executing.

Setting	Accel/Decel Parameters Used	Step Logic Output State	Commanded Direction
0	1	Off	FWD
1	1	Off	REV
2	1	Off	No Output
3	1	On	FWD
4	1	On	REV
5	1	On	No Output
6	2	Off	FWD
7	2	Off	REV
8	2	Off	No Output
9	2	On	FWD
A	2	On	REV
b	2	On	No Output

Table E.C Digit 2 – Defines what step to jump to or how to end program when the logic conditions specified in Digit 1 are met.

Setting	Logic
0	Jump to Step 0
1	Jump to Step 1
2	Jump to Step 2
3	Jump to Step 3
4	Jump to Step 4
5	Jump to Step 5
6	Jump to Step 6
7	Jump to Step 7
8	End Program (Normal Stop)
9	End Program (Coast to Stop)
A	End Program and Fault (F2)

Table E.D Digit 1 – Defines what logic must be met to jump to a step other than the very next step.

Setting	Description	Logic
0	Skip Step (jump immediately)	SKIP
1	Step based on the time programmed in the respective [Stp Logic Time x] parameter.	TIMED
2	Step if “Logic In1” is active (logically true)	TRUE
3	Step if “Logic In2” is active (logically true)	TRUE
4	Step if “Logic In1” is not active (logically false)	FALSE
5	Step if “Logic In2” is not active (logically false)	FALSE
6	Step if either “Logic In1” or “Logic In2” is active (logically true)	OR
7	Step if both “Logic In1” and “Logic In2” is active (logically true)	AND
8	Step if neither “Logic In1” or “Logic In2” is active (logically true)	NOR
9	Step if “Logic In1” is active (logically true) and “Logic In2” is not active (logically false)	XOR
A	Step if “Logic In2” is active (logically true) and “Logic In1” is not active (logically false)	XOR
b	Step after [Stp Logic Time x] and “Logic In1” is active (logically true)	TIMED AND
C	Step after [Stp Logic Time x] and “Logic In2” is active (logically true)	TIMED AND
d	Step after [Stp Logic Time x] and “Logic In1” is not active (logically false)	TIMED OR
E	Step after [Stp Logic Time x] and “Logic In2” is not active (logically false)	TIMED OR
F	Do not step OR no “jump to”, so use Digit 0 logic	IGNORE

Table E.E Digit 0 – Defines what logic must be met to jump to the very next step.

Setting	Description	Logic
0	Skip Step (jump immediately)	SKIP
1	Step based on the time programmed in the respective [Stp Logic Time x] parameter.	TIMED
2	Step if “Logic In1” is active (logically true)	TRUE
3	Step if “Logic In2” is active (logically true)	TRUE
4	Step if “Logic In1” is not active (logically false)	FALSE
5	Step if “Logic In2” is not active (logically false)	FALSE
6	Step if either “Logic In1” or “Logic In2” is active (logically true)	OR
7	Step if both “Logic In1” and “Logic In2” is active (logically true)	AND
8	Step if neither “Logic In1” or “Logic In2” is active (logically true)	NOR
9	Step if “Logic In1” is active (logically true) and “Logic In2” is not active (logically false)	XOR
A	Step if “Logic In2” is active (logically true) and “Logic In1” is not active (logically false)	XOR
b	Step after [Stp Logic Time x] and “Logic In1” is active (logically true)	TIMED AND
C	Step after [Stp Logic Time x] and “Logic In2” is active (logically true)	TIMED AND
d	Step after [Stp Logic Time x] and “Logic In1” is not active (logically false)	TIMED OR
E	Step after [Stp Logic Time x] and “Logic In2” is not active (logically false)	TIMED OR
F	Use logic programmed in Digit 1	IGNORE

PID Set Up

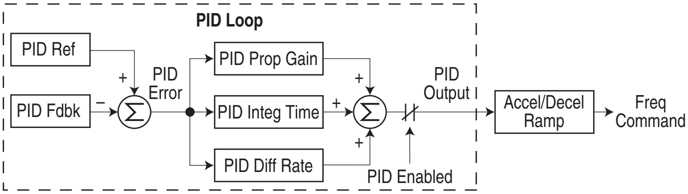
PID Loop

The PowerFlex 40 has a built-in PID (proportional, integral, differential) control loop. The PID loop is used to maintain a process feedback (such as pressure, flow or tension) at a desired set point. The PID loop works by subtracting the PID feedback from a reference and generating an error value. The PID loop reacts to the error, based on the PID Gains, and outputs a frequency to try to reduce the error value to 0. To enable the PID loop, parameter A132 [PID Ref Sel] must be set to an option other than 0 "PID Disabled".

Exclusive Control and Trim Control are two basic configurations where the PID loop may be used.

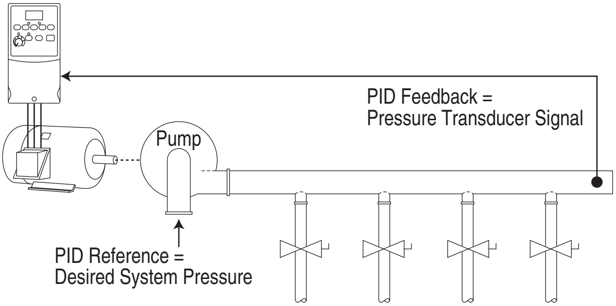
Exclusive Control

In Exclusive Control, the Speed Reference becomes 0, and the PID Output becomes the entire Freq Command. Exclusive Control is used when A132 [PID Ref Sel] is set to option 1, 2, 3 or 4. This configuration does not require a master reference, only a desired set point, such as a flow rate for a pump.



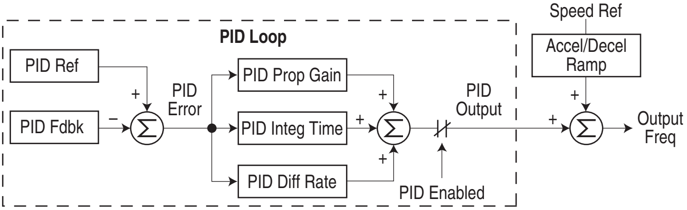
Example

- In a pumping application, the PID Reference equals the Desired System Pressure set point.
- The Pressure Transducer signal provides PID Feedback to the drive. Fluctuations in actual system pressure, due to changes in flow, result in a PID Error value.
- The drive output frequency increases or decreases to vary motor shaft speed to correct for the PID Error value.
- The Desired System Pressure set point is maintained as valves in the system are opened and closed causing changes in flow.
- When the PID Control Loop is disabled, the Commanded Speed is the Ramped Speed Reference.



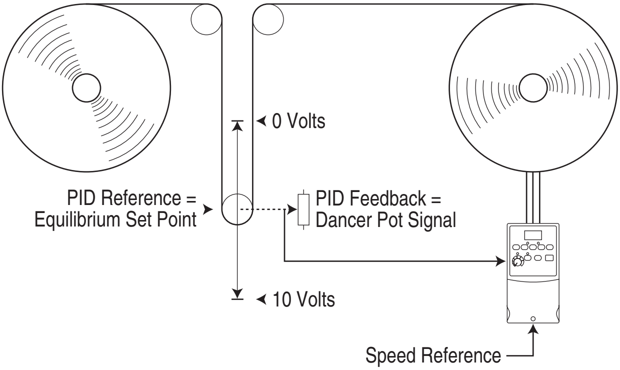
Trim Control

In Trim Control, the PID Output is added to the Speed Reference. In Trim mode, the output of the PID loop bypasses the accel/decel ramp as shown. Trim Control is used when A132 [PID Ref Sel] is set to option 5, 6, 7 or 8.



Example

- In a winder application, the PID Reference equals the Equilibrium set point.
- The Dancer Pot signal provides PID Feedback to the drive. Fluctuations in tension result in a PID Error value.
- The Master Speed Reference sets the wind/unwind speed.
- As tension increases or decreases during winding, the Speed Reference is trimmed to compensate. Tension is maintained near the Equilibrium set point.



PID Reference and Feedback

Parameter A132 [PID Ref Sel] is used to enable the PID mode (A132 ¦ 0 “PID Disabled”) and to select the source of the PID Reference. If A132 [PID Ref Sel] is not set to 0 “PID Disabled”, PID can still be disabled by select programmable digital input options (parameters A051-A054) such as “Jog”, “Local” or “PID Disable”.

Table F.A A132 [PID Ref Sel] Options

Option	Description
0 “PID Disabled”	Disables the PID loop (default setting)
1 “PID Setpoint“	Selects Exclusive Control. A137 [PID Setpoint] will be used to set the value of the PID Reference
2 “0-10V Input”	Selects Exclusive Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
3 “4-20mA Input”	Selects Exclusive Control. Selects the 4-20mA Input.
4 “Comm Port”	Selects Exclusive Control. The reference word from a communication network (see Appendix C for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.
5 “Setpnt, Trim”	Selects Trim Control. A137 [PID Setpoint] will be used to set the value of the PID Reference.
6 “0-10V, Trim”	Selects Trim Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
7 “4-20mA, Trim”	Selects Trim Control. Selects the 4-20mA Input.
8 “Comm, Trim”	Selects Trim Control. The reference word from a communication network (see Appendix C for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.

A133 [PID Feedback Sel] is used to select the source of the PID feedback.

Table F.B A133 [PID Feedback Sel] Options

Option	Description
0 “0-10V Input”	Selects the 0-10V Input (default setting). Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
1 “4-20mA Input“	Selects the 4-20mA Input.
2 “Comm Port”	The reference word from a communication network (see Appendix C of the PowerFlex 40 User Manual for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Feedback. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% Feedback. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% Feedback.

Analog PID Reference Signals

Parameters A110 [Anlg In 0-10V Lo] and A111 [Anlg In 0-10V Hi] are used to scale or invert an analog PID Reference.

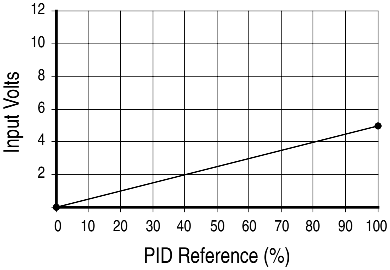
Important: Firmware version FRN 2.xx also allows PID Feedback scaling from an analog input.

Examples

Scale Function

For a 0-5 volt signal, the following parameter settings are used so that a 0 volt signal = 0% PID Reference and a 5 volt signal = 100% PID Reference.

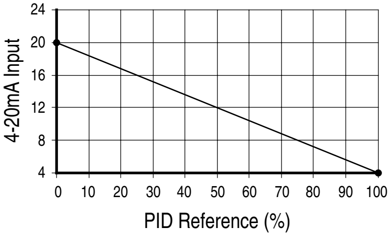
- A110 [Anlg In 0-10V Lo] = 0.0%
- A111 [Anlg In 0-10V Hi] = 50.0%
- A132 [PID Ref Sel] = 0 "0-10V Input"



Invert Function

For a 4-20mA signal, the following parameter settings are used so that a 20mA signal = 0% PID Reference and a 4mA signal = 100% PID Reference.

- A112 [Anlg In 4-20mA Lo] = 100.0%
- A113 [Anlg In 4-20mA Hi] = 0.0%
- A132 [PID Ref Sel] = 3 "4-20mA Input"



PID Deadband

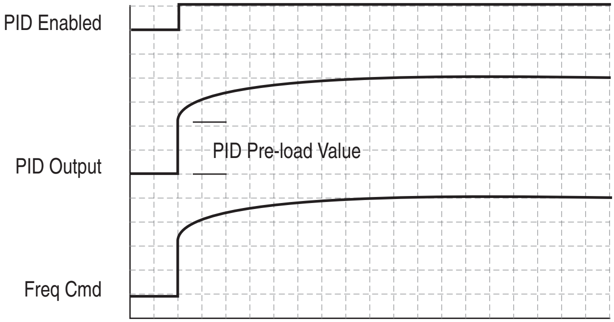
Parameter A138 [PID Deadband] is used to set a range, in percent, of the PID Reference that the drive will ignore.

Example

- [PID Deadband] is set to 5.0
- The PID Reference is 25.0%
- The PID Regulator will not act on a PID Error that falls between 20.0 and 30.0%

PID Preload

The value set in A139 [PID Preload], in Hertz, will be pre-loaded into the integral component of the PID at any start or enable. This will cause the drive's frequency command to initially jump to that preload frequency, and the PID loop starts regulating from there.



PID Pre-load Value > 0

PID Limits

A130 [PID Trim Hi] and A131 [PID Trim Lo] are used to limit the PID output and are only used in trim mode. [PID Trim Hi] sets the maximum frequency for the PID output in trim mode. [PID Trim Lo] sets the reverse frequency limit for the PID output in trim mode. Note that when the PID reaches the Hi or Lo limit, the PID regulator stops integrating so that windup does not occur.

PID Gains

The proportional, integral, and differential gains make up the PID regulator.

- A134 [PID Prop Gain]
  The proportional gain (unitless) affects how the regulator reacts to the magnitude of the error. The proportional component of the PID regulator outputs a speed command proportional to the PID error. For example, a proportional gain of 1 would output 100% of max frequency when the PID error is 100% of the analog input range. A larger value for [PID Prop Gain] makes the proportional component more responsive, and a smaller value makes it less responsive. Setting [PID Prop Gain] to 0.00 disables the proportional component of the PID loop.
- A135 [PID Integ Time]
  The integral gain (units of seconds) affects how the regulator reacts to error over time and is used to get rid of steady state error. For example, with an integral gain of 2 seconds, the output of the integral gain component would integrate up to 100% of max frequency when the PID error is 100% for 2 seconds. A larger value for [PID Integ Time] makes the integral component less responsive, and a smaller value makes it more responsive. Setting [PID Integ Time] to 0 disables the integral component of the PID loop.
- A136 [PID Diff Rate]
  The Differential gain (units of 1/seconds) affects the rate of change of the PID output. The differential gain is multiplied by the difference between the previous error and current error. Thus, with a large error the D has a large effect and with a small error the D has less of an effect. This parameter is scaled so that when it is set to 1.00, the process response is 0.1% of [Maximum Freq] when the process error is changing at 1% / second. A larger value for [PID Diff Rate] makes the differential term have more of an effect and a small value makes it have less of an effect. In many applications, the D gain is not needed. Setting [PID Diff Rate] to 0.00 (factory default) disables the differential component of the PID loop.

Guidelines for Adjusting the PID Gains

1. Adjust the proportional gain. During this step it may be desirable to disable the integral gain and differential gain by setting them to 0. After a step change in the PID Feedback:
   - If the response is too slow increase A134 [PID Prop Gain].
   - If the response is too quick and/or unstable (see Figure F.1), decrease A134 [PID Prop Gain].
   - Typically, A134 [PID Prop Gain] is set to some value below the point where the PID begins to go unstable.
2. Adjust the integral gain (leave the proportional gain set as in Step 1). After a step change in the PID Feedback:
   - If the response is too slow (see Figure F.2), or the PID Feedback does not become equal to the PID Reference, decrease A135 [PID Integ Time].
   - If there is a lot of oscillation in the PID Feedback before settling out (see Figure F.3), increase A135 [PID Integ Time].
3. At this point, the differential gain may not be needed. However, if after determining the values for A134 [PID Prop Gain] and A135 [PID Integ Time]:
   - Response is still slow after a step change, increase A136 [PID Diff Rate].
   - Response is still unstable, decrease A136 [PID Diff Rate].

The following figures show some typical responses of the PID loop at different points during adjustment of the PID Gains.

Figure F.1 Unstable

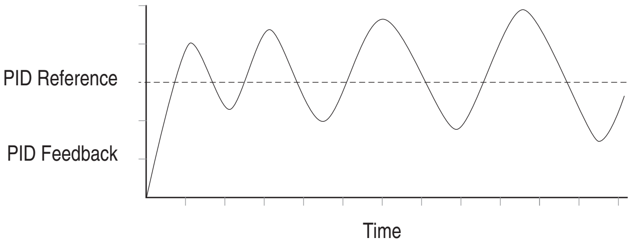


Figure F.2 Slow Response – Over Damped

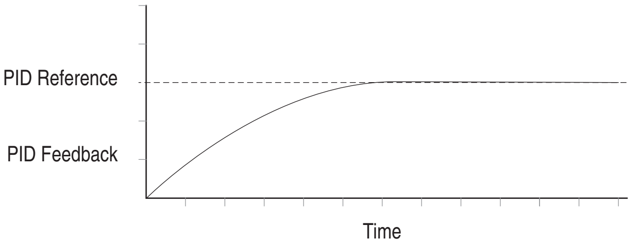


Figure F.3 Oscillation – Under Damped

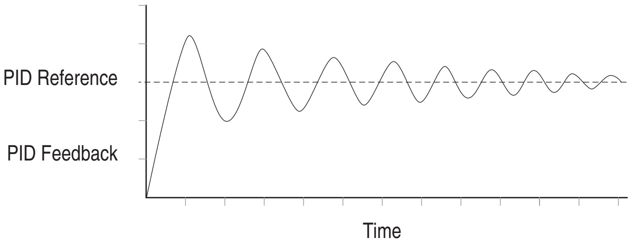
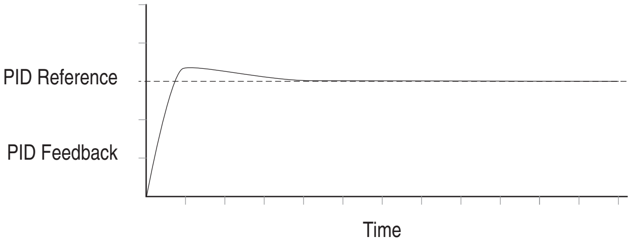


Figure F.4 Good Response – Critically Damped



Notes:

Index

www.rockwellautomation.com

Corporate Headquarters
Rockwell Automation, 777 East Wisconsin Avenue, Suite 1400, Milwaukee, WI, 53202-5302 USA, Tel: (1) 414.212.5200, Fax: (1) 414.212.5201

Headquarters for Allen-Bradley Products, Rockwell Software Products and Global Manufacturing Solutions
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation SA/NV, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Headquarters for Dodge and Reliance Electric Products
Americas: Rockwell Automation, 6040 Ponders Court, Greenville, SC 29615-4617 USA, Tel: (1) 864.297.4800, Fax: (1) 864.281.2433
Europe/Middle East/Africa: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 17741
Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 6356-9077, Fax: (65) 6356-9011

U.S. Allen-Bradley Drives Technical Support
Tel: (1) 262.512.8176, Fax: (1) 262.512.2222, Email: support@drives.ra.rockwell.com, Online: www.ab.com/support/abdrives

Publication 22B-UM001C-EN-E – February 2004
Supersedes June 2003

PowerFlex™ 4-Class AC Drives Technical Data

22B-D4P0N104
22B-D1P4N104

ITEM # 20
& 21

Providing users with powerful motor speed control in a compact, space saving design, the Allen-Bradley PowerFlex 4-Class AC drives are the smallest and most cost-effective members of the PowerFlex family of drives. The PowerFlex 4-Class of drives consists of two products, the **PowerFlex 4** and **PowerFlex 40**. Available in power ratings from 0.2 to 7.5 kW (0.25 to 10 HP) and in voltage classes of 120, 240 and 480 volts, PowerFlex 4 and 40 are designed to meet global OEM and end-user demands for flexibility, space savings and ease of use. They are also cost-effective alternatives for speed control of applications such as machine tools, fans, pumps and conveyors and material handling systems.

Table of Contents

Shaded areas are applicable to PowerFlex 40 only.

PowerFlex 4-Class Common Attributes

Packaging and Mounting

- Installation can be a virtual snap using the **DIN rail mounting** feature on ratings through 4 kW (5 HP). Panel mounting is also available, providing added flexibility.
- **Zero Stacking**™ is allowable for ambient temperatures up to 40°C, saving valuable panel space. 50°C ambient temperatures are permitted with minimal spacing between drives.
- **Integral filtering** is available on all 230V single phase ratings, providing a cost-effective means of meeting EN55011, Class A and B EMC requirements. External filters provide compliance to Class A and B requirements for all PowerFlex 4 and 40 ratings.
- An optional **IP30 (NEMA 1) conduit box** is easily adapted to the standard IP20 (NEMA Type Open) product, providing increased environmental ratings.

Start Up, Programming and Operation

- An **integral keypad** provides out of the box operation using the local potentiometer and control keys.
- The 10 most common application parameters are contained in the **Basic Program Group**, making programming fast and easy.
- The **programming keys** have the same function as all other PowerFlex drives, so if you can program one PowerFlex drive, you can program them all.
- **4 digit display** with 10 additional LED indicators provides an intuitive display of drive status and information.
- Integral **RS-485 communications** can be used for programming from a PC. It can also be used in a multi-drop network configuration. A serial converter module provides connectivity to any controller with a DF1 port.
- A **NEMA Type 4X** remote and **NEMA Type 1 hand-held LCD keypad** provide additional programming and control flexibility, both featuring the popular CopyCat function.

Optimized Performance

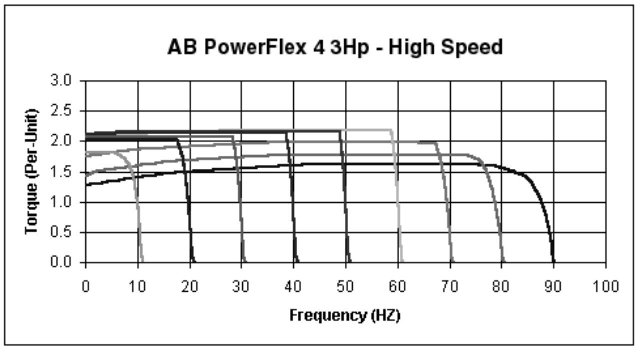
- **Removable MOV** to ground provides trouble-free operation when used on ungrounded distribution systems.
- A **relay pre-charge** limits inrush current.
- **Integral brake transistor**, available on 0.75 kW (1.0 HP) units and larger, provides dynamic braking capability with simple low cost brake resistors.
- DIP switch settable **24V DC sink or source control** for control wiring flexibility.
- 150% overload for 60 seconds or 200% overload for 3 seconds provides **robust overload protection**.
- **Adjustable PWM frequency up to 16 kHz** ensures quiet operation.

Performance

Sensorless Vector Performance

PowerFlex 4

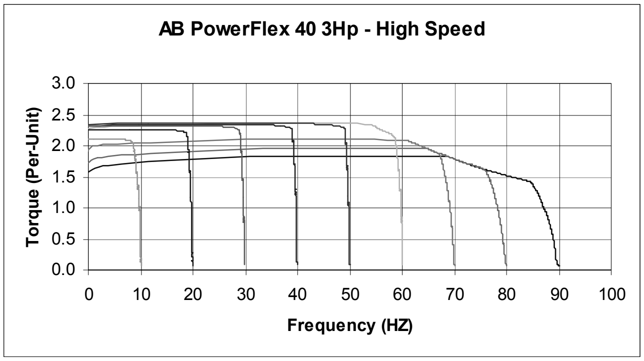
- Drive automatically provides auto boost (IR compensation) and slip compensation.
- Provides excellent speed regulation and high levels of torque across the entire speed range of the drive, and improved speed regulation even as loading increases.



Sensorless Vector Control

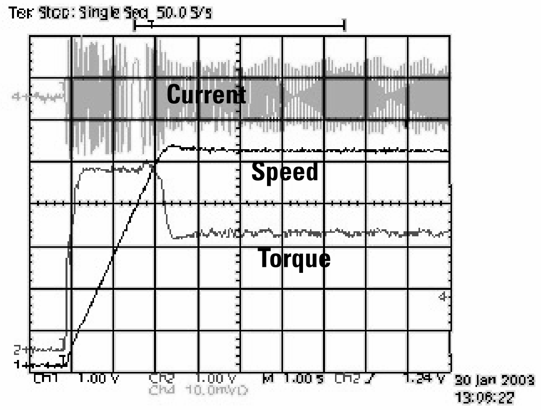
PowerFlex 40

- Sensorless Vector Control provides exceptional speed regulation and very high levels of torque across the entire speed range of the drive.
- The Autotune feature allows the PowerFlex 40 to adapt to individual motor characteristics.



Performance

- This graph depicts the ability of a PowerFlex 40 drive to accelerate into at least 150% load. A PowerFlex 4 will perform similarly, but with a slightly higher acceleration time.
- At 100% motor load, the drive will run the motor at synchronous speed.
- Excellent current regulation.
- Linear acceleration.
- Best in class digital input response time and repeatability.



PowerFlex 40 Advanced Features

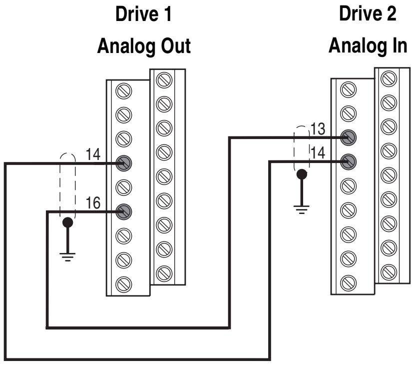
Performance

- **Sensorless Vector Control** develops high torque over a wide speed range and adapts to individual motor characteristics.
- **Variable PWM** allows the drive to output more current at low frequencies.
- Integral **PID** functionality enhances application flexibility.
- **Timer, Counter, Basic Logic and Step Logic functions** can reduce hardware design costs and simplify control schemes.
  - **Timer function**: Relay or opto outputs controlled by drive performing timer function. Timer is initiated by activating a digital input programmed as "Timer Start."
  - **Counter function**: Relay or opto outputs controlled by drive performing counter function. Counter function is activated by a digital input programmed as "Counter Input."
  - **Basic Logic**: Relay or opto outputs controlled by status of digital inputs programmed as "Logic Inputs." Performs basic Boolean logic.
  - **Step Logic**: Logic-based steps using preset speed settings. Each step can be programmed for a specific speed, direction and accel/decel profile. Drive outputs can be used to indicate which step is being performed.

I/O

- **Two (2) Analog Inputs** (one unipolar and one bipolar) are independently isolated from the rest of the drive I/O. These inputs can be toggled between via a digital input.
- **Three (3) fixed** and **four (4) fully programmable Digital Inputs** provide application versatility.
- **One (1) Analog Output** is DIP switch selectable for either 0-10V or 0-20mA. This scalable, 10-bit output is suitable for metering or as a speed reference for another drive.
- **Two (2) Opto Outputs** and one (1) form C relay output can be used to indicate various drive, motor or logic conditions.

Analog Signal Follower



Communications

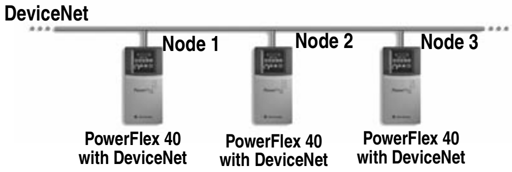
- Integral communication cards such as **DeviceNet™** can improve machine performance.
- **Field installed option** allows for future addition of stand-alone drives to a network.
- **Online EDS file creation** with RSNetWorx™ providing ease of set-up on a network.

Communications & Software

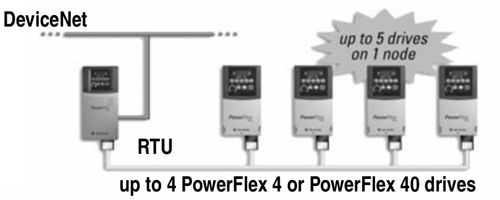
Versatile Programming and Network Solutions

- PowerFlex 4 and PowerFlex 40 are compatible with any device that acts as a RTU Master and support standard 03 and 06 RTU commands.

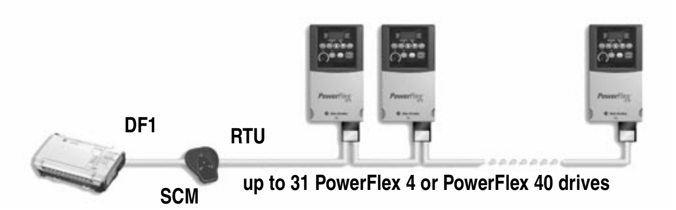
- A network can be configured using PowerFlex 40 drives with DeviceNet cards for high performance and flexible configuration capabilities.



- A multi-drive solution can be reached using a single PowerFlex 40 DeviceNet option, with the ability for up to five (5) drives to reside on one (1) node.

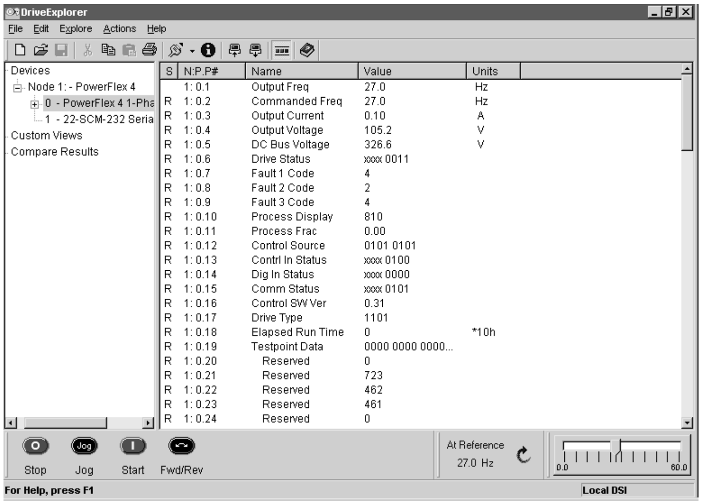


- Integral RS485 communications enable the drives to be used in a multi-drop network configuration. A serial converter module provides connectivity to any controller with a DF1 port.



PC Programming Software

Through the use of a Serial Converter Module and DriveExplorer™ or DriveExecutive™ software, programming can be greatly simplified.



S	N:P.P#	Name	Value	Units
	1: 0.1	Output Freq	27.0	Hz
R	1: 0.2	Commanded Freq	27.0	Hz
R	1: 0.3	Output Current	0.10	A
R	1: 0.4	Output Voltage	105.2	V
R	1: 0.5	DC Bus Voltage	326.6	V
R	1: 0.6	Drive Status	xxxx 0011	
R	1: 0.7	Fault 1 Code	4	
R	1: 0.8	Fault 2 Code	2	
R	1: 0.9	Fault 3 Code	4	
R	1: 0.10	Process Display	810	
R	1: 0.11	Process Frac	0.00	
R	1: 0.12	Control Source	0101 0101	
R	1: 0.13	Contrl In Status	xxxx 0100	
R	1: 0.14	Dig In Status	xxxx 0000	
R	1: 0.15	Comm Status	xxxx 0101	
R	1: 0.16	Control SW Ver	0.31	
R	1: 0.17	Drive Type	1101	
R	1: 0.18	Elapsed Run Time	0	*10h
R	1: 0.19	Testpoint Data	0000 0000 0000...	
R	1: 0.20	Reserved	0	
R	1: 0.21	Reserved	723	
R	1: 0.22	Reserved	462	
R	1: 0.23	Reserved	461	
R	1: 0.24	Reserved	0	

DriveExplorer Software

- View and modify drive and adapter parameters in a method similar to the file management capability of Microsoft Windows Explorer.
- Operate the drive via an on-screen Control Bar, which is a tool that allows you to start, stop, and change the speed reference of the drive.
- Save, restore and print parameter information.
- Compare current parameters with factory defaults or previously saved parameter values.
- Edit, upload and download parameters.

DriveExecutive Software

- Online and offline programming capability
- In-grid and dialog-based parameter editing
- Immediate visual indication of drive and communication status when viewing online drive
- Integrated HTML Help architecture

Feature Comparison

Use the chart below to assist in determining which product is most appropriate for an application.

Feature	PowerFlex™ 4	PowerFlex™ 40
Catalog Reference	22A...	22B....
Maximum (kW) HP Rating/Input Voltage	(1.1)1.5 HP/115V, 1ø	(1.1) 1.5 HP/115V, 1ø
	(1.5) 2 HP/230V, 1ø	(2.2) 3 HP/230V, 1ø
	(3.7) 5 HP/230V, 3ø	(7.5) 10 HP/230V, 3ø
	(3.7) 5 HP/460V, 3ø	(7.5) 10 HP/460V, 3ø
Overload Capacity	150% for 60 seconds 200% for 3 seconds	150% for 60 seconds 200% for 3 seconds
NEMA 1/IP30 Option	●	●
EMC Filtering	Internal - 1ø, 230V External - All 1ø, 115V and 3ø Ratings	Internal - 1ø, 230V External - All 1ø, 115V and 3ø Ratings
DIN Rail Mounting Standard	●	● (Through 5 HP)
Integral Keypad with Speed Pot	●	●
Keypad - Remote LCD	●	●
Keypad CopyCat Function	●	●
Control Type	V/Hz	Sensorless Vector & V/Hz
Internal DB Transistor	● (0.75 kW/1 HP and higher)	● (0.75 kW/1 HP and higher)
Preset Speeds	4	8
Carrier Frequency	2-16 kHz	2-16 kHz
Skip Frequency		●
Process Control Loop		● (PID)
Step Logic Functionality		●
Timer/Counter Functions		●
Common Bus		●
Control Voltage	24V sink/source	24V sink/source
Discrete Inputs	3 fixed for START/STOP/REV	3 fixed for START/STOP/REV
	2 fully programmable	4 fully programmable
Analog Input - Unipolar	1 (0-10V or 4-20 mA)	2 (0-10V and 4-20 mA)
Analog Input - Bipolar		1 (+/- 10V) ❶
Analog Response	2 Hz (500 ms)	100 Hz (10 ms)
Relay Output	1 - N.O./N.C. dry contact	1 - N.O./N.C. dry contact
Digital/Optocoupler Output		2
Analog Output		● (0-10V or 4-20 mA)
Integral RS485	●	●
RS232 *(Requires use of Serial Converter Module)*	●	●
DeviceNet		●

❶ When using bipolar input, the 0-10V unipolar input cannot be used.

Catalog Number Explanation

22A	-	A	1P5	N	1	1	4
Drive	Dash	Voltage Rating	Rating	Enclosure	HIM	Emission Class	Comm Slot

Code	
22A	PowerFlex 4
[✓ 22B]	PowerFlex 40

Code	**Voltage**	**Ph.**
V	120V AC	1
A	240V AC	1
B	240V AC	3
[✓ D]	480V AC	3

Output Current @ 380-480V Input

Code	**Amps**	**kW (HP)**
[✓ 1P4]	1.4	0.4 (0.5)
2P3	2.3	0.75 (1.0)
[✓ 4P0]	4.0	1.5 (2.0)
6P0	6.0	2.2 (3.0)
8P7	8.7	3.7 (5.0)
010	10.5	4.0 (5.0)
012	12	5.5 (7.5)
017	17	7.5 (10.0)

Output Current @ 100-120 Input or 200-240V Input

Code	**Amps**	**kW (HP)**
1P5	1.5	0.2 (0.25)
2P3	2.3	0.4 (0.5)
4P5	4.5	0.75 (1.0)
5P0	5.0	0.75 (1.0)
6P0	6.0	1.1 (1.5)
8P0	8.0	1.5 (2.0)
012	12	2.2 (3.0)
017	17.5	3.7 (5.0)
024	24	5.5 (7.5)
033	33	7.5 (10.0)

Code	**Enclosure**
[✓ N]	Panel Mount - IP 20 (NEMA Type Open)

Code	**Interface Module**
[✓ 1]	Fixed Keypad

Code	**Rating**
[✓ 0]	No Filter
1	Integral EMI Filter (200-240V, 1 Phase Only)

Code	**Version**
[✓ 4]	RS485

Product Selection

Drive Ratings				**PowerFlex 4**			**PowerFlex 40**		
Input Voltage	**Output Voltage**	**kW**	**HP**	**Output Current**	**Catalog Number**	**Frame Size**	**Output Current**	**Catalog Number**	**Frame Size**
100-120V 50/60 Hz 1-Phase No Filter	0-230V 3-Phase	0.2	0.25	1.5A	22A-V1P5N104	A	—	—	—
		0.4	0.5	2.3A	22A-V2P3N104	A	2.3A	22B-V2P3N104	B
		0.75	1.0	4.5A	22A-V4P5N104	B	5.0A	22B-V5P0N104	B
		1.1	1.5	6.0A	22A-V6P0N104	B	6.0A	22B-V6P0N104	B
200-240V 50/60 Hz 1-Phase With Integral "S Type" EMC Filter	0-230V 3-Phase	0.2	0.25	1.5A	22A-A1P5N114	A	—	—	—
		0.4	0.5	2.3A	22A-A2P3N114	A	2.3A	22B-A2P3N114	B
		0.75	1.0	4.5A	22A-A4P5N114	A	5.0A	22B-A5P0N114	B
		1.5	2.0	8.0A	22A-A8P0N114	B	8.0A	22B-A8P0N114	B
		2.2	3.0	—	—	—	12A	22B-A012N114	C
200-240V 50/60 Hz 1-Phase No Filter	0-230V 3-Phase	0.2	0.25	1.5A	22A-A1P5N104	A	—	—	—
		0.4	0.5	2.3A	22A-A2P3N104	A	2.3A	22B-A2P3N104	B
		0.75	1.0	4.5A	22A-A4P5N104	A	5.0A	22B-A5P0N104	B
		1.5	2.0	8.0A	22A-A8P0N104	B	8.0A	22B-A8P0N104	B
		2.2	3.0	—	—	—	12.0A	22B-A012N104	C
200-240V 50/60 Hz 3-Phase No Filter	0-230V 3-Phase	0.2	0.25	1.5A	22A-B1P5N104	A	—	—	—
		0.4	0.5	2.3A	22A-B2P3N104	A	2.3A	22B-B2P3N104	B
		0.75	1.0	4.5A	22A-B4P5N104	A	5.0A	22B-B5P0N104	B
		1.5	2.0	8.0A	22A-B8P0N104	A	8.0A	22B-B8P0N104	B
		2.2	3.0	12.0A	22A-B012B104	B	12.0A	22B-B012N104	B
		3.7	5.0	17.5A	22A-B017N104	B	17.5A	22B-B017N104	B
		5.5	7.5	—	—	—	24.0A	22B-B024N104	C
		7.5	10.0	—	—	—	33.0A	22B-B033N104	C
380-480V 50/60 Hz 3-Phase No Filter	0-460V 3-Phase	0.4	0.5	1.4A	22A-D1P4N104	A	1.4A	[✓ 22B-D1P4N104]	B
		0.75	1.0	2.3A	22A-D2P3N104	A	2.3A	22B-D2P3N104	B
		1.5	2.0	4.0A	22A-D4P0N104	A	4.0A	[✓ 22B-D4P0N104]	B
		2.2	3.0	6.0A	22A-D6P0N104	B	6.0A	22B-D6P0N104	B
		4.0	5.0	8.7A	22A-D8P7N104	B	10.5A	22B-D010N104	B
		5.5	7.5	—	—	—	12.0A	22B-D012N104	C
		7.5	10.0	—	—	—	17.0A	22B-D017N104	C

See page 19 for dimensions.

Shaded areas denote options for PowerFlex 40 only.

User Installed Options

IP30/NEMA 1/UL Type 1 Conversion Kit

Item	Description	Drive Frame	PowerFlex 4	PowerFlex 40
			Catalog Number ❶	Catalog Number ❶
IP30/NEMA 1/UL Type 1 Kit	Field installed kit. Converts drive to IP30/NEMA 1/UL Type 1 enclosure. Includes conduit box with mounting screws and plastic top panel.	A	22-JBAA	–
		B	22-JBAB	22-JBAB
		C	–	22-JBAC
IP30/NEMA 1/UL Type 1 Kit with Communication Option	Field installed kit. Converts drive to IP30/NEMA 1/UL Type 1 enclosure. Includes communication option conduit box with mounting screws and plastic top panel.	B	–	22-JBCB
		C	–	22-JBCC

Human Interface Module Option Kits and Accessories

Item	Description	Catalog Number ❶
Remote Human Interface Modules (HIMs)	LCD Display, Remote Panel Mount, Digital Speed Control, Full Numeric Keypad, CopyCat capable, IP66 (NEMA Type 4X/12) indoor use only. Includes 2.9 meter cable.	22-HIM-C2
	LCD Display, Remote Handheld, Digital Speed Control, Full Numeric Keypad, CopyCat capable, IP30 (NEMA Type 1). Includes 1.0 meter cable, Panel Mount with optional Bezel Kit.	22-HIM-A3
Bezel Kit	Panel Mount for LCD Display, Remote Handheld unit, IP30 (NEMA Type 1).	22-HIM-B1
DSI HIM Cable	DSI HIM Cable (DSI HIM to RJ45 cable)	
	1.0 Meter (3.3 Feet)	22-HIM-H10
	2.9 Meter (9.51 Feet)	22-HIM-H30

Communication Option Kits

Item	Description	Catalog Number ❶
Serial Converter Module (RS485 to RS232)	Provides serial communication via DF1 protocol for use with DriveExplorer™ and DriveExecutive™ software. Includes: DSI to RS232 serial converter (1) 1203-SFC serial cable (1) 22-RJ45CBL-C20 cable (1) DriveExplorer Lite CD (1)	22-SCM-232
Serial Cable	2.0 meter serial cable with a locking low profile connector to connect to the serial converter and a 9-pin sub-miniature D female connector to connect to a computer.	1203-SFC
Null Cable Converter	For use when connecting the serial converter to DriveExplorer on a handheld PC.	1203-SNM
DSI Cable	2.0 meter RJ45 to RJ45 cable, male to male connectors.	22-RJ45CBL-C20
Splitter Cable	RJ45 one to two port splitter cable.	AK-U0-RJ45-SC1
Terminating Resistors	RJ45 120 Ohm resistors (2 pieces).	AK-U0-RJ45-TR1
Terminal Block	RJ45 Two position terminal block (5 pieces).	AK-U0-RJ45-TB2P
DeviceNet™ Card	Embedded communication option for use with the PowerFlex family of drives. Requires a Communication Adapter Cover (Ordered Separately).	22-COMM-D
Communication Covers	Houses the DeviceNet Communication Adapter. These covers add 25 mm (0.98 in.) to the overall depth of the drive.	
	PowerFlex 40 Drive Frame B	22B-CCB
	PowerFlex 40 Drive Frame C	22B-CCC

PC Programming Software

Item	Description	Catalog Number
DriveExecutive™ Software, Version 1.01 or later	"Windows" based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communications adapters online and offline. Compatibility: Windows 98, ME, NT, 4.0 (Service Pack 3 or later), 2000 and XP. ❷	9303-4DTE01ENE
DriveExplorer™ Software, Version 3.01 or later	"Windows" based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communications adapters online and offline. Compatibility: Windows 95, 98, ME, NT, 4.0 (Service Pack 3 or later), 2000, XP and CE. ❷	9306-4EXP01ENE
DC Bus Inductors	Use MTE RB Series or equivalent inductors: 240V 50/60 Hz, 3-Phase 480V 50/60 Hz, 3-Phase	❸

❶ For pricing information, refer to the PowerFlex 4-Class Price List, publication 22-PL001.

❷ See www.ab.com/drive/ for support devices.

❸ See www.mtecorp.com for catalog numbers.

User Installed Options

Dynamic Brake Resistors

Drive Ratings			PowerFlex 4	PowerFlex 40
Input Voltage	kW	HP	Catalog Number ❶	Catalog Number ❶
120V 50/60 Hz 1-Phase	0.2	0.25	❷	–
	0.4	0.5	❷	❷
	0.75	1.0	AK-R2-091P500	AK-R2-091P500
	1.1	1.5	AK-R2-091P500	AK-R2-091P500
240V 50/60 Hz 1-Phase	0.2	0.25	❷	–
	0.4	0.5	❷	❷
	0.75	1.0	AK-R2-091P500	AK-R2-091P500
	1.5	2.0	AK-R2-091P500	AK-R2-091P500
	2.2	3.0	–	AK-R2-047P500
240V 50/60 Hz 3-Phase	0.2	0.25	❷	–
	0.4	0.5	❷	❷
	0.75	1.0	AK-R2-091P500	AK-R2-091P500
	1.5	2.0	AK-R2-091P500	AK-R2-091P500
	2.2	3.0	AK-R2-047P500	AK-R2-047P500
	3.7	5.0	AK-R2-047P500	AK-R2-047P500
	5.5	7.5	–	AK-R2-030P1K2
	7.5	10.0	–	AK-R2-030P1K2
480V 50/60 Hz 3-Phase	0.4	0.5	❷	❷
	0.75	1.0	AK-R2-360P500	AK-R2-360P500
	1.5	2.0	AK-R2-360P500	AK-R2-360P500
	2.2	3.0	AK-R2-120P1K2	AK-R2-120P1K2
	4.0	5.0	AK-R2-120P1K2	AK-R2-120P1K2
	5.5	7.5	–	AK-R2-120P1K2
	7.5	10.0	–	AK-R2-120P1K2

❶ Resistors listed in this table are rated for a minimum 5% duty cycle. See publication no. PLFEX-AT001 for additional information.

❷ Drive does not support dynamic braking.

3% Line Reactors

Input Voltage	kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance	Watts Loss	Catalog Number ❶
240V 50/60 Hz 3-Phase	0.2	0.25	2	3	12.0 mh	7.5 W	1321-3R2-A
	0.4	0.5	4	6	12.0 mh	21 W	1321-3R4-D
	0.75	1.0	8	12	3.0 mh	29 W	1321-3R8-B
	1.5	2.0	8	12	1.5 mh	19.5 W	1321-3R8-A
	2.2	3.0	12	18	1.25 mh	26 W	1321-3R12-A
	3.7	5.0	18	27	0.8 mh	36 W	1321-3R18-A
	5.5	7.5	25	37.5	0.5 mh	48 W	1321-3R25-A
	7.5	10.0	35	52.5	0.4 mh	49 W	1321-3R35-A
480V 50/60 Hz 3-Phase	0.4	0.5	2	3	20.0 mh	11.3 W	1321-3R2-B
	0.75	1.0	4	6	9.0 mh	20 W	1321-3R4-C
	1.5	2.0	4	6	6.5 mh	20 W	1321-3R4-B
	2.2	3.0	8	12	5.0 mh	25.3 W	1321-3R8-C
	3.7	5.0	18	27	3.0 mh	29 W	1321-3R8-B
	4.0	5.0	12	18	2.5 mh	31 W	1321-3R12-B
	5.5	7.5	12	18	2.5 mh	31 W	1321-3R12-B
	7.5	10.0	18	27	1.5 mh	43 W	1321-3R18-B

❶ Catalog numbers listed are for 3% impedance open style units. NEMA Type 1 and 5% impedance reactor types are also available. Refer to publication 1321-TD001.

PowerFlex 4 EMC Filters

Drive Ratings			S Type Filter	L Type Filter
Input Voltage	kW	HP	Catalog Number ❶	Catalog Number ❷
120V 50/60 Hz 1-Phase	0.2	0.25	–	22-RF010-AL
	0.4	0.5	–	22-RF010-AL
	0.75	1.0	–	22-RF018-BL
240V 50/60 Hz 1-Phase	0.2	0.25	❸	22-RF010-AL
	0.4	0.5	❸	22-RF010-AL
	0.75	1.0	❸	22-RF010-AL
	1.5	2.0	❸	22-RF018-BL
240V 50/60 Hz 3-Phase	0.2	0.25	22-RF9P5-AS	22-RF9P5-AL
	0.4	0.5	22-RF9P5-AS	22-RF9P5-AL
	0.75	1.0	22-RF9P5-AS	22-RF9P5-AL
	1.5	2.0	22-RF9P5-AS	22-RF9P5-AL
	2.2	3.0	22-RF021-BS	22-RF021-BL
	3.7	5.0	22-RF021-BS	22-RF021-BL
480V 50/60 Hz 3-Phase	0.4	0.5	22-RF5P7-AS	22-RF5P7-AL
	0.75	1.0	22-RF5P7-AS	22-RF5P7-AL
	1.5	2.0	22-RF5P7-AS	22-RF5P7-AL
	2.2	3.0	22-RF012-BS	22-RF012-BL
	3.7	5.0	22-RF012-BS	22-RF012-BL

PowerFlex 40 EMC Filters

Drive Ratings			S Type Filter	L Type Filter
Input Voltage	kW	HP	Catalog Number ❶	Catalog Number ❷
120V 50/60 Hz 1-Phase	0.4	0.5	–	22-RF018-BL
	0.75	1.0	–	22-RF018-BL
	1.1	1.5	–	22-RF018-BL
240V 50/60 Hz 1-Phase	0.4	0.5	❸	22-RF018-BL
	0.75	1.0	❸	22-RF018-BL
	1.5	2.0	❸	22-RF018-BL
	2.2	3.0	❸	22-RF025-CL
240V 50/60 Hz 3-Phase	0.4	0.5	22-RF021-BS ❹	22-RF021-BL
	0.75	1.0	22-RF021-BS ❹	22-RF021-BL
	1.5	2.0	22-RF021-BS ❹	22-RF021-BL
	2.2	3.0	22-RF021-BS ❹	22-RF021-BL
	3.7	5.0	22-RF021-BS ❹	22-RF021-BL
	5.5	7.5	22-RF034-CS	22-RF034-CL
	7.5	10.0	22-RF034-CS	22-RF034-CL
480V 50/60 Hz 3-Phase	0.4	0.5	22-RF012-BS	22-RF012-BL
	0.75	1.0	22-RF012-BS	22-RF012-BL
	1.5	2.0	22-RF012-BS	22-RF012-BL
	2.2	3.0	22-RF012-BS	22-RF012-BL
	4.0	5.0	22-RF012-BS	22-RF012-BL
	5.5	7.5	22-RF018-CS	22-RF018-CL
	7.5	10.0	22-RF018-CS	22-RF018-CL

❶ This filter is suitable for use with a cable length of at least 10 meters for Class A and 1 meter for Class B environments.

❷ This filter is suitable for use with a cable length of at least 100 meters for Class A and 5 meters for Class B environments.

❸ Drives are available in these ratings with internal "S Type" filters.

❹ Filter must be Series B or later.

Shaded areas are applicable to PowerFlex 40 only.

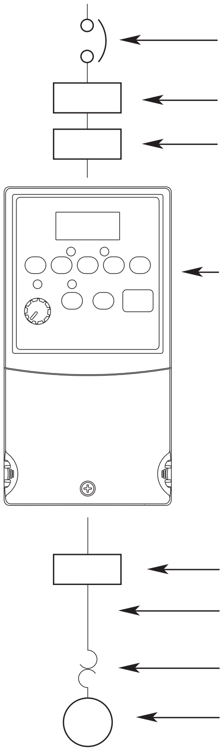
Installation Considerations

The PowerFlex 4-Class drives have the following built in protective features to help simplify installation.

- Ground fault protection while starting and running ensures reliable operation
- Electronic motor overload protection increases motor life
- Removable MOV to ground ensures compatibility with ungrounded systems
- 6kV transient protection provides increased robustness for 380-480V system voltages

There are many other factors that must be considered for optimal performance in any given application. The block diagram below highlights the primary installation considerations. Consult the PowerFlex 4 or PowerFlex 40 *User Manual*, Publications 22A-UM001 or 22B-UM001 available online at **www.ab.com/manuals/dr**, for detailed recommendations on input power conditioning, CE conformance (EMC filtering), dynamic braking, reflected wave protection, motor cable types and motor cable distances.

Block Diagram



Branch Circuit Protective Devices – *See Specifications on page 14*

Input Power Conditioning – *See Line Reactors on page 10*

Line (EMC) Filter – *See page 10*

Integral Keypad

Reflected Wave Protection – *(Consult the appropriate User Manual)*

Motor Cable Type and Length Recommendations –
(Consult the appropriate User Manual)

Class 10 Overload Protection – *Provided by the PowerFlex drive*

Motor – *See publication MOTORS-CA001*

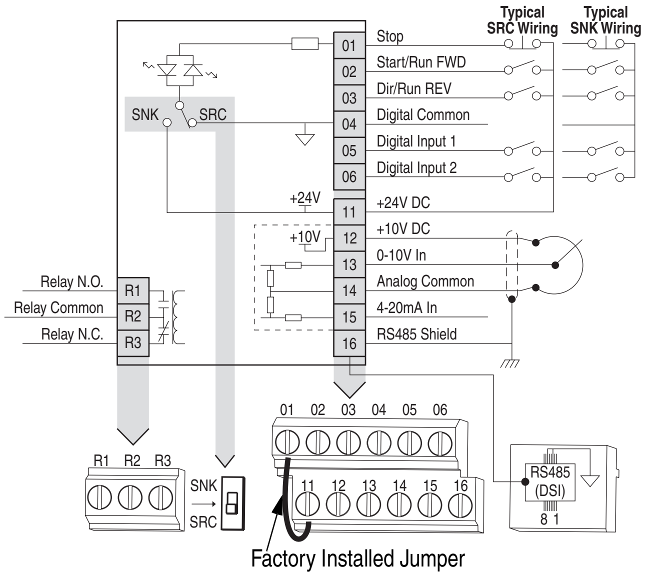
Control Wiring

PowerFlex 4

- The control logic is 24V DC and can be set for either Sink or Source control via a DIP switch setting.
- Control terminal screws are sized for a conventional blade screw driver.
- I/O Terminals 1, 2 and 3 are dedicated for Stop, Start and Reverse operation respectively. These I/O Terminals can be programmed for 2- or 3-Wire operation to meet application requirements.
- I/O Terminals 4 and 5 are programmable and provide added flexibility. Programmable functions include:

– Local Control	– Preset Frequencies
– Jog	– RS485 Control
– Second Accel/Decel	– Auxiliary Fault
– Clear Fault	

- Speed can be controlled via a 0-10V input or 4-20 mA input. Both are electrically isolated from the drive.
- One form C relay can be programmed to provide the status of a wide variety of drive conditions.
- The drive is shipped with a jumper installed between I/O Terminals 01 and 11 to allow out of box operation from the keypad.



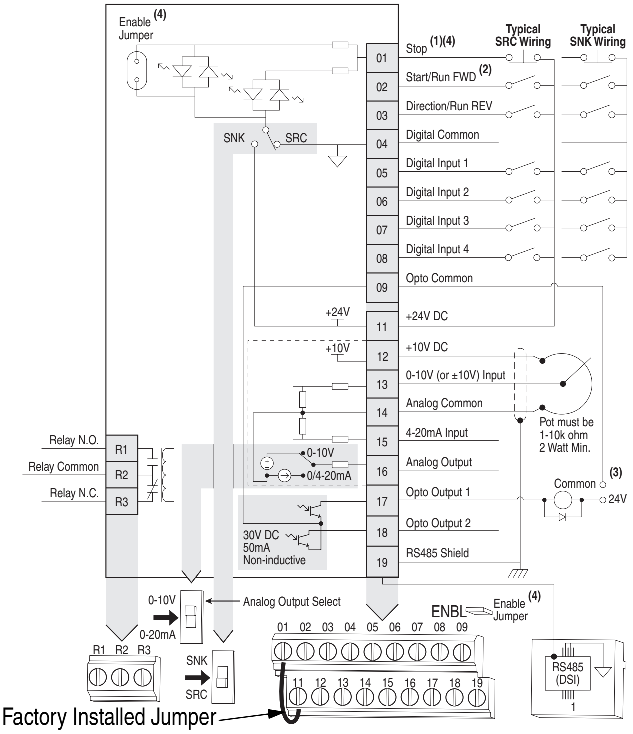
<table>
<tr><th>Terminal</th><th>Signal</th><th>Default</th><th>Description</th></tr>
<tr><td>R1</td><td>Relay N.O.</td><td>Fault</td><td rowspan="3"><table><tr><th></th><th>30V DC</th><th>125V AC</th><th>240V AC</th></tr><tr><td>Resistive</td><td>3.0A</td><td>3.0A</td><td>3.0A</td></tr><tr><td>Inductive</td><td>0.5A</td><td>0.5A</td><td>0.5A</td></tr></table></td></tr>
<tr><td>R2</td><td>Relay Common</td><td>–</td></tr>
<tr><td>R3</td><td>Relay N.C.</td><td>Fault</td></tr>
<tr><td colspan="2">Sink/Source DIP Switch</td><td>Source (SRC)</td><td>Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.</td></tr>
<tr><td>01</td><td>Stop</td><td>Coast</td><td>The factory installed jumper or a normally closed input must be present for the drive to start.</td></tr>
<tr><td>02</td><td>Start/Run FWD</td><td>Not Active</td><td rowspan="2">Command comes from the integral keypad by default. To disable reverse operation, see A095 [Reverse Disable].</td></tr>
<tr><td>03</td><td>Dir/Run REV</td><td>Not Active</td></tr>
<tr><td>04</td><td>Digital Common</td><td>–</td><td>For digital inputs. Electronically isolated with digital inputs from analog I/O.</td></tr>
<tr><td>05</td><td>Digital Input 1</td><td>Preset Frequencies</td><td>Program with A051 [Digital In1 Sel].</td></tr>
<tr><td>06</td><td>Digital Input 2</td><td>Preset Frequencies</td><td>Program with A052 [Digital In2 Sel].</td></tr>
<tr><td>11</td><td>+24V DC</td><td>–</td><td>Drive supplied power for digital inputs. Maximum output current is 100mA.</td></tr>
<tr><td>12</td><td>+10V DC</td><td>–</td><td>Drive supplied power for 0-10V external potentiometer. Maximum output current is 15mA.</td></tr>
<tr><td>13</td><td>0-10V In ❶</td><td>Not Active</td><td>For external 0-10V input supply (input impedance = 100k ohm) or potentiometer wiper.</td></tr>
<tr><td>14</td><td>Analog Common</td><td>–</td><td>For 0-10V In or 4-20mA In. Electronically isolated with analog inputs from digital I/O.</td></tr>
<tr><td>15</td><td>4-20mA In ❶</td><td>Not Active</td><td>For external 4-20mA input supply (input impedance = 250 ohm).</td></tr>
<tr><td>16</td><td>RS485 (DSI) Shield</td><td>–</td><td>Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port.</td></tr>
</table>

❶ Only one analog frequency source may be connected at a time. If more than one reference is connected at the same time, an undetermined frequency reference will result.

Control Wiring

PowerFlex 40

- The control logic is 24V DC and can be set for either Sink or Source control via a DIP switch setting.
- Control terminal screws are sized for a conventional blade screw driver.
- I/O Terminals 1, 2 and 3 are dedicated for Stop, Start and Reverse operation respectively. These I/O Terminals can be programmed for 2- or 3-Wire operation to meet application requirements.
- I/O Terminals 5, 6, 7 and 8 are programmable and provide added flexibility. Programmable functions include Local Control, Jog, Second Accel/Decel, Clear Fault, Preset Frequencies, RS485 Control and Auxiliary Fault.
- Speed can be controlled via a 0-10V input and/or 4-20 mA input. Both inputs are independently isolated from the rest of the drive and can be used for applications such as PID. Voltage input can be programmed for bipolar operation.
- The drive is shipped with a jumper installed between I/O Terminals 01 and 11 to allow out of box operation from the keypad.



Terminal	Signal	Default	Description
R1	Relay N.O.	Fault	
R2	Relay Common	–	
R3	Relay N.C.	Fault	

	30V DC	125V AC	240V AC
Resistive	3.0A	3.0A	3.0A
Inductive	0.5A	0.5A	0.5A

Terminal	Signal	Default	Description
Analog Output Select DIP Switch		0-10V	Sets analog output to either voltage or current. Setting must match A065 [Analog Out Sel].
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.
01	Stop	Coast	The factory installed jumper or a normally closed input must be present for the drive to start.
02	Start/Run FWD	Not Active	Command comes from the integral keypad by default. To disable reverse operation, see A095 [Reverse Disable].
03	Dir/Run REV	Not Active	
04	Digital Common	–	For digital inputs. Electronically isolated with digital inputs from analog I/O.
05	Digital Input 1	Preset Frequencies	Program with A051 [Digital In1 Sel].
06	Digital Input 2	Preset Frequencies	Program with A052 [Digital In2 Sel].
07	Digital Input 3	Local	Program with A053 [Digital In3 Sel].
08	Digital Input 4	Jog Forward	Program with A054 [Digital In4 Sel].
09	Opto Common	–	For opto-coupled outputs. Electronically isolated with opto outputs from analog I/O and digital inputs.
11	+24V DC	–	Drive supplied power for digital inputs. Maximum output current is 100mA.
12	+10V DC	–	Drive supplied power for 0-10V external potentiometer. Maximum output current is 15mA.
13	0-10V In	Not Active	For external 0-10V input supply (input impedance = 100k ohm) or potentiometer wiper.
14	Analog Common	–	For 0-10V In or 4-20mA In. Electronically isolated with analog inputs from digital I/O.
15	4-20mA In	Not Active	For external 4-20mA input supply (input impedance = 250 ohm).
16	Analog Output	OutFreq 0-10	The default analog output is 0-10V. To convert to a current value, change the Analog output Select DIP Switch to 0-20mA. Program with A065 [Analog Out Sel]. Maximum analog value can be scaled with A066 [Analog Out High]. Maximum load: 0-20mA - 525 Ohm (10.5V) 0-10V = 1k ohm (10 mA)
17	Opto Output 1	MotorRunning	Program with A058 [Opto Out1 Sel]
18	Opto Output 2	At Frequency	Program with A061 [Opto Out2 Sel]
19	RS485 (DSI) Shield	–	Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port.

Specifications

Drive Ratings — PowerFlex 4

	Output Ratings		Input Ratings			Branch Circuit Protection			Power Dissipation
Catalog Number	**kW (HP)**	**Amps**	**Voltage Range**	**kVA**	**Amps**	**Fuses ❶**	**140M Motor Protectors ❷**	**Contactors**	**IP20 Open Watts**
100 - 120V AC – 1-Phase Input, 0 - 230V 3-Phase Output									
22A-V1P5N104	0.2 (0.25)	1.5	90-126	0.75	6.0	10	140M-xxE-C10	100-C09	25
22A-V2P3N104	0.4 (0.5)	2.3	90-126	1.15	9.0	15	140M-xxE-C16	100-C12	30
22A-V4P5N104	0.75 (1.0)	4.5	90-126	2.25	18.0	30	140M-xxE-C20	100-C23	50
22A-V6P0N104	1.1 (1.5)	6.0	90-126	3.00	24.0	40	140M-xxE-C32	100-C37	70
200 - 240V AC – 1-Phase ① Input, 0 - 230V 3-Phase Output									
22A-A1P5N104	0.2 (0.25)	1.5	180-265	0.75	5.0	10	140M-xxE-B63	100-C09	25
22A-A2P3N104	0.4 (0.5)	2.3	180-265	1.15	6.0	10	140M-xxE-B63	100-C09	30
22A-A4P5N104	0.75 (1.0)	4.5	180-265	2.25	10.0	15	140M-xxE-C16	100-C12	50
22A-A8P0N104	1.5 (2.0)	8.0	180-265	4.0	18.0	30	140M-xxE-C20	100-C23	80
200 - 240V AC – 3-Phase Input, 0 - 230V 3-Phase Output									
22A-B1P5N104	0.2 (0.25)	1.5	180-265	0.75	1.8	3	140M-xxE-B25	100-C09	25
22A-B2P3N104	0.4 (0.5)	2.3	180-265	1.15	2.5	6	140M-xxE-B40	100-C09	30
22A-B4P5N104	0.75 (1.0)	4.5	180-265	2.25	5.2	10	140M-xxE-C10	100-C09	50
22A-B8P0N104	1.5 (2.0)	8.0	180-265	4.0	9.5	15	140M-xxE-C16	100-C12	80
22A-B012N104	2.2 (3.0)	12.0	180-265	5.5	15.5	25	140M-xxE-C16	100-C16	115
22A-B017N104	3.7 (5.0)	17.5	180-265	8.6	21.0	35	140M-xxE-C25	100-C23	165
380 - 480V AC – 3-Phase Input, 0 - 460V 3-Phase Output									
22A-D1P4N104	0.4 (0.5)	1.4	340-528	1.4	1.8	3	140M-xxE-B25	100-C09	30
22A-D2P3N104	0.75 (1.0)	2.3	340-528	2.3	3.2	6	140M-xxE-B40	100-C09	40
22A-D4P0N104	1.5 (2.0)	4.0	340-528	4.0	5.7	10	140M-xxE-B63	100-C09	60
22A-D6P0N104	2.2 (3.0)	6.0	340-528	5.9	7.5	15	140M-xxE-C10	100-C09	90
22A-D8P7N104	3.7 (5.0)	8.7	340-528	8.6	9.0	15	140M-xxE-C16	100-C16	145

Drive Ratings — PowerFlex 40

	Output Ratings		Input Ratings			Branch Circuit Protection			Power Dissipation
Catalog Number	**kW (HP)**	**Amps**	**Voltage Range**	**kVA**	**Amps**	**Fuses ❶**	**140M Motor Protectors ❷**	**Contactors**	**IP20 Open Watts**
100 - 120V AC – 1-Phase Input, 0 - 230V 3-Phase Output									
22B-V2P3N104	0.4 (0.5)	2.3	90-126	1.15	9.0	15	140M-xxE-C16	100-C12	30
22B-V5P0N104	0.75 (1.0)	5.0	90-126	2.45	20.3	35	140M-xxE-C20	100-C23	56
22B-V6P0N104	1.1 (1.5)	6.0	90-126	3.0	24.0	40	140M-xxE-C32	100-C37	70
200 - 240V AC – 1-Phase Input, 0 - 230V 3-Phase Output ❸									
22B-A2P3N104	0.4 (0.5)	2.3	180-265	1.15	6.0	10	140M-xxE-B63	100-C09	30
22B-A5P0N104	0.75 (1.0)	5.0	180-265	2.45	12.0	20	140M-xxE-C16	100-C12	55
22B-A8P0N104	1.5 (2.0)	8.0	180-265	4.0	18.0	30	140M-xxE-C20	100-C23	80
22B-A012N104	2.2 (3.0)	12.0	180-265	5.5	25.0	40	140M-xxE-C32	100-C37	110
200 - 240V AC – 3-Phase Input, 0 - 230V 3-Phase Output									
22B-B2P3N104	0.4 (0.5)	2.3	180-265	1.15	2.5	6	140M-xxE-B40	100-C07	30
22B-B5P0N104	0.75 (1.0)	5.0	180-265	2.45	5.7	10	140M-xxE-C10	100-C09	55
22B-B8P0N104	1.5 (2.0)	8.0	180-265	4.0	9.5	15	140M-xxE-C16	100-C12	80
22B-B012N104	2.2 (3.0)	12.0	180-265	5.5	15.5	25	140M-xxE-C16	100-C23	115
22B-B017N104	3.7 (5.0)	17.5	180-265	8.6	21.0	35	140M-xxE-C25	100-C23	165
22B-B024N104	5.5 (7.5)	24.0	180-265	11.8	26.1	40	140M-xxE-C32	100-C37	226
22B-B033N104	7.5 (10.0)	33.0	180-265	16.3	34.6	60	140M-xxE-C45	100-C60	290
380 - 480V AC – 3-Phase Input, 0 - 460V 3-Phase Output									
22B-D1P4N104	0.4 (0.5)	1.4	340-528	1.4	1.8	3	140M-xxE-B25	100-C07	30
22B-D2P3N104	0.75 (1.0)	2.3	340-528	2.3	3.2	6	140M-xxE-B40	100-C07	40
22B-D4P0N104	1.5 (2.0)	4.0	340-528	4.0	5.7	10	140M-xxE-B63	100-C09	60
22B-D6P0N104	2.2 (3.0)	6.0	340-528	5.9	7.5	15	140M-xxE-C10	100-C09	90
22B-D010N104	4.0 (5.0)	10.5	340-528	10.3	13.0	20	140M-xxE-C16	100-C23	150
22B-D012N104	5.5 (7.5)	12.0	340-528	11.8	14.2	25	140M-xxE-C20	100-C23	160
22B-D017N104	7.5 (10.0)	17.0	340-528	16.8	18.4	30	140M-xxE-C20	100-C23	200

❶ Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.

❷ Refer to Bulletin 140M Motor Protectors Selection Guide, publication 140-SG001 to determine the frame and breaking capacity required for your application.

❸ 200-240V AC - 1-Phase drives are also available with an integral EMC filter. Catalog suffix changes from N104 to N114.

Shaded areas are applicable to PowerFlex 40 only.

Specifications

Input/Output Ratings

Output Frequency: 0-240 Hz (Programmable) | 0-400 Hz (Programmable)
Efficiency: 97.5% (Typical)

Approvals

UL508C
c UL CSA 22.2
EMC Directive 89/336
LV: EN 50178, EN 60204
EMC: EN 61800-3, EN 50081-1, EN 50082-2

Digital Control Inputs (Input Current = 6mA)

SRC (Source) Mode:	SNK (Sink) Mode:
18-24V = ON	0-6V = ON
0-6V = OFF	18-24V = OFF

Analog Control Inputs

4-20mA Analog: 250 ohm input impedance
0-10V DC Analog: 100k ohm input impedance
External Pot: 1-10k ohms, 2 Watt minimum

Control Output

Programmable Output (form C relay)
Resistive Rating: 3.0A at 30V DC, 3.0A at 125V AC, 3.0A at 240V AC
Inductive Rating: 0.5A at 30V DC, 0.5A at 125V AC, 0.5A at 240V AC

Opto Outputs	*Analog Output (10-bit)*
30V DC, 50 mA	*0-10V, 1k ohm Min.*
Non-inductive	*4-20 mA, 525 ohm Max.*

Fuses and Circuit Breakers

Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.

Recommended Circuit Breakers: HMCP circuit breaker or equivalent.

Protective Features

Motor Protection: I²t overload protection - 150% for 60 Secs, 200% for 3 Secs (Provides Class 10 protection)

Overcurrent: 200% hardware limit, 300% instantaneous fault

Over Voltage:
100-120V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 150V AC incoming line)
200-240V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 290V AC incoming line)
380-480V AC Input – Trip occurs at 810V DC bus voltage (equivalent to 575V AC incoming line)

Under Voltage:
100-120V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 75V AC incoming line)
200-240V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 150V AC incoming line)
380-480V AC Input – Trip occurs at 390V DC bus voltage (equivalent to 275V AC incoming line)

Control Ride Through: Minimum ride through is 0.5 Secs - typical value 2 Secs

Faultless Power Ride Through: 100 milliseconds

Dynamic Braking

Internal brake IGBT included with all ratings 0.75 kW (1 HP) and larger. Refer to page 10 for ordering information.

Environment

Altitude:	1000 m (3300 ft) max. without derating
Ambient Operating Temperature	
IP20:	–10 to 50 degrees C (14 to 122 degrees F)
NEMA 1:	–10 to 40 degrees C (14 to 104 degrees F)
Cooling Method Fan:	All drive ratings
Storage Temperature:	–40 to 85 degrees C (–40 to 185 degrees F)
Atmosphere:	**Important:** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
Relative Humidity:	0 to 95% non-condensing
Shock (operating):	15G peak for 11ms duration (±1.0ms)
Vibration (operating):	1G peak, 5 to 2000 Hz

Control

Carrier Frequency	2-16 kHz. Drive rating based on 4 kHz.
Frequency Accuracy	
Digital Input:	Within ±0.05% of set output frequency.
Analog Input:	Within 0.5% of maximum output frequency.
Analog Output:	±2% of full scale, 10-bit resolution
Speed Regulation - Open Loop with Slip Compensation:	±2% of base speed across a 40:1 speed range. 1% of base speed across a 60:1 speed range.
Stop Modes:	Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S Curve.
Accel/Decel:	Two independently programmable accel and decel times. Each time may be programmed from 0 - 600 seconds in 0.1 second increments.
Intermittent Overload:	150% Overload capability for up to 1 minute 200% Overload capability for up to 3 seconds
Electronic Motor Overload Protection	Class 10 protection with speed sensitive response.

Shaded areas are applicable to PowerFlex 40 only.

Parameter Descriptions

Parameter Number	Parameter Name	Description	Factory Default
Display Group			
d001	Output Freq	Output frequency present at T1, T2 & T3 (U, V & W)	Read Only
d002	Commanded Freq	Value of the active frequency command	Read Only
d003	Output Current	Output current present at T1, T2 & T3 (U, V & W)	Read Only
d004	Output Voltage	Output voltage present at T1, T2 & T3 (U, V & W)	Read Only
d005	DC Bus Voltage	Present DC bus voltage level	Read Only
d006	Drive Status	Present operating condition of the drive	Read Only
d007-d009	Fault x Code	A code that represents a drive fault	Read Only
d010	Process Display	The output frequency scaled by parameter A099 [Process Factor]	Read Only
d012	Control Source	Displays the source of the Start Command and Speed Reference	Read Only
d013	Contrl In Status	Status of the control terminal block control inputs	Read Only
d014	Dig In Status	Status of the control terminal block digital inputs	Read Only
d015	Comm Status	Status of the communications device	Read Only
d016	Control SW Ver	Main Control Board software version	Read Only
d017	Drive Type	Used by Rockwell Automation field service personnel	Read Only
d018	Elapsed Run Time	Accumulated time drive is outputting power	Read Only
d019	Testpoint Data	The present value of the function selected in parameter A102 [Testpoint Sel]	Read Only
d020	Analog In 0-10V	The present value of the voltage at I/O Terminal 13 (100.0% = 10 volts)	Read Only
d021	Analog In 4-20mA	The present value of the current at I/O Terminal 15 (0.0% = 4 mA, 100.0% = 20 mA)	Read Only
d022	Output Power	Output power present at T1, T2 & T3 (U, V & W)	Read Only
d023	Output Power Fctr	The angle in electrical degrees between motor voltage and motor current	Read Only
d024	Drive Temp	Present operating temperature of the drive power section	Read Only
d025	Counter Status	The current value of the counter when counter is enabled	Read Only
d026	Timer Status	The current value of the timer when timer is enabled	Read Only
d028	Stp Logic Status	When P038 [Speed Reference] is set to 6 "Stp Logic", this parameter will display the current step logic profile as defined by parameters A140-A147	Read Only
Basic Program Group			
P031	Motor NP Volts	20 to 240V for 120V and 240V drives, 20 to 460V for 460V drives	230 or 460
P032	Motor NP Hertz	10 to 240 Hz	60 Hz
		15 to 400 Hz	60 Hz
P033	Motor OL Current	0.0 Amps to (Drive Rated Amps x 2) in units of 0.1 Amps	Based on Drive Rating
P034	Minimum Freq	0.0 to 240.0 Hz	0.0 Hz
		0.0 to 400.0 Hz	0.0 Hz
P035	Maximum Freq	0.0 to 240.0 Hz	60.0 Hz
		0.0 to 400.0 Hz	60.0 Hz
P036	Start Source	6 settings; Keypad, 3-Wire, 2-Wire, 2-Wire Level Sensitive, 2-Wire High Speed, RS485 (DSI) Port	Keypad
P037	Stop Mode	8 settings; Ramp-Clear Fault, Coast-Clear Fault, DC Brake-Clear Fault, DC Brake w/Shutoff-Clear Fault, Ramp, Coast, DC Brake, DC Brake w/Shutoff	Ramp, CR (Clear Fault)
P038	Speed Reference	6 settings; Drive Potentiometer, Internal Freq, 0-10V Input/Remote Potentiometer, 4-20 mA Input, Preset Freq 0-3, RS485 (DSI) Port	Drive Pot
		7 settings; Drive Potentiometer, Internal Freq, 0-10V Input/Remote Potentiometer, 4-20 mA Input, Preset Freq 0-3, RS485 (DSI) Port, Step Logic	Drive Pot
P039	Accel Time 1	0.0 to 600.0 seconds	10.0 Secs
P040	Decel Time 1	0.1 to 600.0 seconds	10.0 Secs
P041	Reset To Defaults	Used to reset drive to factory default settings	Ready/Idle
Advanced Program Group			
A051 A052	Digital In1 Sel Digital In2 Sel	8 settings; Not Used, Accel 2 & Decel 2, Jog, Auxiliary Fault, Preset Frequencies, Local, RS485 (DSI) Port, Clear Fault	Preset Freq
		26 settings; Not Used, Accel 2 & Decel 2, Jog, Auxiliary Fault, Preset Frequencies, Local, RS485 (DSI) Port, Clear Fault, Ramp Stop - Clear Fault, Coast Stop - Clear Fault, DC Brake - Clear Fault, Jog Forward, Jog Reverse, 10V In Control, 20 mA In Control, PID Disable, MOP Up, MOP Down, Timer Start, Counter In, Reset Timer, Reset Counter, Reset Timer and Counter, Logic In1, Logic In2, Current Limit2	
A053	Digital In3 Sel	26 settings; Not Used, Accel 2 & Decel 2, Jog, Auxiliary Fault, Preset Frequencies, Local, RS485 (DSI) Port, Clear Fault, Ramp Stop - Clear Fault, Coast Stop - Clear Fault, DC Brake - Clear Fault, Jog Forward, Jog Reverse, 10V In Control, 20 mA In Control, PID Disable, MOP Up, MOP Down, Timer Start, Counter In, Reset Timer, Reset Counter, Reset Timer and Counter, Logic In1, Logic In2, Current Limit2	Local
A054	Digital In4 Sel		Jog Forward
A055	Relay Out Sel	10 different settings for a variety of drive status conditions	Ready (Not Faulted)
		21 different settings for a variety of drive status conditions	Ready/Fault

Parameter Descriptions

Parameter Number	Parameter Name	Description	Factory Default
A056	Relay Out Level	0.0 to 9999	0.0
A058	Opto Out1 Sel	21 settings; Ready/Fault, At Frequency, Motor Running, Reverse, Motor Overload, Ramp Regulator, Above Frequency, Above Current, Above DC Voltage, Retries Exceeded, Above Analog Voltage, Logic In1, Logic In2, Logic 1 & 2, Logic 1 or 2, Step Logic Out, Timer Out, Counter Out, Above PF Angle, Analog Input Loss, Param Control	MotorRunning
A059	Opto Out1 Level	0.0 to 9999	0.0
A061	Opto Out2 Sel	21 settings; Ready/Fault, At Frequency, Motor Running, Reverse, Motor Overload, Ramp Regulator, Above Frequency, Above Current, Above DC Voltage, Retries Exceeded, Above Analog Voltage, Logic In1, Logic In2, Logic 1 & 2, Logic 1 or 2, Step Logic Out, Timer Out, Counter Out, Above PF Angle, Analog Input Loss, Param Control	At Frequency
A062	Opto Out2 Level	0.0 to 9999	0.0
A064	Opto Out Logic	Determines the logic (NO or NC) of the opto outputs, 4 settings - NO/NO, NC/NO, NO/NC, NC/NC	NO/NO
A065	Analog Out Sel	Sets the analog output signal mode, various settings	Output Freq 0-10, 0V=0Hz
A066	Analog Out High	0 to 800%	100%
A067	Accel Time 2	0.0 to 600.0 seconds	20.0 Secs
A068	Decel Time 2	0.1 to 600.0 seconds	20.0 Secs
A069	Internal Freq	0.0 to 240.0 Hz	60.0 Hz
		0.0 to 400.0 Hz	60.0 Hz
A070	Preset Freq 0	0.0 to 240.0 Hz	0.0 Hz
A071	Preset Freq 1	0.0 to 240.0 Hz	5.0 Hz
A072	Preset Freq 2	0.0 to 240.0 Hz	10.0 Hz
A073	Preset Freq 3	0.0 to 240.0 Hz	20.0 Hz
A074	Preset Freq 4	0.0 to 400.0 Hz	30.0 Hz
A075	Preset Freq 5	0.0 to 400.0 Hz	40.0 Hz
A076	Preset Freq 6	0.0 to 400.0 Hz	50.0 Hz
A077	Preset Freq 7	0.0 to 400.0 Hz	60.0 Hz
A078	Jog Frequency	0.0 to (Value set in P035 [Maximum Freq]	10.0 Hz
A079	Jog Accel/Decel	0.1 to 600.0 seconds	10.0 Secs
A080	DC Brake Time	0.0 to 90.0 seconds	0.0 Secs
		0.0 to 99.0 seconds	0.0 Secs
A081	DC Brake Level	0.0 to (Drive Rated Amps x 1.8)	Drive Rated Amps x 0.05
A082	DB Resistor Sel	Used to set percent duty cycle for external dynamic braking	Disabled
A083	S Curve %	0 to 100%	0% (Disabled)
A084	Boost Select	14 boost settings (in % of P031 [Motor NP Volts]), redefines the Volts per Hertz curve	5.0 (2.5 for 5 HP drives)
		15 boost settings (in % of P031 [Motor NP Volts]), redefines the Volts per Hertz curve	5.0, CT (2.5 for 5, 7.5 and 10 HP drives)
A085	Start Boost	0.0 to 25.0%	2.5%
A086	Break Voltage	0.0 to 100.0%	25.0%
A087	Break Frequency	0.0 to 400.0 Hz	15.0 Hz
A088	Maximum Voltage	20 to Drive Rated Volts	Drive Rated Volts
A089	Current Limit 1	0.1 to (Drive Rated Volts x 1.8)	Drive Rated Amps x 1.5
A090	Motor OL Select	3 settings; No Derate, Minimum Derate, Maximum Derate	No Derate
A091	PWM Frequency	2.0 to 16.0 kHz	4.0 kHz
A092	Auto Rstrt Tries	0 to 9	0
A093	Auto Rstrt Delay	0.0 to 120.0 seconds	1.0 Secs
		0.0 to 300.0 seconds	1.0 Secs
A094	Start At PowerUp	2 settings; Disabled, Enabled	Disabled
A095	Reverse Disable	2 settings; Reverse Enabled, Reverse Disabled	Rev Enabled

Shaded areas are applicable to PowerFlex 40 only.

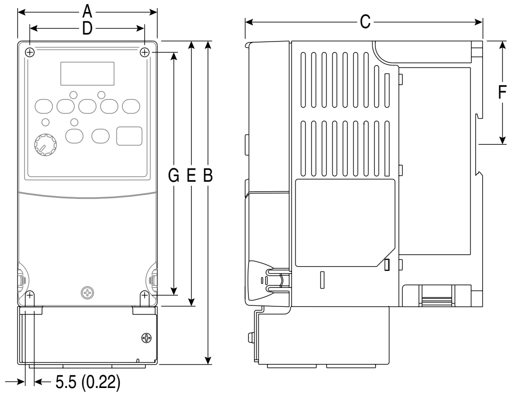
Parameter Descriptions

Parameter Number	Parameter Name	Description	Factory Default
Advanced Program Group, Continued			
A096	Flying Start En	2 settings; Disabled, Enabled	Disabled
A097	Compensation	4 settings; Disabled, Electrical, Mechanical, Both	Disabled
A098	SW Current Trip	Software instantaneous trip, 0.0 to (Drive Rated Amps x 2)	0.0 (Disabled)
A099	Process Factor	0.1 to 999.9	30.0
A100	Fault Clear	Resets a fault and clears the fault queue	Ready/Idle
A101	Program Lock	Protects parameters against change by unauthorized personnel	Unlocked
A102	Testpoint Sel	Used by Rockwell Automation field service personnel	400
A103	Comm Data Rate	6 settings; 1200, 2400, 4800, 9600, 19.2K, 38.4K	9600
A104	Comm Node Addr	1 to 247	100
A105	Comm Loss Action	4 settings; Fault, Coast to Stop, Stop, Continue Last Speed	Fault
A106	Comm Loss Time	0.1 to 60.0 seconds	5.0 Secs
A107	Comm Format	3 settings; RTU 8-N-1, RTU 8-E-1, RTU 8-O-1	RTU 8-N-1
A108	Language	11 settings; English, Francais, Espanol, Italiano, Deutsch, Reserved, Portugues, Reserved, Reserved, Nederlands	English
A110	Anlg In 0-10V Lo	0.0 to 100.0%	0.0%
A111	Anlg In 0-10V Hi	0.0 to 100.0%	100.0%
A112	Anlg In4-20mA Lo	0.0 to 100.0%	0.0%
A113	Anlg In4-20mA Hi	0.0 to 100.0%	100.0%
A114	Slip Hertz @ FLA	0.0 to 10.0 Hz	2.0 Hz
A118	Current Limit 2	0.0 to (Drive Rated Amps x 1.8)	Drive Rated Amps x 1.5
A119	Skip Frequency	0 to 400 Hz	0 Hz
A120	Skip Freq Band	0.0 to 30.0 Hz	0.0 Hz
A121	Stall Fault Time	6 settings; 60 Seconds, 120 Seconds, 240 Seconds, 360 Seconds, 480 Seconds, Flt Disabled	60 Seconds
A122	Analog In Loss	7 settings; Disabled, Fault (F29), Stop, Zero Ref, Min Freq Ref, Max Freq Ref, Int Freq Ref	Disabled
A123	10V Bipolar Enbl	2 settings; Uni-Polar In, Bi-Polar In	Uni-Polar In
A124	Var PWM Disable	2 settings; Enabled, Disabled	Enabled
A125	Torque Perf Mode	2 settings; V/Hz, Sensorless Vector	Sensrls Vect
A126	Motor NP FLA	0.1/(Drive Rated Amps x 2)	Drive Rated Amps
A127	Autotune	3 settings; Ready/Idle, Static Tune, Rotate Tune	Ready/Idle
A128	IR Voltage Drop	0.0 to 230.0 VAC	Based on Drive Rating
A129	Flux Current Ref	0.00 to Motor NP Volts	Based on Drive Rating
A130	PID Trim High	0.0 to 400.0	60.0
A131	PID Trim Low	0.0 to 400.0	0.1
A132	PID Reference Select	9 settings; PID Disabled, PID Setpoint, 0-10V Input, 4-20mA Input, Comm Port, Setpoint - Trim, 0-10V - Trim, 4-20mA - Trim, Comm - Trim	PID Disabled
A133	PID Feedback Select	3 settings; 0-10V Input, 4-20mA Input, Comm Port	0-10V Input
A134	PID Proportional Gain	0.00 to 99.99	0.01
A135	PID Integral Time	0.0 to 999.9 Seconds	0.1
A136	PID Differential Rate	0.00 to 99.99 (1/Secs)	0.01 (1/Secs)
A137	PID Setpoint	0.0 to 100.0%	0.0%
A138	PID Deadband	0.0 to 10.0%	0.0%
A139	PID Preload	0.0 to 400.0 Hz	0.0
A140-A147	Step Logic 0-7	0001 to 4990	00F1
A150-157	Step Logic Time 0-7	0.0 to 999.9 Seconds	30.0

Shaded areas are applicable to PowerFlex 40 only.

Dimensions

Approximate Dimensions



Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).

Frame	A	B ❶	C	D	E ❷	F	Shipping Weight
A	80 (3.15)	152 (5.98)	136 (5.35)	67 (2.64)	140 (5.51	59.3 (2.33)	1.4 (3.1)
B	100 (3.94)	180 (7.09)	136 (5.35)	87 (3.43)	168 (6.61)	87.4 (3.44)	2.2 (4.9)
C	130 (5.1)	260 (10.2)	180 (7.1)	116 (4.57)	246 (9.7)	–	4.3 (9.5)

❶ Overall height of drive with IP 30/NEMA 1/ UL Type 1 option kit installed.

❷ Overall height of standard IP 20/Open Type drive.

Ratings are in kW and (HP).

PowerFlex 4 — Frame	120V AC – 1-Phase	240V AC – 1-Phase	240V AC – 3-Phase	480V AC – 3-Phase
A	0.2 (0.25) 0.4(0.5)	0.2 (0.25) 0.4 (0.5) 0.75 (1.0)	0.2 (0.25) 0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)
B	0.75 (1.0) 1.1 (1.5)	1.5 (2.0)	2.2 (3.0) 3.7 (5.0)	2.2 (3.0) 3.7 (5.0)

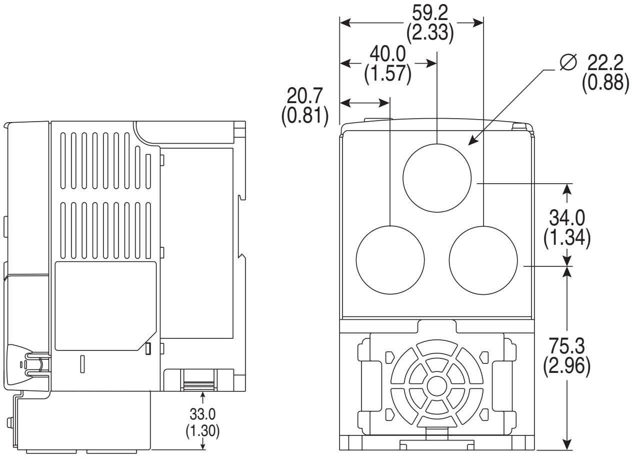
PowerFlex 40 — Frame	120V AC – 1-Phase	240V AC – 1-Phase	240V AC – 3-Phase	480V AC – 3-Phase
B	0.4 (0.5) 0.75 (1.0) 1.1 (1.5)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0) 2.2 (3.0) 3.7 (5.0)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0) 2.2 (3.0) 4.0 (5.0)
C		2.2 (3.0)	5.5 (7.5) 7.5 (10.0)	5.5 (7.5) 7.5 (10.0)

Shaded areas are applicable to PowerFlex 40 only.

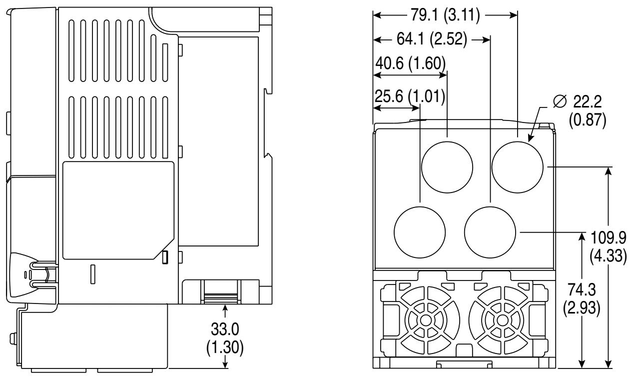
Dimensions

IP 30/NEMA Type 1/UL Type 1 Option Kit without Communication Options

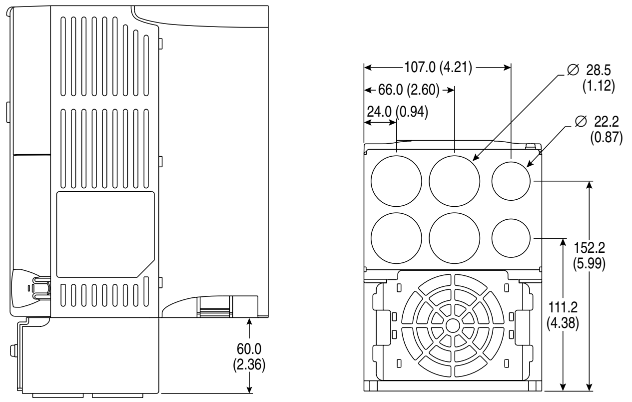
PowerFlex 4 uses Frames A & B. PowerFlex 40 uses Frames B & C.



Frame A — 22-JBAA

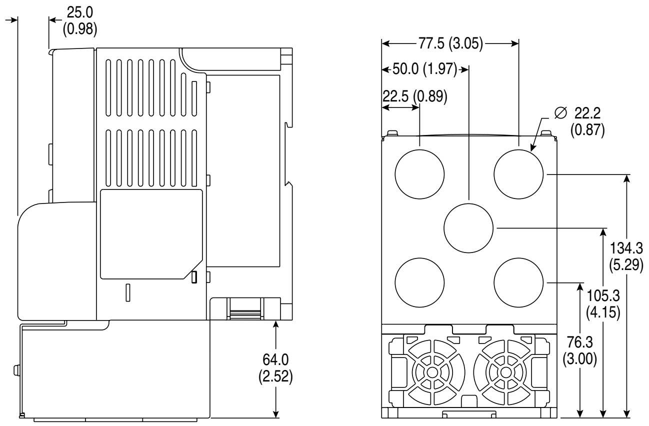


Frame B — 22-JBAB

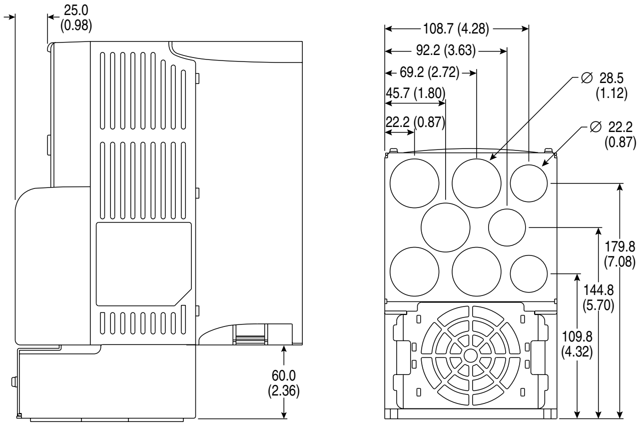


Frame C — 22-JBAC

PowerFlex 40 IP 30/NEMA 1/UL Type 1 Option Kit with Communication Option



Frame B — 22-JBCB



Frame C — 22-JBCC

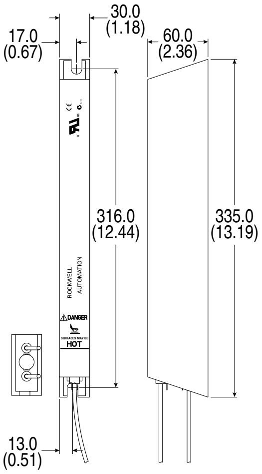
Shaded areas are applicable to PowerFlex 40 only.

Dimensions

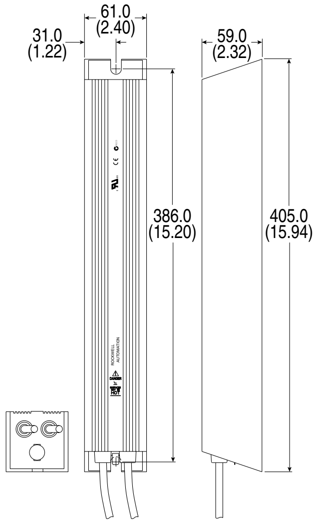
Dynamic Brake Resistors

Dimensions are in millimeters and (inches)

Frame A



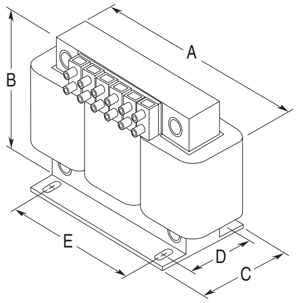
Frame B



Frame	Catalog Number
A	AK-R2-091P500, AK-R2-047P500, AK-R2-360P500
B	AK-R2-030P1K2, AK-R2-120P1K2

Bulletin 1321-3R Series Line Reactors

Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).

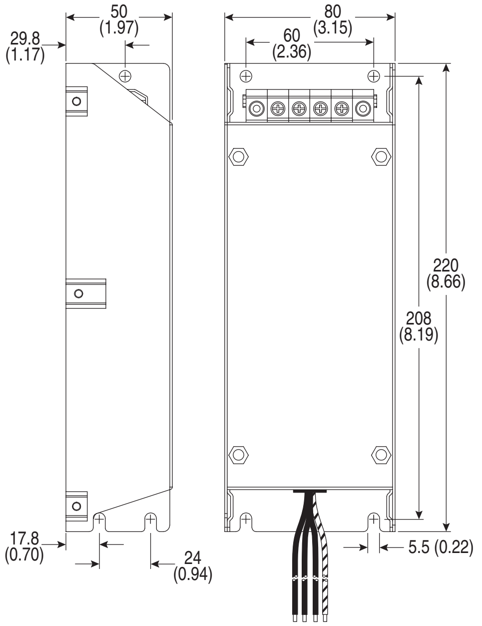


Catalog Number	A	B	C	D	E	Weight
1321-3R2-A	112 (4.40)	104 (4.10)	70 (2.75)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-B	112 (4.40)	104 (4.10)	70 (2.75)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-A	112 (4.40)	104 (4.10)	76 (3.00)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-B	112 (4.40)	104 (4.10)	76 (3.00)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-C	112 (4.40)	104 (4.10)	86 (3.38)	60 (2.35)	37 (1.44)	2.3 (5)
1321-3R8-A	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	3.1 (7)
1321-3R8-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	3.6 (8)
1321-3R8-C	152 (6.00)	127 (5.00)	85 (3.35)	63 (2.48)	51 (2.00)	4.9 (11)
1321-3R12-A	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R12-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.5 (10)
1321-3R18-A	152 (6.00)	133 (5.25)	79 (3.10)	54 (2.13)	51 (2.00)	4.1 (9)
1321-3R18-B	152 (6.00)	133 (5.25)	86 (3.40)	63 (2.48)	51 (2.00)	5.4 (12)
1321-3R25-A	183 (7.20)	146 (5.76)	85 (3.35)	60 (2.35)	76 (3.00)	4.9 (11)
1321-3R35-A	193 (7.60)	146 (5.76)	91 (3.60)	66 (2.60)	76 (3.00)	6.3 (14)

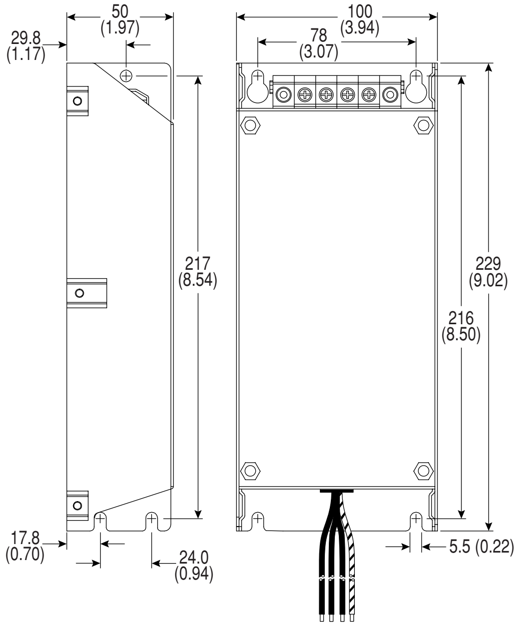
Dimensions

EMC Line Filters

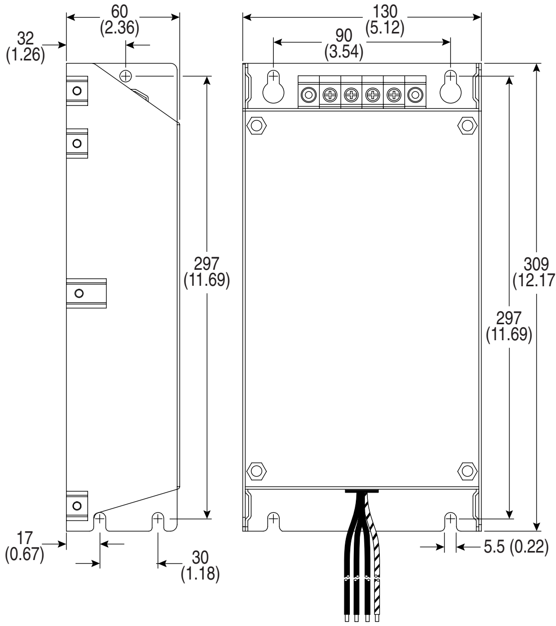
Frame A EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF5P7-AS, -AL; 22-RF9P5-AS, -AL; 22-RF010-AL



Frame B EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF012-BS, -BL; 22-RF018-BS; 22-RF021-BS, -BL



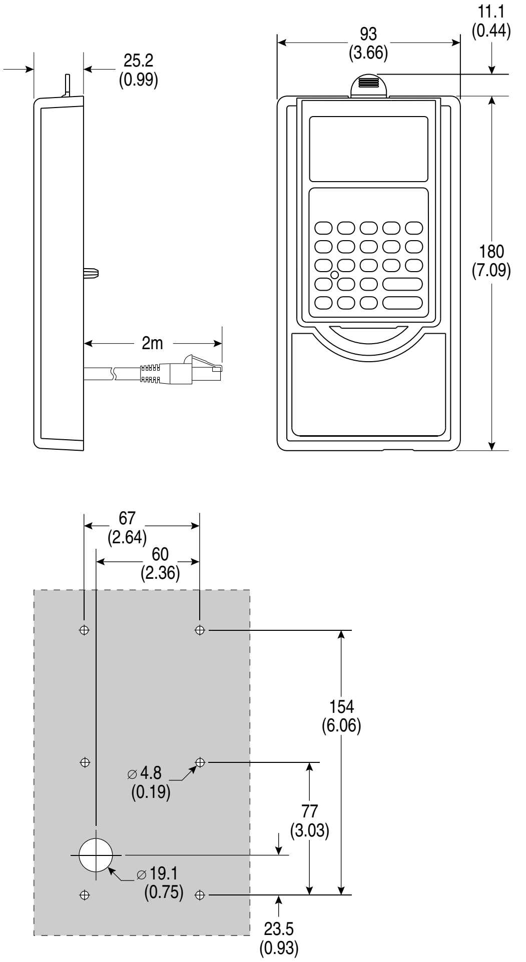
Frame C EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF018-CS, -CL; 22-RF021-BL; 22-RF025-CL; 22RF034-CS, -CL



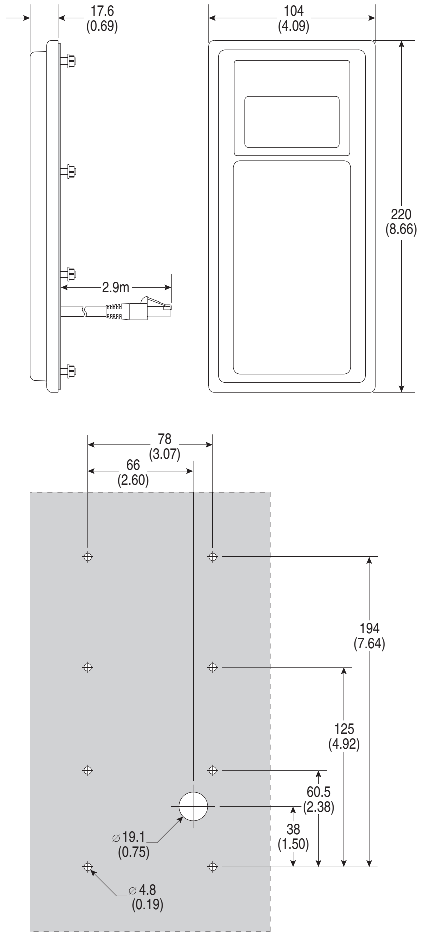
Dimensions

Human Interface Module (HIM) Dimensions

NEMA Type 1 Bezel – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-B1



Remote (Panel Mount) HIM – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-C2



Integrated Architecture

Superior Value-Added Services & Expertise

Global Supply & Local Capabilities

Complete Automation

World Class Products

™

The Allen-Bradley PowerFlex family of AC drives provides a single-source solution for virtually any drive application requirement ranging from 0.2 to 3,000 kW (0.25 to 4,000 hp). Significant commonality across multiple platforms including networks, operator interface, programming and hardware make PowerFlex drives easy to start up, operate and maintain. Multi-lingual programming, operator interface text and voltage-sensitive defaults in PowerFlex drives will help global OEMs and end-users save time and money during set-up, integration and maintenance of virtually any automation system.

Rockwell Automation supports drive users whenever and wherever needed, providing drive specialists and manufacturing expertise for unmatched service and support around the globe. In fact, one of every five Rockwell Automation employees is in the field with users every day. Rockwell Automation also offers a full spectrum of value-added services and expertise to help simplify maintenance and enhance productivity.

Rockwell Automation is committed to helping its customers meet ever-changing demands. PowerFlex drives illustrate our commitment to user productivity through timely delivery of world-class products and continued backward compatibility to minimize life-cycle costs. Count on Rockwell Automation to be your Complete Automation™ partner – now and in the future.

For further information on PowerFlex drives visit our web site at: **www.abpowerflex.com**

PowerFlex, Zero Stacking, DriveExplorer, DriveExecutive and Complete Automation are trademarks of Rockwell Automation.

DeviceNet is a trademark of the Open DeviceNet Vendor Association.

www.rockwellautomation.com

Corporate Headquarters
Rockwell Automation, 777 East Wisconsin Avenue, Suite 1400, Milwaukee, WI, 53202-5302 USA, Tel: (1) 414.212.5200, Fax: (1) 414.212.5201

Headquarters for Allen-Bradley Products, Rockwell Software Products and Global Manufacturing Solutions
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe: Rockwell Automation SA/NV, Vorstlaan/Boulevard du Souverain 36-BP 3A/B, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Headquarters for Dodge and Reliance Electric Products
Americas: Rockwell Automation, 6040 Ponders Court, Greenville, SC 29615-4617 USA, Tel: (1) 864.297.4800, Fax: (1) 864.281.2433
Europe: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 1774
Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 351 6723, Fax: (65) 355 1733

U.S. Allen-Bradley Drives Technical Support
Tel: (1) 262.512.8176, Fax: (1) 262.512.2222, Email: support@drives.ra.rockwell.com, Online: www.ab.com/support/abdrives

Publication 22-TD001A-EN-P — January 2003
Supersedes February 2002

800H-FRXTQH24RA1 ITEM # 51

30.5 mm Push Buttons

Type 4/4X/13, Corrosion-Resistant/Watertight/Oiltight

2-Position Push-Pull/Twist Release Units, Illuminated

Illuminated 2-Position Push-Pull/Twist
Cat. No. 800H-FRXTP16RA1

Type	Lamp	Volts	Color	Operator Position			Push-Pull/ Twist Release
					Maintained	Maintained	
				Contacts	Out	In	Cat. No.
Full Voltage	Incandescent	120 AC/DC	Red	N.O. - N.C.L.B. ❶	O X	X O	800H-FRXTQ10RA1 ❷
		24 AC/DC					800H-FRXTQ24RA1 ❷
	LED	120 AC/DC					800H-FRXTQH10RA1 ❷
		24 AC/DC					800H-FRXTQH24RA1 ❷
Transformer	Incandescent	120 AC	Red	N.O. - N.C.L.B. ❶	O X	O X O	800H-FRXTP16RA1 ❷
		240 AC					800H-FRXTP26RA1 ❷
	LED	120 AC					800H-FRXTPH16RA1 ❷
		240 AC					800H-FRXTPH26RA1 ❷

Note: X=Closed/O=Open

3-Position Push-Pull Units, Illuminated

Illuminated 3-Position Push-Pull
Cat. No. 800H-FRXMP16A7

Operator Position				Operator Position			
	Momentary	Maintained	Maintained		Momentary	Maintained	Momentary
Contacts	Out	Center	In	Contacts	Out	Center	In
N.C. - N.C.L.B. ❶	X X	O X	O O	N.C. - N.C.L.B. ❶	X X	O X	O O

Type	Lamp	Volts	Color	Push-Pull	Push-Pull
				Cat. No.	Cat. No.
Full Voltage	Incandescent	120 AC/DC	Red	800H-FRXMQ10RA7	800H-FRXNQ10RA7
		24 AC/DC		800H-FRXMQ24RA7	800H-FRXNQ24RA7
	LED	120 AC/DC		800H-FRXMQH10RA7	800H-FRXNQH10RA7
		24 AC/DC		800H-FRXMQH24RA7	800H-FRXNQH24RA7
Transformer	Incandescent	120 AC	Red	800H-FRXMP16RA7	800H-FRXNP16RA7
	LED			800H-FRXMPH16RA7	800H-FRXNPH16RA7

Note: X=Closed/O=Open

❶ Normally closed late break contact. When button is pushed from the OUT to IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.

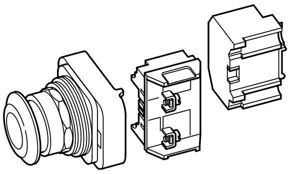
❷ Meets EN-418 and IEC 60947-5-5 standards for emergency stop applications.

Accessories — Page 10-85
Lamp Information — Page 10-95

Legend Plates — Page 10-96
Approximate Dimensions — Page 10-99

2-Position Push-Pull/Twist Release and 3-Position Push-Pull Units, Illuminated

800H		– FRX	M	PH	16	R	A1
	a	*b*	*c*	*d*	*e*	*f*	*g*



a

Finger-Safe Guards	
Code	**Description**
Blank	No Guards
C	Guards on Terminals

b

Head Type	
Code	**Description**
FRX	Mushroom Head
FRXJ	Jumbo Mushroom Head

c

Operator Function	
2-Position ❶	
Code	**Description**
T	Push-Pull/Twist

3-Position			
Code	**Operator Position**		
	Out	**Ctr.**	**In**
M	★	‡	‡
N	★	‡	★

★ Momentary ‡Maintained

d

Illumination Options	
Transformer	
Code	**Description**
P	Incandescent
PF	Flashing Incandescent ❷
PH	LED ❸

d (cont'd)

Illumination Options	
Full Voltage	
Code	**Description**
Q	Incandescent
QF	Flashing Incandescent ❷
QH	LED ❸
Resistor	
Code	**Description**
Q	Incandescent
Neon	
Code	**Description**
R	Neon ❹
Dual Input	
Code	**Description**
D	Diode Type ❺
DH	Diode Type LED ❸❺
DT	Transformer — Relay Type
DTH	Transformer — Relay Type LED ❸

e

Voltage	
Transformer	
Code	**Description**
36	48V AC 50/60 Hz
16	120V AC 50/60 Hz
26	240V AC 50/60 Hz
76	277V AC 50/60 Hz
46	480V AC 50/60 Hz
56	600V AC 50/60 Hz

e (cont'd)

Voltage	
Full Voltage	
Code	**Description**
06	6V AC/DC
12	12V AC/DC
24	24V AC/DC
32	32V AC/DC ❻
48	48V AC/DC
10	120V AC/DC ❼
13	130V AC/DC ❻
20	240V AC/DC ❻
Resistor	
Code	**Description**
11	120V AC/DC Resistor
Neon	
Code	**Description**
10	120V AC/DC
20	240V AC/DC
Dual Input	
Code	**Description**
16	120V AC
24	24V AC/DC ❽

f

Color Cap	
Code	**Color**
X	No Cap ❾
A	Amber
B	Blue
C	Clear
G	Green
R	Red
W	White

g

Contact Blocks	
Code	**Description**
Blank	No Contacts on operator
Standard	
D1	1 N.O.
D2	1 N.C.
D4	1 N.C.L.B.
A	1 N.O. - 1 N.C.
A1	1 N.O. - 1 N.C.L.B.
A2	2 N.O.
A5	2 N.C.L.B.
A7	1 N.C. - 1 N.C.L.B.
Pen*TUFF* (Low Voltage)	
D1V	1 N.O.
D2V	1 N.C.
D4V	1 N.C.L.B.
AV	1 N.O. - 1 N.C.
Class I, Div. 2/Zone 2	
Logic Reed	
D1R	1 N.O.
D2R	1 N.C.
AR	1 N.O. - 1 N.C.
A2R	2 N.O.
A4R	2 N.C.
Sealed Switch	
D1P	1 N.O.
D2P	1 N.C.
AP	1 N.O. - 1 N.C.
Stackable Sealed Switch	
D1Y	1 N.O.
D2Y	1 N.C.
A2Y	2 N.O.
A4Y	2 N.C.
AY	1 N.O. - 1 N.C.

Note: See Table 1 for Target description.

Table 1. Target Selection

2-Position			Contact Description	3-Position			
g Code	**Out**	**In**		**Out**	**Ctr.**	**In**	**g Code**
D1_	O	X	N.O.	—	—	—	—
D4_	X	O	N.C.L.B.	—	—	—	—
A/AV/AR/AP/AY	O X	X O	N.O. N.C.	O X	O O	X O	A/AV/AR/AP/AY
A1	O X	X O	N.O. N.C.L.B.	O X	O X	X O	A1
A2_	O O	X X	N.O. N.O.	O O	O O	X X	A2_
A5	X X	O O	N.C.L.B N.C.L.B	X X	X X	O O	A5
A4_	X X	O O	N.C. N.C.	— —	— —	— —	—
—	— —	— —	N.C. N.C.L.B.	X X	O X	O O	A7

Note: X=Closed/O=Open

❶ 2-position push-pull and push-pull/twist-to-release devices with N.C.L.B. contacts meet EN-418 and IEC 60947-5-5 standards for emergency stop applications.

❷ Flashing lamps are only available for 6V full voltage units and all Transformer units.

❸ LEDs available in red, green, amber, blue, and white. White LEDs only available in 6V and 24V full voltage and all transformer units. LED color must match lens color, except clear lens supplied with white LED and white lens supplied with amber LED. All LEDs except 120V have an internal shunt resistor for use with solid-state outputs.

❹ Neon is available in amber or clear.

❺ Diode type dual input provides circuit isolation via opposing diodes. Not recommended for use with solid-state outputs and neon indicators.

❻ 32V and 130V are LED only. 240V is incandescent only.

❼ 120V LED is AC only and does not contain internal shunt resistor. For AC/DC and internal shunt resistor, order 130V AC/DC LED (code 13).

❽ Dual input diode only.

❾ Not valid with head type **J**.

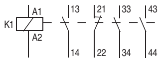
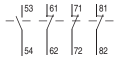
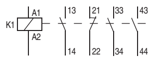
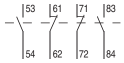
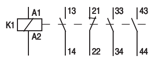
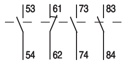
700S-CF620DC ITEM # 47

Bulletin 700S-CF

- IEC Industrial Safety Relay
- Positively Guided/Mechanically Linked Contacts as Per IEC 947-5-1 Annex L
- Third Party Certification By SUVA
- Red Cover and Mechanically Linked Contact Symbol on Front Face

Table Of Contents

Type CF Safety Control Relays — 8-Pole AC Voltage

AC-1			**AC-11 and AC-15**							**Connection Diagrams**		**Contacts**		**Catalog Number** ❶
*I*e [A]			*I*e [A]							**Main Contacts**	**Auxiliary Contacts**			
	40°C	**60°C**	**24/48V**	**120V**	**240V**	**400V**	**500V**	**600V**	**690V**			**N.O.**	**N.C.**	
Main Contacts	25	20	16	14	10	5	2.5	1.8	1			4	4	700S-CF440⊗C
												5	3	700S-CF530⊗C
Adder Deck Contacts	10	6	6	6	3	2	2	1.2	0.7			6	2	700S-CF620⊗C

❶ All Cat. Nos. are factory-stocked.

⊗ AC Voltage Suffix Code

Voltage	**12**	**24**	**32**	**36**	**42**	**48**	**100**	**100-110**	**110**	**120**	**127**	**200**	**200-220**	**208**	**208-240**	**220-230**
50 Hz	R	K	V	W	X	Y	KP	–	D	P	S	KG	–	–	–	F
60 Hz	Q	J	–	V	–	X	–	KP	–	D	–	–	KG	H	L	–
50/60 Hz	–	KJ	–	–	–	KY	KP	–	KD		–	KG	–	–	–	–

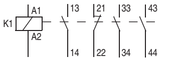
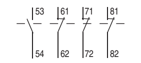
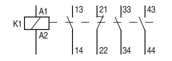
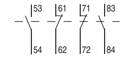
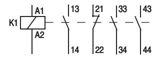
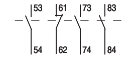
Voltage	**230**	**230-240**	**240**	**277**	**347**	**380**	**380-400**	**400**	**400-415**	**440**	**480**	**500**	**550**	**600**
50 Hz	–	VA	T	–	–	–	N	–	G	B	–	M	C	–
60 Hz	–	–	A	T	I	E	–	–	–	N	B	–	–	C
50/60 Hz	KF	–	KA	–	–	–	–	KN	–	KB	–	–	–	–

❶ All Cat. Nos. are factory-stocked.
❷ See page 198 for coil voltage selection information.

Product Selection, Continued

Ordering Details

Type CF Control Relays — 8-Pole DC Voltage

DC-1		DC-11 and DC-15							Connection Diagrams		Contacts		Catalog Number ❶ ❷
I_e [A]		I_e [A]							Main Contacts	Auxiliary Contacts			
40°C	60°C	24/48V	120V	240V	400V	500V	600V	690V			N.O.	N.C.	
25	20	16	14	10	5	2.5	1.8	1			4	4	**700S-CF440Z⊗C**
											5	3	**700S-CF530Z⊗C**
											6	2	**700S-CF620Z⊗C**

❶ All Cat. Nos. are factory-stocked.
❷ See page 198 for coil voltage selection information.

⊗ DC Voltage Suffix Code ❸

Voltage	9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Standard	**R**	**Q**	**J**	**W**	**Y**	**Z**	**B**	**G**	**E**	**D**	**P**	**S**	**A**	**F**	**T**
With diode suppressor å	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—

❸ When ordering **DJ** coil with built-in surge suppression, remove **Z** from the Cat. No. Example: Cat. No. 700S-CF440Z⊗C becomes Catalog Number 700S-CF440DJC

Accessories

Safety Control Relays with	mm.	(inches)
Auxiliary contact block for side mounting 1- or 2-pole	a + 9	(a + 23/64)
Electronic Timing Module on coil terminal side	b + 24	(b + 15/16)
Mechanical Interlock on side of contactor	a + 9	(a + 23/64)
Interface Module on coil terminal side	b + 9	(b + 23/64)
Surge Suppressor on coil terminal side	b + 3	(b + 1/8)
Labeling with label sheet marking tag sheet with clear cover marking tag adapter for System Bul. 1492W	+ 0 + 0 + 5.5	(+ 0) (+ 0) (+ 7/32)

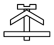
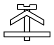
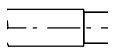
General

		Main Relay Cat. No. 700S-CF ❸	Front Adder Deck Contacts	Side-mounted Contacts
Contact Ratings — NEMA		A600, P600	A600, Q600	
Min. Contact Rating	Standard	20V, 10 mA		
	Gold	12V, 8 mA		
Contact Ratings — IEC AC-15 (solenoids, contactors) at rated voltage IEC 947, EN 60947	24V	16 A	6 A	6 A
	48V	16 A	6 A	6 A
	120V	14 A	6 A	6 A
	240V	10 A	5 A	3 A
	400V	5 A	3 A	2 A
	480V/500V	2.5 A	1.6 A	2 A
	600V	1.8 A	1.2 A	1.2 A
	690V	1 A	1.0 A	0.7 A
AC-12 (Control of resistive loads) IEC 60947	**40°C** I_{th}	25 A	10 A	
	230 V	10 kW		
	400 V	17 kW		
	690 V	30 kW		
	60°C I_{th}	20 A	6 A	
	230V	8 kW		
	400V	14 kW		
	690V	24 kW		
DC-12 Switching DC Loads				
L/R < 1ms, Resistive Loads	24V	12 A	12 A	
IEC 60947	48V	9 A	9 A	
	110V	3.5 A	3.5 A	
	220V	0.55 A	0.55 A	
	440V	0.2 A	0.2 A	
DC-13 IEC 60947, Solenoids and contactors	24V	5 A	5 A	3 A
	48V	2 A	2 A	1.5 A
	125V	0.7 A	0.7 A	0.6 A
	220V	0.25 A	0.25 A	0.3 A
	440V	0.12 A	0.12 A	0.2 A
	660V	0.14 A	0.1 A	0.1 A
		Yes	Yes ❶	

	Location of welded N.O. contacts	State of N.C. Contacts if N.O. contact welds			
		Main	Front aux.	Left side aux.	Right side aux.
Positively Guided Contacts ❷	Main	Open	Open ❶	Open	Open
	Front aux.	Open	Open ❶	Open	Open
	Left side aux.	Open	Open ❶	Open	Open
	Right side aux.	Open	Open ❶	Open	Open

❶ If the accessory is a pneumatic timer or latch, there is no positive guidance; the accessory contacts are independent.

❷ Defined in IEC 947-5-1 annex L. Positive guidance is a relationship between contacts of opposite types (i.e., N.O. and N.C.).

			Cat. No. 700S-CF	Aux./Pneumatic Timer Contact (Front-mounted)
Mechanical Life		[Mil]	15	15
Electrical Life	AC-15 (240V, 3 A)	[Mil]	1.5	1.5
Weight	AC Op. Mechanism	[g]	390	—
Terminal Cross-Sections				
Terminal Type				
Terminal Size per IEC 947-1			2 x A4	2 x A4
 Solid/Stranded ❸	1 Conductor	[mm²]	1.5…6	0.5…2.5
	2 Conductor	[mm²]	1.5…6	0.75…2.5
Max. Wire Size per UL/CSA		[AWG]	16…10	18…14
Tightening Torque		[lb.-in.]	8.9…22	8.9…13.3
Tightening Torque		[N•m]	1…2.5	1…1.5

❸ For 16 or more strands, end ferrule is required

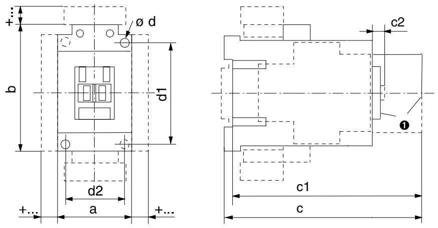
DC Switching Ratings for 700S-CF Main Poles in Series (Resistive Load at 60° C)

	1 pole	2 poles	3 poles
24/48 V	25/20 A	25 A	25 A
125 V	6 A	25 A	25 A
220 V	1.5 A	8 A	25 A
440 V	0.4 A	1 A	3 A

Industrial Relays

Approximate Dimensions

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended for manufacturing purposes.



AC Safety Control Relays

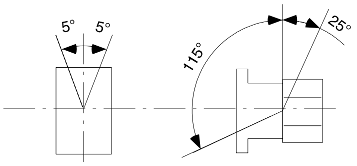
a	b	c	c1	c2	Ød	d1	d2	Cat. No.
45 (1-25/32)	81 (3-3/16)	119.5 (4-3/4)	114.5 (4-43/64)	6 (1/4)	2 - 4.5 (2 - 3/16)	60 (2-23/64)	35 (1-25/64)	**700S-CF**

DC Safety Control Relays

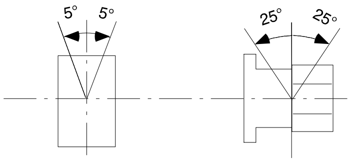
a	b	c	c1	c2	Ød	d1	d2	Cat. No.
45 (1-25/32)	81 (3-3/16)	145.5 (5-49/64)	140.5 (5-37/64)	6 (1/4)	2 - 4.5 (2 -3/16)	60 (2-23/64)	35 (1-25/64)	**700S-CF**

Mounting Positions

Mounting Position



AC Safety Control Relays



DC Safety Control Relays

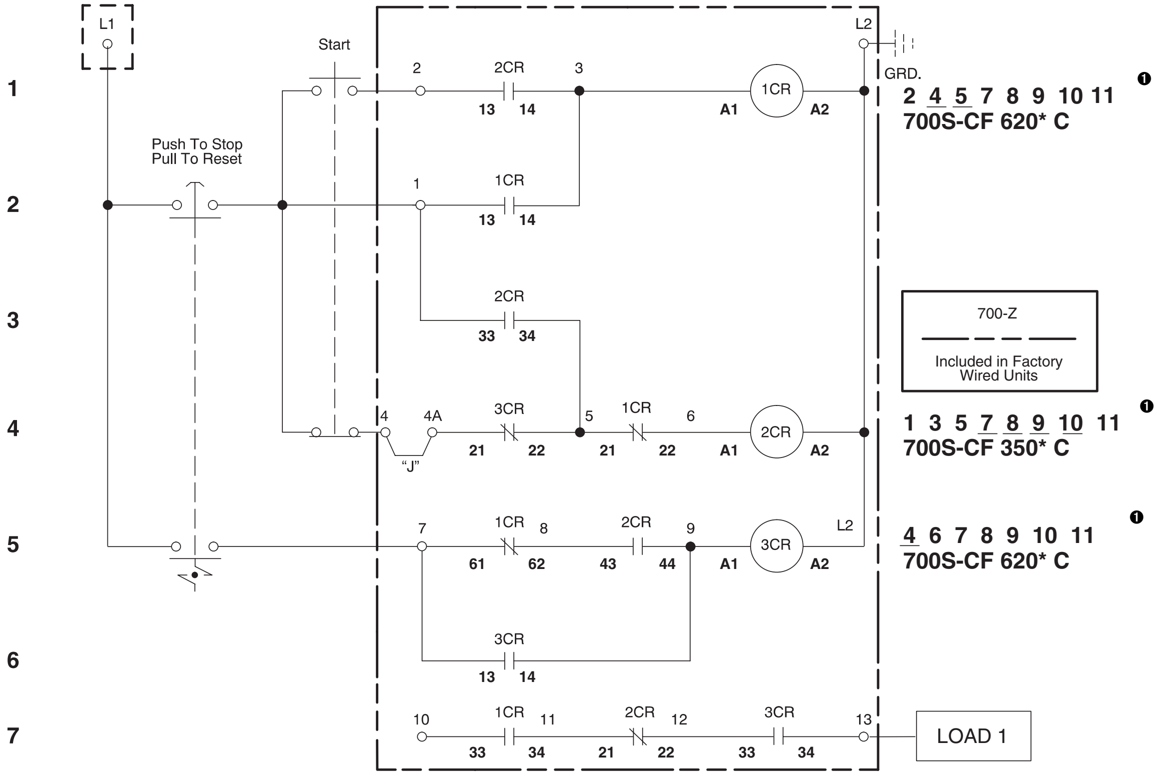
Safety Relay Circuit With 5 Safety Outputs

- Use for E-stop control. E-stop will work properly if any one fault occurs (a fault could be one welded contact or one undesired open connection such as a loose wire).
- High output switching capability and long contact life.
- Circuit complies with EN 954 categories 1, 2, 3, 4
- Prevents restart of the 5 safety outputs if there is a single fault anywhere in the system.

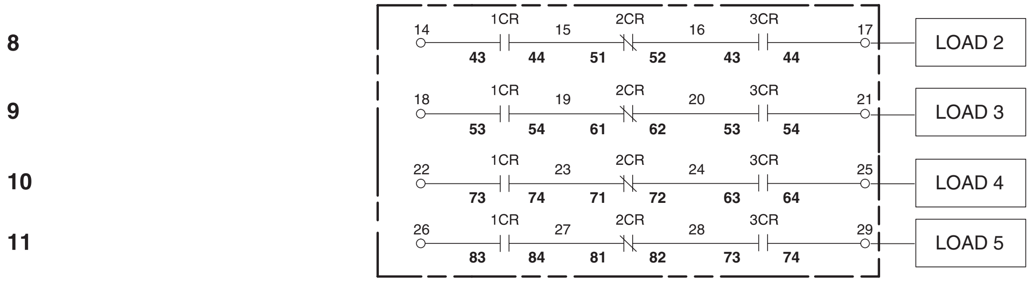
Use (3) 700S-CF relays and this diagram to construct the circuit, or contact your local Allen Bradley sales office for pre-assembled module

Basic Circuit

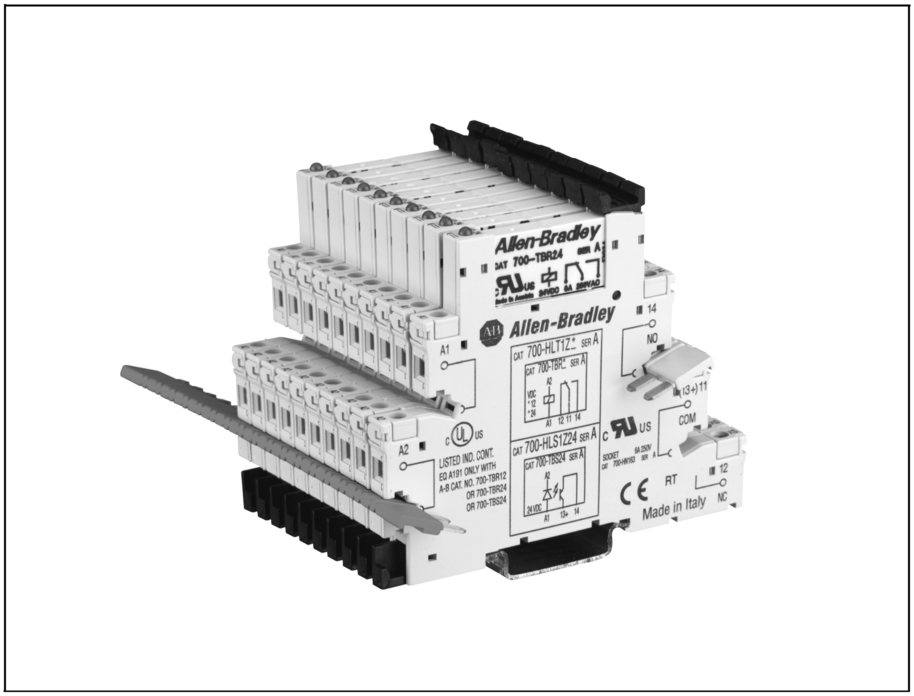
(1) Output Circuit (3 Relays, 9 Terminal Blocks)



(5) Output Circuit (3 Relays, 17 Terminal Blocks)



❶ Numbers shown are the line numbers where the contacts for this relay appear.



Bulletin 700-HL

- **Relay and Socket Assembled Interface**
- **SPDT – 6 A Output**
- **1 N.O. SSR Output**
- **Externally Replaceable Relay**
- **Built-in Retainer Clip**
- **Standard LED**
- **Ideal for PLC and Drives Applications**

TABLE OF CONTENTS

Description

The Bulletin 700-HL General Purpose Interface Relays feature a fully assembled relay (electro-mechanical or solid-state) and socket. The SPDT version is capable of 6 A per pole. The 1 N.O. solid-state relay has a 2 A rating. The SPDT relay feature AgSnO contacts. All 700-HL assembled devices are UL listed. Coils are available in a variety of AC and DC voltages.

Your order must include:

- Cat. No. of the assembled relay.
- If required, Cat. No. of any accessories.

Conformity to Standards:

EN60947-4-1
EN60947-5-1
IEC 947
CSA 22.2
UL 508
NEMA IEE MAC Compliant
ICS-2 Compliant

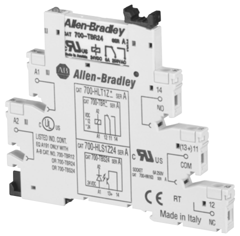
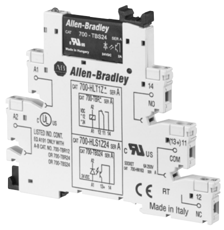
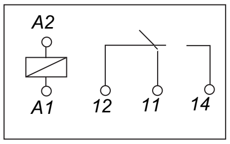
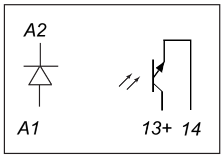
Approvals:

cURus Recognized, File E3125
Guide NLDX 2
cULus Listed, with Allen-Bradley socket
CE Marked (per EU Low Voltage
Directive 73/23 EEC 93/68 EEC)
ABS (American Bureau of Shipping)

Bulletin 700-HL

Interposing/Isolation Relays

Product Selection

Standard built-in Features: • LED • Reverse Polarity Protection for DC Inputs • Surge Protection	 Cat. No. 700-HLT1Z24			 Cat. No. 700-HLS1Z24		
Specifications				 ❶		
Output Type	SPDT (1 C/O); I_{th} = 6A			1 N.O. solid-state; I_{th} = 2 A		
Recommended Tightening Torque	0.5 Nm max. (4.4 lb.–in.)			0.5 Nm max (4.4 lb.–in.)		
Wire Range	0.14 mm^2…2.5 mm^2 (#26…#14 AWG)			0.14 mm^2…2.5 mm^2 (#26…#14 AWG)		
Approvals	cULus, cURus, ABS, CE			cULus, cURus, ABS, CE		
Assembled Devices	Cat. No.	Pkg Qty.	Factory-stocked Item	Cat. No.	Pkg Qty.	Factory-stocked Item
Input Voltages:						
12V DC	700-HLT1Z12 ❷	10	✔	—	–	
24V DC	700-HLT1Z24 ❷	10	✔	700-HLS1Z24 ❷	10	✔
48V DC	700-HLT12Z48 ❷	10		700-HLS1Z48 ❷	10	
12V AC/DC	700-HLT1U12	10		—	—	
24V AC/DC	700-HLT1U24	10	✔	—	10	
48V AC/DC	700-HLT1U48	10		—	10	
110/125V AC/DC	700-HLT1U1	10	✔	700-HLS1U1 ❷	10	✔
220-240V AC/DC	700-HLT1U2	10	✔	700-HLS1U2 ❷	10	
Built-in LCSC (leakage current suppression circuit) 120V AC and 125V DC	700-HLT1L1 ❷ (Available in November 2001)	10		700-HLS1L1 ❷ (Available in November 2001)	10	
Built-in LCSC (leakage current suppression circuit) 240V AC	700-HLT1L2 ❷ (Available in November 2001)	10		700-HLS1L2 ❷ (Available in November 2001)	10	

❶ Reverse polarity on the output terminals of the solid-state relay will result in the output being "ON" regardless of the state of the input voltage.

❷ Electromechanical relay to solid-state relay interchangeability possible.

Bulletin 700-HL

Interposing/Isolation Relays

Specifications ❶

Cat. No. 700-HLT… (Relay Output)			
Electrical Ratings			
Rated Thermal Current (I_{th})	1-Pole — 6 A		
Rated Insulation Voltage (U_i)	250V IEC, 300V UL/CSA		
Contacts	Inductive	1-Pole	
	24V AC, 1-phase	30 A ►][◄	5 A ◄][►
	120V AC, 1-phase	30 A	3 A
	240V AC, 1-phase	15 A	1.5 A
	Make, Break, & Continuous V DC	24V DC	1.0 A
		120V DC	0.2 A
		240V DC	0.1 A
Min. Permissible Contact Ratings	12V, 6 mA (72 mW)		
Permissible Coil Voltage Variation	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC		
Power Consumption ±10%	AC	0.3 VA	
	DC	0.2 W	
Design Specification/Test Requirements			
Dielectric Withstand Voltage	Pole to Pole (VRMS)	1500 VA	
	Contact to Coil (VRMS)	4000 VA	
Mechanical			
Degree of Protection	IP20		
Mechanical Life Operations	1 x 10^7		
Switching Frequency Operations (no-load)	10 cycles/sec		
Coil Voltages	See Product Selection		
Operating Time at Nominal Voltage at 20°C (ms)	Pickup	7 ms	
	Dropout	3 ms	
Maximum Operating Rate (full load = 6 A)	6 cycles/min.		
Environmental			
Temperature	Operating	–40…+55°C	
	Storage	-40…100°C	
Altitude	2000 m (6560 ft)		
Construction			
Insulating Material	Molded High Dielectric Material		
Enclosure	Relay IP67		
Contact Material	Silver Cad. Ox., AgSnO		
Terminal Markings on Socket	In accordance with EN50 0005		
Certifications	cULus, cURus, ABS, CE		

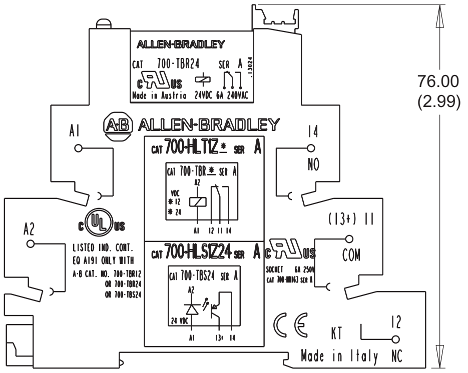
❶ Performance Data – See page Important-2, publication A113.

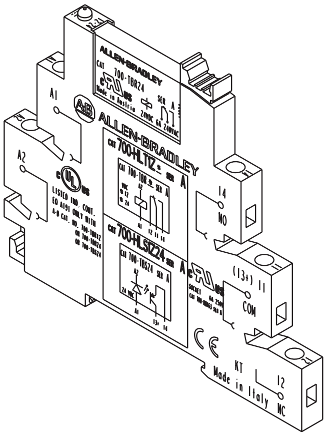
Bulletin 700-HL

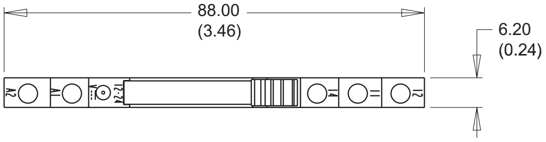
Interposing/Isolation Relays

Approximate Dimensions

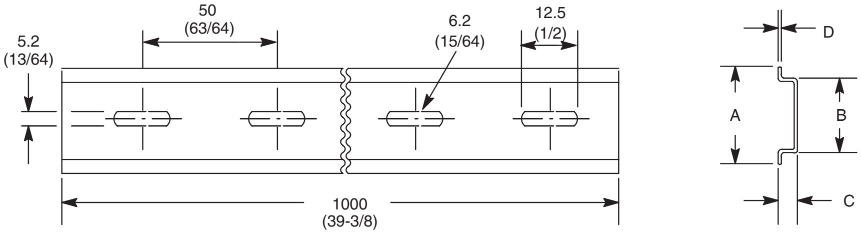
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.







Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.



Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes

Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lbs.) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lbs.) (5/pkg)

440E-L13141
440E-A13083

ITEM # 76 & 78

Cable (Rope) Pull Switches

Lifeline Rope Tensioner System (LRTS)

Description

The LRTS is a unique cable (rope) tensioning system which enables quicker installation of cable actuated systems. Other methods are traditionally time consuming and sometimes awkward to fit. Features of the system include:

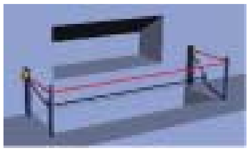
1. Cable adjustment up to 300mm (11.8in) (150mm (5.9in) either side of tensioner)
2. Quick thread and grip of cable with cable grip
3. Cable tidy incorporated into the cable grips
4. Simple tensioning via the setting bolt with allen key.

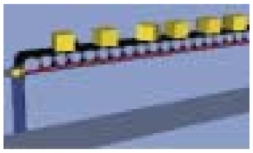
Due to the appeal of quick installation and universal use, the LRTS can also be used for applications other than cable actuated emergency stop systems.

Features

- Unique cable grip system
- Can be installed and commissioned in approximately 3 minutes
- Ease of installation, no specialist tools required
- Up to 300mm (11.8in) of cable adjustment
- Cable tidy incorporated into cable grips

Typical Applications



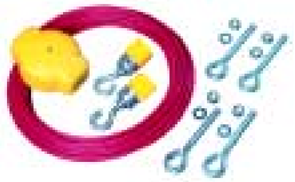


Specifications

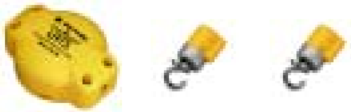
Material	
Tensioner	Glass filled nylon
Cable gripper	Acetal, aluminium alloy, stainless steel
Cable gripper gears	Stainless steel
Cable	Cable to BS 302:1987, wire Ø4.0
P. Bolt	Stainless steel
Colour	
Tensioner	Yellow
Cable gripper	Yellow/natural
Cable	Red
P. Bolt	Natural
Weight	
Tensioner	140g (0.31lb)
Cable gripper	80g (0.17lb)
Operating Temperature	-25°C to +80°C (13°F to 176°F)
Cable Diameter	4mm (0.15in)
Max. Cable Adjustment	300mm (11.8in)
Tensioner Holding Force	500N (112.5lb) max.
Gripper Holding Force	280N (63.0lb) max.
Protection	IP 30
Tensioner Adjustment	5mm A/F Allen key

Four Steps to Install

Product Selection

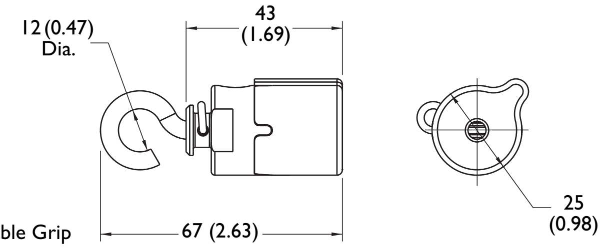
Description		Catalogue Number
	Installation kit—5m	**440E-A13079**
	Installation kit—10m	**440E-A13080**
	Installation kit—15m	**440E-A13081**
	Installation kit—20m	**440E-A13082**
	Installation kit—30m	**440E-A13083**
	Installation kit—50m	**440E-A13084**
	Installation kit—75m	**440E-A13085**

Accessories

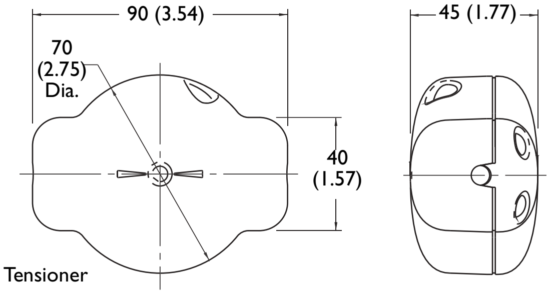
Description		Catalogue Number
	Tensioner and Allen wrench only	**440E-A17105**
	Gripper 2 pack	**440E-A17107**
	Gripper 20 pack	**440E-A17106**
	Tensioner, 2 Grippers and Allen wrench	**440E-A17112**
	2 Tensioners, 2 Grippers and Allen wrench	**440E-A17140**
Red Cable	15m	**440E-A17026**
	30m	**440E-A17027**
	100m	**440E-A17028**
	125m	**440E-A17129**
	300m	**440E-A17095**
	500m	**440E-A17032**

Approximate Dimensions—mm (inches)

Dimensions are not intended to be used for installation purposes.



Cable Grip



Tensioner

Cable (Rope) Pull Switches

Lifeline 4

BIA 974020

Description

The Lifeline 4 cable/push button operated system can be installed along or around awkward machinery such as conveyors and provide a constant emergency stop access.

The Lifeline 4 is the only device of its kind to incorporate the following features in one unit making it the most versatile cable switch on the market.

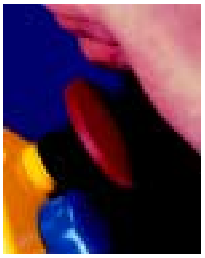
1. The positive mode mechanism ensures that the contacts are immediately latched open on actuation and can only be reset by the intentional action of turning the blue reset knob. The design also protects against nuisance tripping and the effects of thermal expansion.
2. A mushroom head emergency stop button is included on the unit to provide E-Stop access even at the extreme ends of the span.
3. The cable status indicator makes the system easy to set up and maintain for spans up to 125 meters.
4. Four sets of contacts are provided: 2 N.C. + 2 N.O., 3 N.C. + 1 N.O., or 4 N.C. contacts.
5. Sealed to IP 66 with rugged construction using die cast alloy and stainless steel to withstand harsh conditions.

Features

- Switches up to 125 meter span
- Universal mounting and operation
- Lid mounted emergency stop button, designed to conform to EN418
- Switch lockout on cable pulled and cable slack
- Cable status indicator on switch lid

Lid mounted E-Stop button

A mushroom head emergency stop button is included on the unit to provide total E-Stop access even at the extreme ends of the span.



Cable status indicator on lid

The cable status indicator makes the system easy to setup and maintain for spans up to 125 meters.

Specifications

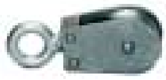
Standards	EN60947-5-5, ISO13850, ISOTR 12100, IEC 60947-5-1, EN 418
Approvals	CE marked for all applicable directive, cULus and BG
Safety Contact	2 N.C. or 3 N.C. or 4 N.C. direct opening action
Designation/Utilization Cat. A600/AC-15 (Ue) (Ie) N600/DC-13 (Ue) (Ie)	 600V 500V 240V 120V 1.2A 1.4A 3A 6A 600V 500V 250V 125V 0.4A 0.55A 1.1A 2.2A
Thermal Current (Ith)	10A
Minimum Current	5V 5mA
Safety Contact Gap	>2 x 2mm (0.078in)
Rtd. Insulation Voltage	(Ui) 500V
Rtd. Impulse withstand Voltage	(Uimp) 2500V
Pollution Degree	3
Max. Actuation Frequency	1 Cycle per sec
Case Material	Heavy duty die cast alloy
Eye Nut Material	Stainless Steel
Emergency Stop & Indicator Material	Acetal
Protection	IP66
Conduit Entry	3 x M20, 3 x 1/2in NPT, quick-disconnect style
Operating Temperature	-25°C to 80°C (-13°F to 176°F)
Operation Force	<125N (300mm deflection; 28.1lb deflection)
Max Cable Span Between Switches	75m (246ft) standard model 75m to 125m extended length model
Fixing	4 x M5
Mounting	Any position
Mechanical Life	1,000,000
Weight	630g (1.38lb)
Colour	Yellow body, Red E-Stop button, Blue reset button

Important: It is recommended that the LRTS (Lifeline Rope Tensioning System) should be used with the Lifeline 4 cable rope switch.

Product Selection

Cable Span	Safety Contacts	Auxiliary Contacts	Catalogue Number		
			1/2in NPT Conduit	M20 Conduit	Quick Disconnect
Up to 75m	2 N.C.	2 N.O.	**440E-L13133**	**440E-L13137**	**440E-L13140**
	3 N.C.	1 N.O.	**440E-L13043**	**440E-L13042**	**440E-L13141**
	4 N.C.	—	**440E-L13135**	**440E-L13139**	**440E-L13142**
75 to 125m	2 N.C.	2 N.O.	**440E-L13155**	**440E-L13153**	**440E-L13163**
	3 N.C.	1 N.O.	**440E-L13152**	**440E-L13150**	**440E-L13164**
	4 N.C.	—	**440E-L13149**	**440E-L13147**	**440E-L13165**
	Recommended Standard Cable Connector/Cordset (2m (6.5ft) (see page 15-13).				**889M-F12X9AE-2**

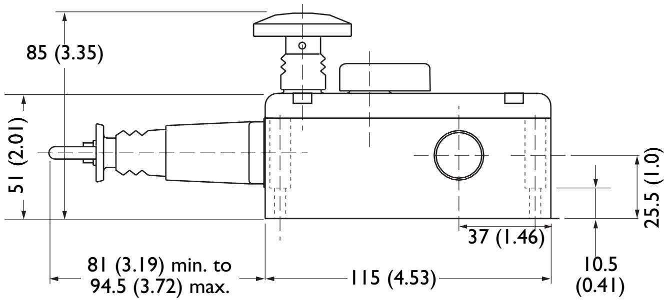
Accessories

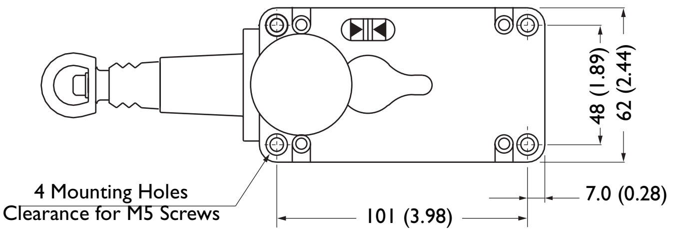
	Description	Catalogue Number
	P. Bolt complete M8 x 1.25 Thread Size 58mm (2.28in) Threaded Length 12mm (0.47in) Dia. Eye 95mm (3.74in) Overall Length	**440E-A17003**
	Tensioner spring 19mm (0.75in) Diameter 210mm (8.27in) Overall Length 50N Force	**440E-A13078**
	Replacement cover	**440E-A13054**
	Replacement cover no E-Stop	**440E-A17115**
	Inside corner pulley	**440A-A17101**
	Outside corner pulley	**440A-A17102**
	Mounting Bracket	**440E-A17130**

Approximate Dimensions—mm (inches)

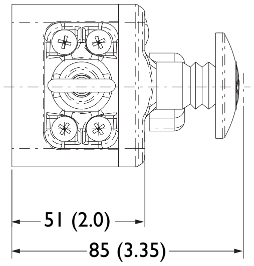
Dimensions are not intended to be used for installation purposes.

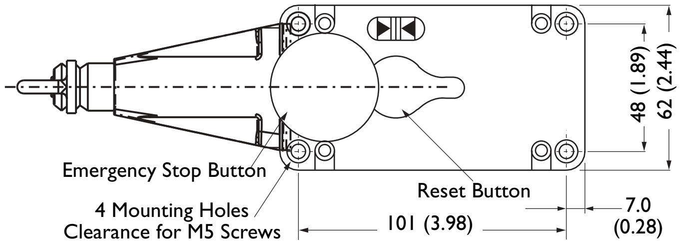
Standard Model

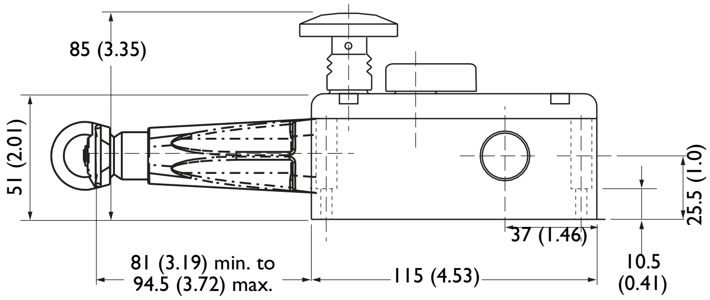




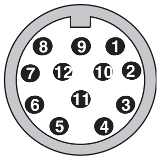
Extended Length Models (75 to 125m cable span)







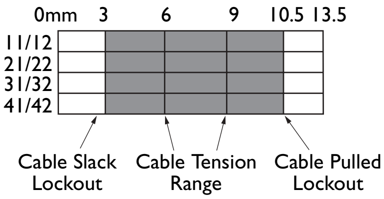
Typical Wiring Diagrams

Connector Pinout		4 N.C.		3 N.C. + 1 N.O.		2 N.C. + 2 N.O.	
		Terminal	Contact	Terminal	Contact	Terminal	Contact
	1	11	N.C.	11	N.C.	11	N.C.
	3	12		12		12	
	4	21	N.C.	21	N.C.	21	N.C.
	6	22		22		22	
	7	31	N.C.	31	N.C.	33	N.O.
	8	32		32		34	
	9	41	N.C.	43	N.O.	43	N.O.
	10	42		44		44	
	12	Ground					

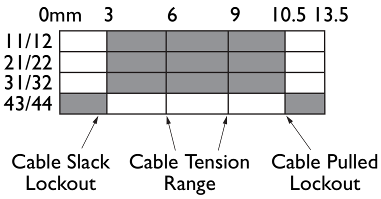
Contact Action

☐ Contact Open ▨ Contact Closed

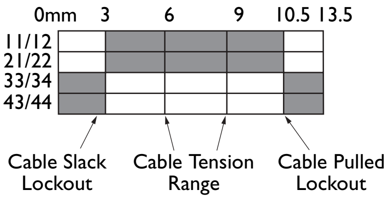
4 N.C. style



3 N.C. + 1 N.O. style

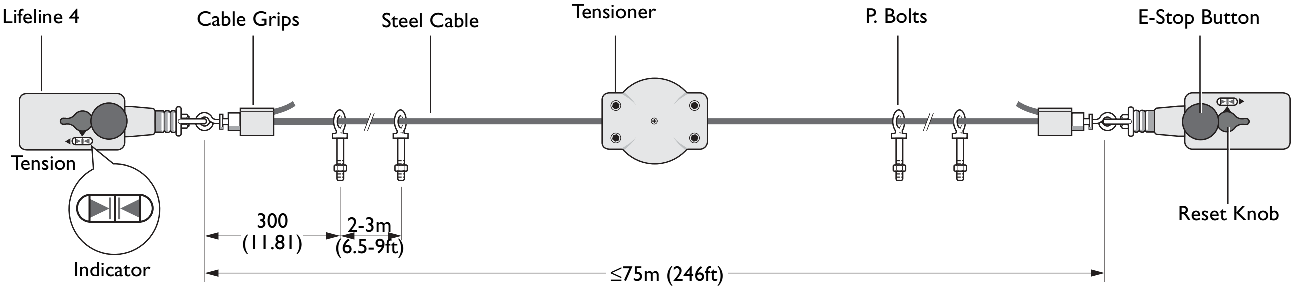


2 N.C. + 2 N.O. style

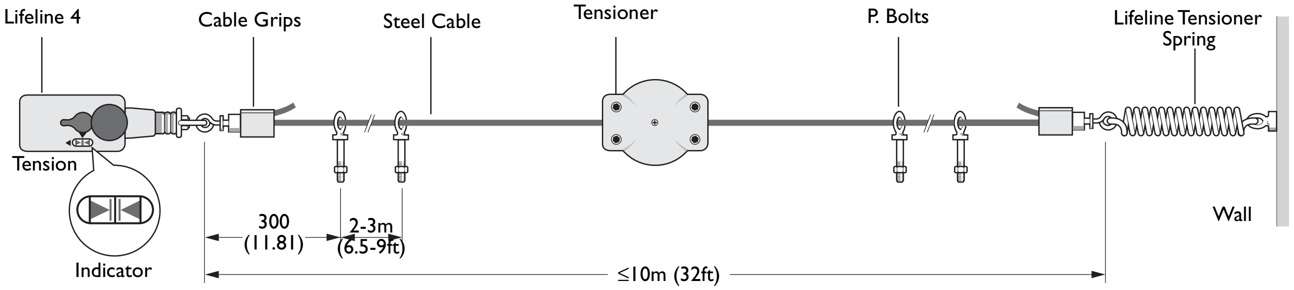


Application Detail—mm (inches)

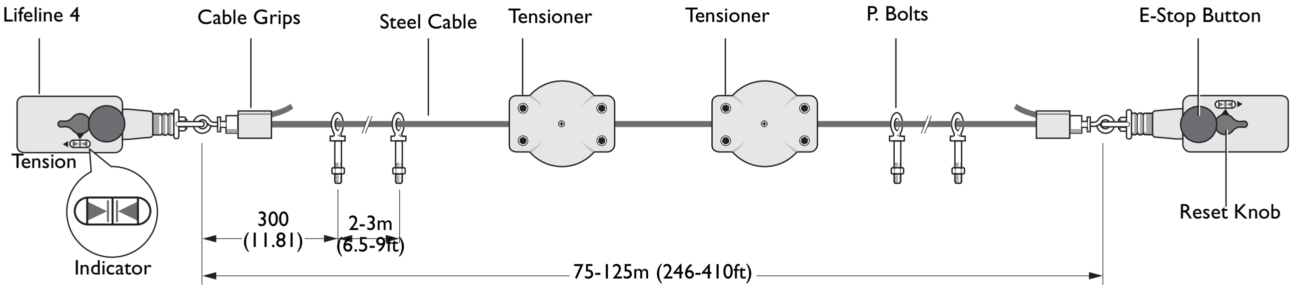
Mounting Specifications



Mounting Specifications with Spring Tensioner



Mounting Specifications for Extended Length Models



140M-C-PEC23 ITEM # 30

Motor Circuit Protectors/Motor Protection Circuit Breakers

Accessories, Continued

Description			For Use With	Cat. No.
	**ECO Connecting Modules — 25 A** Eco-starters mount on **SINGLE** DIN Rail (140M on DIN Rail) **ELECTRICAL AND MECHANICAL** interconnection of 140M MPCB and 100-M (with AC or DC coils) or 100-C (with AC coils) contactors		140M-C to 100-M	140M-C-PEM12
			140M-C to 100-C09…C23	140M-C-PEC23
			140M-D to 100-C09…C23	140M-D-PEC23
	Connecting Modules — 25 A and 45 A • Contactor and MPCB **MUST BE** mounted separately on (2) DIN Rails **ELECTRICAL** interconnection between 140M MPCB and 100-C contactors (with AC coils)		140M-C to 100-C09…C23	140M-C-PNC23
			140M-D to 100-C09…C23	140M-D-PNC23
			140M-D to 100-C30…C37	140M-D-PNC37
			140M-F to 100-C30…C37	140M-F-PNC37
			140M-F to 100-C43	140M-F-PNC43
	Coil Modules — 25 A and 45 A • For use with Bulletin 103T/107T 3-component starters		140M-C, -D to 100-C09…C23	140M-C-PSC23
			140M-D, -F to 100-C30…C43	140M-F-PSC23
	**Spacing Adapter** Required for Self-Protected combination motor controller (Type E) applications of 140M-C, -D, and -F MPCBs		140M-C, -D	140M-C-TE
			140M-F	140M-F-TE
	**Compact Busbar Feeder Block** Supply of compact busbars Increases terminal capacity	IEC terminal spacings	140M-C, -D	140M-C-WB
		UL terminal spacings		140M-C-WBE
			140M-F	140M-F-WBE
	**Compact Busbar Feeder Terminal** For supply of commoning links Top feed — overlaps commoning link		140M-C, -D	140M-C-WTE
			140M-F	140M-F-WTE
	**Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current** 45 mm spacing For use with front-mounted auxiliary contact	2 connections	140M-C, -D	140M-C-W452
		3 connections		140M-C-W453
		4 connections		140M-C-W454
		5 connections		140M-C-W455
	Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current 54 mm spacing For use with side-mounted auxiliary contact	2 connections	140M-C, -D	140M-C-W542
		3 connections		140M-C-W543
		4 connections		140M-C-W544
		5 connections		140M-C-W545
	Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current 63 mm spacing For use with side-mounted undervoltage trip and shunt trip	2 connections	140M-C, -D	140M-C-W632
		3 connections		140M-C-W633
		4 connections		140M-C-W634
		5 connections		140M-C-W635
	**Jumper for 140M-D to 140M-C** Accommodates difference in depth from 140M-D to 140M-C Can be used with all other commoning links 54 mm spacing	2 connections	140M-D to 140M-C	140M-C-WD542
	**Three-Phase Compact Busbar for 45 A Motor Protection Circuit Breakers — 115 A Max Continuous Current** 54 mm spacing For use with front-mounted auxiliary contact	2 connections	140M-F	140M-F-W542
		3 connections		140M-F-W543
		4 connections		140M-F-W544
	Three-Phase Compact Busbar for 45 A Motor Protection Circuit Breakers — 115 A Max Continuous Current 63 mm spacing For use with side-mounted auxiliary contact	2 connections	140M-F	140M-F-W632
		3 connections		140M-F-W633
		4 connections		140M-F-W634
	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10 pcs/kg	140M-D 140M-F	199-DR1
	**DIN (#3) Symmetrical Rail** 35 mm x 15 mm x 1 m long Top Hat Rail (DIN #3 Symmetrical Rail)	5 pcs/kg	140M-C 140M-D 140M-F 140-CMN	1492-DR9

140M-C-KN ITEM # 29

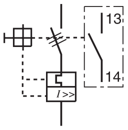
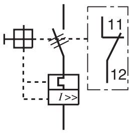
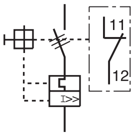
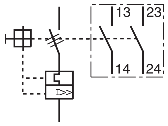
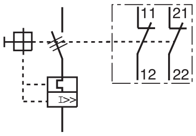
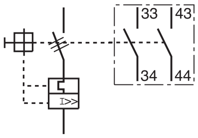
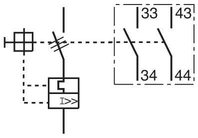
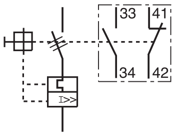
Motor Circuit Protectors/Motor Protection Circuit Breakers

Accessories, Continued

Description			For Use With	Cat. No.
	**Anti-Tamper Shield** Provides protection against inadvertent adjustment of the current setting	10 pcs/pkg	140M-C, D, F	140M-C-CA
	**Lockable Twist Knob** For 1 padlock 4…8 mm (5/16 in.) dia. shackle Can be locked in OFF position	Black	140M-C, D, F	140M-C-KN
		Red/Yellow	140M-C/-D	140M-C-KRY
		Red/Yellow	140M-F	140M-F-KRY
	**Padlockable Operating Knob** Accepts 8 mm (5/16 in.) padlock — up to three padlocks Permits padlocking in the off position	Black	140-CMN	140-KN
		Red/Yellow		140-KRY
	**Door Coupling Handle** For 3 padlocks 4…8 mm (5/16 in.) in diameter IP66 Protection/Type 1, 12 Interlock override capability Can be modified for locking in ON position Ships with coupling — order extension shaft and legend plate separately Mounting depth (adapter-door): 140-C: 105.5 mm ± 5 mm (4.5 in. ± 3/16 in.) 140-D: 114.5 mm ± 5 mm (4.5 in. ± 3/16 in.) 140-F: 137.1 mm ± 5 mm (5.4 in. ± 3/16 in.)	Black	140M-C, D, F	140M-C-DN66
			140-CMN	140-CDN66
		Red/Yellow	140M-C, D, F	140M-C-DRY66
			140-CMN	140-CDRY66
	**Extension Shaft** Cut to required length for mounting depth (adapter-door): 140M-C: 117…338 mm (4.6 in.…13.3 in.) 140M-D: 126…347 mm (5.0 in.…13.7in.) 140M-F: 149…369 mm (5.4 in.…14.5 in.) 140-CMN: 180…403 mm (7.1 in.…15.9 in.)		140M-C-DN66, 140M-C-DRY66, 140-CDN66, 140-CDRY66	140M-C-DS
	**Legend Plate** Marking: “Haupschalter” and “Main Switch” Marking: “Not-Aus” and “Emergency Off”		140-CDN66	140M-C-DFCN
			140-CDRY66	140M-C-DFCRY
	**Locking Tag** Padlock attachment to the lockable handles Up to three padlocks 4…8 mm (5/16 in.) shackle		140M-C-KN 140M-C-KRY 140M-F-KRY	140M-C-M3
	**IP65 Non-Metallic Enclosure** Knockouts for PG16 and PG21 fittings Suitable for flexible cable with internal ground wire or conduit when externally grounded around the outside of the enclosure	Black Handle	140M-C	198E-AYTG2
		Red/Yellow Handle	140M-C	198E-AYTJ2
	**Terminal Cover** For covering of unused Commoning Link terminals IP2X finger protection		140M-C, 140M-D	140M-C-WS
			140M-F	140M-F-WS
	**Screw Adapter** For screw arrangement of a Motor Protection Circuit Breaker	10 pcs/pkg	140M-C, D, F	140M-C-N45
	**Disconnector Module** Provides visible isolation from line side connections to the Bulletin 140M-C, -D circuit breakers. Can be removed or put in a “park” position. Padlockable with up to 2 padlocks 3...6mm (1/4”) in diameter.		140M-C, -D	140M-C-TRE

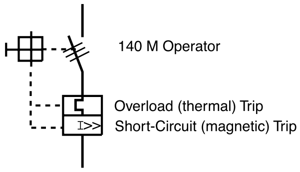
140M-C-AFA10 ITEM # 28

Accessories

Description									
		Operator Position∗			Term. No.	Description	Connection Diagram†	For Use With	Cat. No.
		OFF	ON	Tripped					
		←	↑	↘					
	**Front-Mounted Auxiliary Contact** 1-pole or 2-pole No additional space required - Only (1) per MPCB	O	X	O	13-14	N.O. Aux		140M-C, D, F	140M-C-AFA10
		X	O	X	11-12	N.C. Aux		140M-C, D, F	140M-C-AFA01
		O	X	O	13-14	N.O. Aux		140M-C, D, F	140M-C-AFA11
		X	O	X	21-22	N.C. Aux			
		O	X	O	13-14	N.O. Aux		140M-C, D, F	140M-C-AFA20
		O	X	O	23-24	N.O. Aux			
		X	O	X	11-12	N.C. Aux		140M-C, D, F	140M-C-AFA02
		X	O	X	21-22	N.C. Aux			
	**Right Side-Mounted Auxiliary Contact** 2-pole Adds 9 mm to the width of the device - (2) per MPCB	O	X	O	33-34	N.O. Aux		140M-C, D, F	140M-C-ASA20
		O	X	O	43-44	N.O. Aux			
		X	O	X	31-32	N.C. Aux		140M-C, D, F	140M-C-ASA02
		X	O	X	41-42	N.C. Aux			
		O	X	O	33-34	N.O. Aux		140M-C, D, F	140M-C-ASA11
		X	O	X	41-42	N.C. Aux			

∗ X = Contact Closed
O = Contact Open

†



‡ Accessories for 140M-H, page 2-57. Accessories for 140M-J, page 2-62.

140M-C2E-C16
140M-C2E-C20

ITEM # 27 & 27A

Product Selection

Motor Protection Circuit Breakers

- Short Circuit Protection — Standard Magnetic Trip (Fixed at 13 x I_e)
- Overload Protection — Trip Class 10

Cat. No. 140M-C

Cat. No. 140M-D

Cat. No. 140M-F

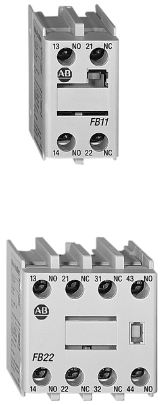
Cat. No. 140-CMN

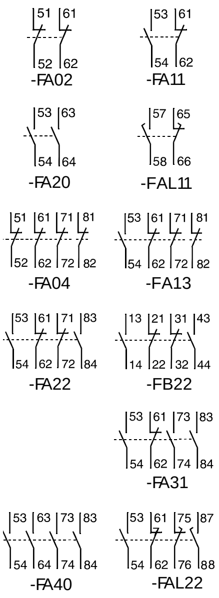
Rated Operational Current (I_e)	Motor Current Adjustment Range	Magnetic Trip Current	Ultimate Interrupting Current [kA] (I_{cu})		3-phase Hp Ratings [Hp]*				Max. kW, 3-Phase				
[A]	[A]	[A]	400V	480V	200V	230V	460V	575V	230V	400/415V	500V	690V	Cat. No.
C-Frame													
0.16 A	0.10…0.16	2.1	100	65	—	—	—	—	—	0.02	—	—	140M-C2E-A16
0.25 A	0.16…0.25	3.3	100	65	—	—	—	—	—	0.06	—	—	140M-C2E-A25
0.40 A	0.25…0.40	5.2	100	65	—	—	—	—	—	0.09	—	—	140M-C2E-A40
0.63 A	0.40…0.63	8.2	100	65	—	—	—	—	0.06…0.09	0.12…0.18	0.18	0.25	140M-C2E-A63
1.0 A	0.63…1.0	13	100	65	—	—	—	0.5	0.12	0.25	0.25…0.37	0.37…0.55	140M-C2E-B10
1.6 A	1.0…1.6	21	100	65	—	—	0.5…0.75	0.75	0.18…0.25	0.37…0.55	0.55…0.75	0.75…1.1	140M-C2E-B16
2.5 A	1.6…2.5	33	100	65	0.5	0.5	0.75…1	1…1.5	0.37	0.75	1.1	1.8	140M-C2E-B25
4.0 A	2.5…4.0	52	100	65	0.75	0.75	1.5…2	2…3	0.55…0.75	1.1…1.5	1.5…2.2	2.2…3.0	140M-C2E-B40
6.3 A	4.0…6.3	82	100	65	1	1…1.5	3	5	1.1…1.5	2.2	2.5…3.0	4.0	140M-C2E-B63
10 A	6.3…10	130	100	65	1.5…2	2…3	5	7.5	2.2	3.0…4.0	4.0…6.3	5.5…7.5	140M-C2E-C10
16 A	10…16	208	50	30	3	—	7.5…10	10	3.0…4.0	5.5…7.5	7.5…10	11…13	140M-C2E-C16
20 A	14.5…20	260	15	30	5	5	—	15	4.0…5.5	7.5…10	11	15…17	140M-C2E-C20
25 A	18…25	325	15	25	—	7.5	15	20	—	11	15	18.5…22	140M-C2E-C25
D-Frame													
2.5 A	1.6…2.5	33	100	65	0.5	0.5	0.75…1	1…1.5	0.37	0.75	1.1	1.8	140M-D8E-B25
4.0 A	2.5…4.0	52	100	65	0.75	0.75	1.5…2	2-3	0.55…0.75	1.1…1.5	1.5…2.2	2.2…3.0	140M-D8E-B40
6.3 A	4.0…6.3	82	100	65	1	1…1.5	3	5	1.1…1.5	2.2	2.5…3.0	4.0	140M-D8E-B63
10 A	6.3…10	130	100	65	1.5…2	2…3	5	7.5	2.2	3.0…4.0	4.0…6.3	5.5…7.5	140M-D8E-C10
16 A	10…16	208	100	65	3	—	7.5…10	10	3.0…4.0	5.5…7.5	7.5…10	11…13	140M-D8E-C16
20 A	14.5…20	260	50	65	5	5	—	15	4.0…5.5	7.5…10	11	15…17	140M-D8E-C20
25 A	18…25	325	50	65	—	7.5	15	20	—	11	15	18.5…22	140M-D8E-C25
F-Frame													
10 A	6.3…10	130	65	65	1.5…2	2…3	5	7.5	2.2	3.0…4.0	4.0…6.3	5.5…7.5	140M-F8E-C10
16 A	10…16	208	65	65	3	—	7.5…10	10	3.0…4.0	5.5…7.5	7.5…10	11…13	140M-F8E-C16
20 A	14.5…20	260	65	65	5	5	—	15	4.0…5.5	7.5…10	11	15…17	140M-F8E-C20
25 A	18…25	325	65	65	—	7.5	15	20	5.5…6.3	11	15	18.5…22	140M-F8E-C25
32 A	23…32	416	65	65	7.5	10	20	25…30	7.5	15	15…20	22…25	140M-F8E-C32
45 A	32…45	585	—	—	10	15	25…30	30…40	11…13	18.5…22	22…30	30…40	140M-F8E-C45
CMN-Frame													
25 A	16…25	350	65	65	5	7.5	15	15…20	5.5…7.5	7.5…13	11…15	15…22	140-CMN-2500
40 A	25…40	560	65	65	10	10	20…30	25…30	10…11	15…22	18.5…25	25…30	140-CMN-4000
63 A	40…63	882	65	42	15…20	15…20	30…40	40…60	13…20	25…32	30…40	37…55	140-CMN-6300
90 A	63…90	1260	50	35	25…30	25…30	50…60	75	22…25	37…45	45…55	63…75	140-CMN-9000

* Horsepower/kW ratings shown in the table above are for reference. **The final selection of the MPCB depends on the actual motor full load current and service factor.**

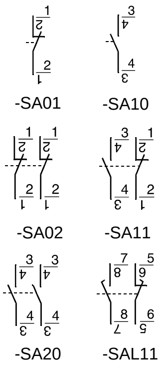
100-SA20 ITEM # 48

Auxiliary Contacts





	Description	N.O.	N.C.	Connection Diagrams	For Use With	Cat. No.
	Auxiliary Contact Blocks for Front Mounting ❶❸ • 2- and 4-pole • Quick and easy mounting without tools • Mutual positive guidance to the main contactor poles (except for L types) • Models with equal function with several terminal numbering choices L = Late break/Early make	0	2		700-CF	100-FA02
		1	1		700-CF	100-FA11
		2	0		700-CF	100-FA20
		1L	1L		700-CF	100-FAL11
		0	4		700-CF	100-FA04
		1	3		700-CF	100-FA13
		2	2		700-CF	100-FA22
		3	1		700-CF	100-FA31
		4	0		700-CF	100-FA40
		1+1L	1+1L		700-CF	100-FAL22



	Description	N.O.	N.C.	Connection Diagrams	For Use With	Cat. No.
	Auxiliary Contact Blocks for Side Mounting without Sequence Terminal Designations ❷❸ • 1- and 2-pole • Two-way numbering for right or left mounting on the contactor • Quick and easy mounting without tools • Mutual positive guidance and to the main relay poles (except for L types) L = Late break/Early make	0	1		700-CF	100-SA01
		1	0		700-CF	100-SA10
		0	2		700-CF	100-SA02
		1	1		700-CF	100-SA11
		2	0		700-CF	100-SA20
		L1	L1		700-CF	100-SAL11

❶ Control Relay and Auxiliary Contact

❷ Up to 8 auxiliary contacts may be mounted (a maximum of 4 N.C. contacts on the front of the contactor and a maximum of 2 N.O. contacts on each side).

❸ Maximum No. of Contacts: Refer to the following tables

700CF (AC and DC coils), vertical mounting, 60°C

Cat. No. 700-	Max. N.O. Side Aux.	Max. N.C. Side Aux.	Max. N.O. Front + Side Aux.	Max. N.C. Front + Side Aux.	Max. N.O. + N.C. Front + Side Aux.
CF400	2	4	6	6	6
CF310	2	4	6	6	6
CF220	2	4	6	6	6
CF040 ❹	2	2	4	4	4

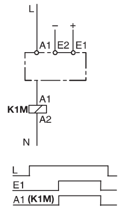
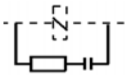
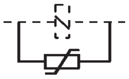
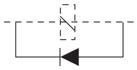
700CF (AC and DC coils), vertical mounting, 40°C

Cat. No. 700-	Max. N.O. Side Aux.	Max. N.C. Side Aux.	Max. N.O. Front + Side Aux.	Max. N.C. Front + Side Aux.	Max. N.O. + N.C. Front + Side Aux.
CF400	2	4	6	7	7
CF310	2	4	6	7	7
CF220	2	4	6	7	7
CF040 ❹	2	3	4	5	5

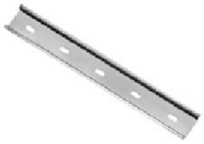
❹ AC coils only.

100-JE | ITEM # 32

Control Modules (For 100-C09…C85 contactors), Continued

	Description		Voltage Range	Connection Diagrams	For Use With	Cat. No.
	**DC Interface** (electronic) Interface between the DC control signal (PLC) and the AC operating mechanism of the contactor. Requires no additional surge suppression on the relay coils		Input: 12V DC Output: 110…240V AC		100-C with AC coils 110…240V AC	100-JE12
			Input: 18…30V DC Output: 110…240V AC			100-JE
			Input: 48V DC Output: 110…240V AC			100-JE48
	**Surge Suppressors** For limitation of coil switching transients. Plug-in, coil mounted Suitable for all 100-C contactor sizes, 9…85 A RC, Varistor and Diode Versions	**RC Module** AC Operating Mechanism	24…48V AC, 50/60 Hz		100-C with AC coils	100-FSC48
			110…280V AC, 50/60 Hz			100-FSC280
			380…480V AC, 50/60 Hz			100-FSC480
		Varistor Module AC/DC Operating Mechanism	12…55V AC/ 12…77V DC		100-C all	100-FSV55
			56…136V AC/ 78…180V DC		100-C all	100-FSV136
			137…277V AC/ 181…350V DC		100-C all	100-FSV277
			278…575V AC		100-C all	100-FSV575
		Diode Module DC Operating Mechanism	12…250V DC		100-C with DC coils	100-FSD250

Assembly Components (For 100-C09…C85 contactors)

	Description	For Use With	Pkg. Quantity∗	Cat. No.
 *Cat. No. 100-S0*	**Dovetail Connectors** For use in contactor and starter assemblies. Single Connector — 0 mm Spacing	100-C all	10	100-S0
	Dovetail Connectors For use in contactor and starter assemblies. Dual Connector — 9 mm Spacing			100-S9
 *Cat. No. 100-SCCA*	**Protective Covers** Provides protection against unintended manual operation For contactors and front mounted auxiliary contacts, pneumatic timers and latches	100-C all	1	100-SCCA
 *Cat. No. 100-SCFA*		100-FA, -FB, -FC, -FP, -FL;	10	100-SCFA
 *Cat. No. 105-PW23*	**Reversing Power Wiring Kits** For reversing connection with a solid-state or thermal overload relay	100-C09…C23	1	105-PW23
		100-C30…C37		105-PW37
		100-C43		105-PW43
		100-C60…85		105-PW85
	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	100-C09…85	10	199-DR1

∗ Must be ordered in multiples of package quantities.

Contactors

100-C16D10
100-C23D10

ITEM # 31 & 31A

3-Pole AC-Operated Contactors

∼

- **AC Operating Mechanism**
- **3 Main Contacts**

Cat. No. 100-C23⊗10

Cat. No. 100-C37⊗00

Cat. No. 100-C43⊗00

Cat. No. 100-C85⊗00

Ie [A]		Ratings for Switching AC Motors — AC-2, AC-3, AC-4										Aux. Contacts		Cat. No.
		kW (50 Hz)				Hp (60 Hz)								
						1∅		3∅						
AC-3	AC-1	230V	380V 415V 400V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	
9	32	3	4	4	4	1/3	1	2	2	5	7-1/2	1	0	100-C09⊗10
												0	1	100-C09⊗01
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	1	0	100-C12⊗10
												0	1	100-C12⊗01
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	1	0	100-C16⊗10
												0	1	100-C16⊗01
23	32	7.5	11	11	11	2	3	5	7-1/2	15	15	1	0	100-C23⊗10
												0	1	100-C23⊗01
30	50	10	15	15	15	2	5	7-1/2	10	20	25	0	0	100-C30⊗00
												1	0	100-C30⊗10
												0	1	100-C30⊗01
37	50	11	18.5	18.5	18.5	3	5	10	10	25	30	0	0	100-C37⊗00
												1	0	100-C37⊗10
												0	1	100-C37⊗01
43	85	13	22	22	22	3	7-1/2	10	15	30	30	0	0	100-C43⊗00
												1	0	100-C43⊗10
												0	1	100-C43⊗01
60	100	18.5	30	30	30	5	10	15	20	40	50	0	0	100-C60⊗00
												1	0	100-C60⊗10
												0	1	100-C60⊗01
72	100	22	37	37	37	5	15	20	25	50	60	0	0	100-C72⊗00
												1	0	100-C72⊗10
												0	1	100-C72⊗01
85	100	25	45	45	45	7-1/2	15	25	30	60	60	0	0	100-C85⊗00
												1	0	100-C85⊗10
												0	1	100-C85⊗01

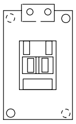
⊗ Voltage Suffix Code and Terminal Position

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: 120V, 60 Hz: **Cat. No. 100-C09⊗10** becomes **Cat. No.100-C09D10**.

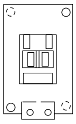
V / Hz	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
50Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	—	—	—	—	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

Coil Terminal Position

- All contactors are delivered with the coil terminals located on the **line side**.
- For **load side** coil terminations, insert a **U** prior to the coil voltage code. Example: **Cat. No. 100-C09UD10**.



Cat. No. 100-C09⊗10 Line Side



Cat. No. 100-C09U⊗10 Load Side

www.abpowerflex.com

Allen-Bradley

PowerFlex® 400

Adjustable Frequency AC Drive for Fan & Pump Applications

FRN 4.xx

22C-D045A103

ITEM # 19

User Manual

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at **http://www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc. is prohibited.

Throughout this manual, when necessary we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

Shock Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

Burn Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

Summary of Changes

Manual Updates

The information below summarizes the changes to the PowerFlex 400 *User Manual* since the August 2005 release.

Description of New or Updated Information	See Page(s)
Important statement regarding differences in parameter defaults for packaged drives added to parameter P041 [Reset To Defalts].	3-11
Important statement regarding related parameter added to parameter A167 [Flying Start En].	3-37

New Parameter

The following new parameter has been added with the release of Firmware Release Number (FRN) 4.xx.

Parameter Name	Parameter Number	See Page(s)
[Motor NP FLA]	A200	3-46

Manual Updates

The information below summarizes the changes to the PowerFlex 400 *User Manual* since the April 2005 release.

Description of New or Updated Information	See Page(s)
Attention statement clarified.	1-6
Min/Max wire sizes for Frame F corrected.	1-15
Note added regarding the function of I/O Terminal 18, Analog Common 2.	1-17
Connection Examples corrected for Analog Input and Analog Output.	1-20
Required filters corrected for 380-480V, 2.2-11 kW (3.0-15 HP) drives in First Environment Unrestricted.	1-28
Important statement regarding differences in parameter defaults for packaged drives added to parameter P041 [Reset To Defalts].	3-11
Fault F64 Drive Overload description corrected.	4-4
Overcurrent protection for hardware limit and instantaneous fault levels corrected.	A-3
Max storage temperatures corrected to 70 degrees C (158 degrees F).	A-3
Max and Actual Short Circuit Ratings added to Electrical specification.	A-4
Optional Relay specifications added.	A-5
Supported communication protocols expanded.	A-5
Watts Loss table added.	A-6
Power Structure detail added to Appendix A.	A-7
Appendix D provides setup information for Damper Control, PID Control, and Auxiliary Control schemes.	D-1
Appendix G, P1 network protocol added.	G-1

New Parameters

The following new parameters have been added with the release of Firmware Release Number (FRN) 3.xx.

Parameter Name	Parameter Number	See Page(s)
[Motor OL Ret]	P043	3-11
[Anlg Loss Delay]	T088	3-26
[Start Source 2]	C108	3-29
[Speed Ref 2]	C109	3-30

Table of Contents

Overview

The purpose of this manual is to provide you with the basic information needed to install, start-up and troubleshoot the PowerFlex 400 Adjustable Frequency AC Drive.

Who Should Use this Manual?

This manual is intended for qualified personnel. You must be able to program and operate Adjustable Frequency AC Drive devices. In addition, you must have an understanding of the parameter settings and functions.

Reference Materials

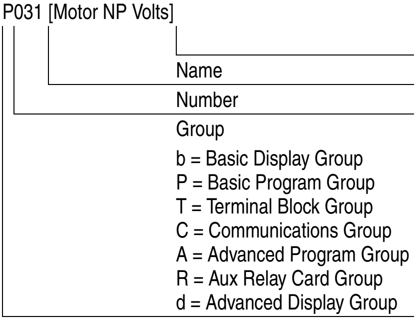
The following manuals are recommended for general drive information:

Title	Publication	Available Online at …
Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives	DRIVES-IN001…	**www.rockwellautomation.com/literature**
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001…	
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1	
A Global Reference Guide for Reading Schematic Diagrams	100-2.10	

Manual Conventions

- In this manual we refer to the PowerFlex 400 Adjustable Frequency AC Drive as; drive, PowerFlex 400 or PowerFlex 400 Drive.

- Parameter numbers and names are shown in this format:



b = Basic Display Group
P = Basic Program Group
T = Terminal Block Group
C = Communications Group
A = Advanced Program Group
R = Aux Relay Card Group
d = Advanced Display Group

- The following words are used throughout the manual to describe an action:

Word	**Meaning**
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Must	Unavoidable, you must do this
Shall	Required and necessary
Should	Recommended
Should Not	Not Recommended

Drive Frame Sizes

Similar PowerFlex 400 drive sizes are grouped into frame sizes to simplify spare parts ordering, dimensioning, etc. A cross reference of drive catalog numbers and their respective frame sizes is provided in Appendix B.

General Precautions

ATTENTION: The drive contains high voltage capacitors which take time to discharge after removal of mains supply. Before working on drive, ensure isolation of mains supply from line inputs [R, S, T (L1, L2, L3)]. Wait three minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death.

A darkened LCD display and LEDs is not an indication that capacitors have discharged to safe voltage levels.

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

ATTENTION: The bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. However, it can also cause either of the following two conditions to occur.
1. Fast positive changes in input voltage or imbalanced input voltages can cause uncommanded positive speed changes;
2. Actual deceleration times can be longer than commanded deceleration times
However, a “Stall Fault” is generated if the drive remains in this state for 1 minute. If this condition is unacceptable, the bus regulator must be disabled (see parameter A187). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

Catalog Number Explanation

1-3	4	5	6-8	9	10	11	12
22C	**-**	**D**	**038**	**A**	**1**	**0**	**3**
Drive	Dash	Voltage Rating	Rating	Enclosure	HIM	Emission Class	Comm Slot

Code	
[✓ 22C]	PowerFlex 400

Code	Voltage	Ph.
B	240V AC	3
[✓ D]	480V AC	3

Output Current @ 200-240V 60Hz Input

Code	Amps	kW (HP)	Frame
012	12	2.2 (3.0)	C
017	17.5	3.7 (5.0)	C
024	24	5.5 (7.5)	C
033	33	7.5 (10)	C
049	49	11 (15)	D
065	65	15 (20)	D
075	75	18.5 (25)	D
090	90	22 (30)	D
120	120	30 (40)	E
145	145	37 (50)	E

Output Current @ 380-480V Input

Code	Amps	kW (HP)	Frame
6P0	6.0	2.2 (3.0)	C
010	10.5	4.0 (5.0)	C
012	12	5.5 (7.5)	C
017	17	7.5 (10)	C
022	22	11 (15)	C
030	30	15 (20)	C
038	38	18.5 (25)	D
045	45.5	22 (30)	D
[✓ 060]	60	30 (40)	D
072	72	37 (50)	E
088	88	45 (60)	E
105	105	55 (75)	E
142	142	75 (100)	E
170	170	90 (125)	F
208	208	110 (150)	F

Code	Enclosure
N	Panel Mount - IP20/UL Open-Type(1)
[✓ A]	Panel Mount - IP30/NEMA 1/UL Type 1(2)
F	Flange Mount - IP20/UL Open Type(3)

Code	Interface Module
[✓ 1]	Fixed Keypad

Code	Rating
[✓ 0]	Not Filtered

Code	Version
[✓ 3]	RS485

(1) Frame C drives only available with IP20/UL Open-Type enclosure. Field installed conversion kit available to achieve IP30/NEMA 1/UL Type 1 rating.

(2) Frame D, E and F drives only available with IP30/NEMA 1/UL Type 1 enclosure.

(3) Frame C drives only.

Additional accessories, options and adapters are available. See Appendix B for details.

Installation/Wiring

This chapter provides information on mounting and wiring the PowerFlex 400 Drive.

Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.

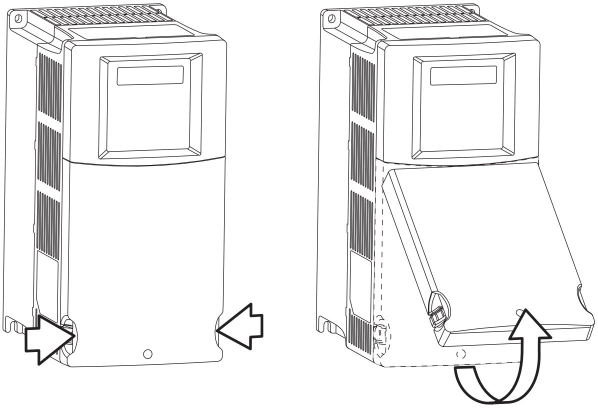
ATTENTION: The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

Opening the Cover

Frame C Drives

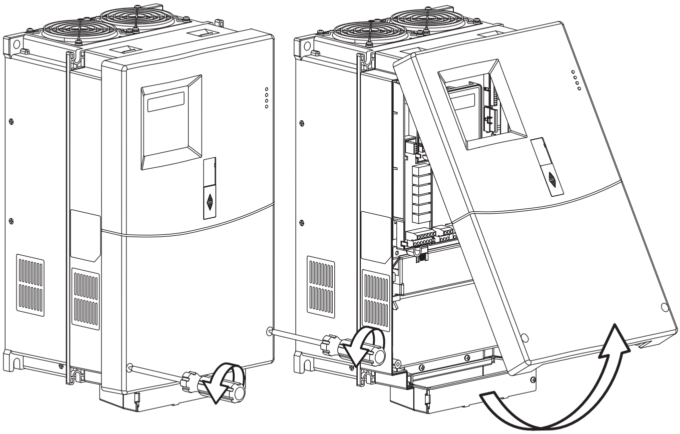
1. Press and hold in the tabs on each side of the cover.

2. Pull the cover out and up to release.



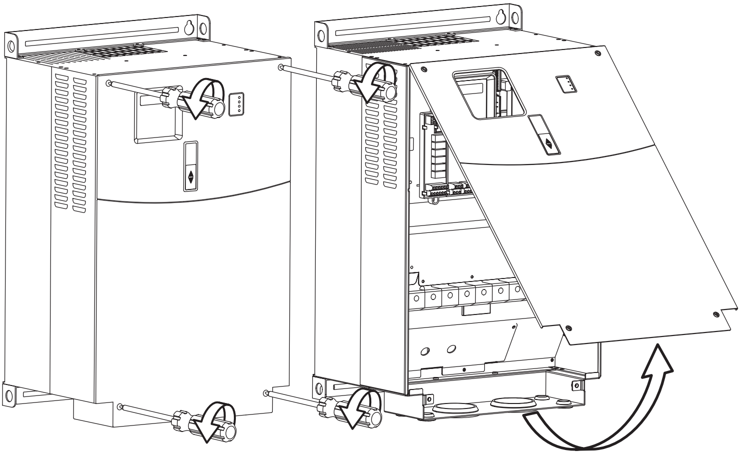
Frame D Drives

1. Loosen the two captive cover screws.
2. Pull the bottom of the cover out and up to release.



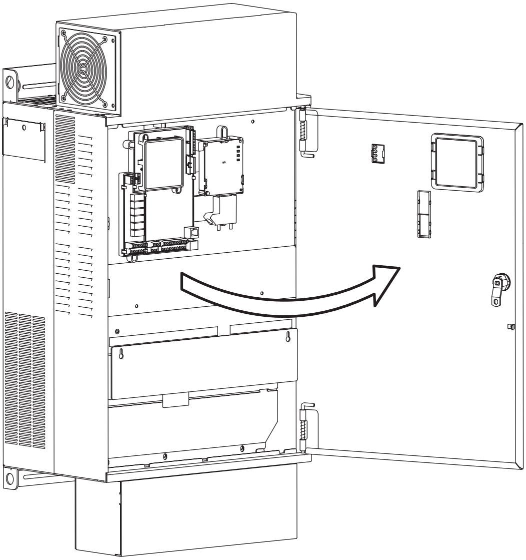
Frame E Drives

1. Loosen the four captive cover screws.
2. Pull the bottom of the cover out and up to release.



Frame F Drives

1. Turn the latch counterclockwise.
2. Pull on the latch to swing the door open.



Mounting Considerations

- Mount the drive upright on a flat, vertical and level surface.

Frame	Screw Size	Screw Torque
C	M5 (#10-24)	2.45-2.94 N-m (22-26 lb.-in.)
D	M8 (5/16 in.)	6.0-7.4 N-m (53.2-65.0 lb.-in.)
E	M8 (5/16 in.)	8.8-10.8 N-m (78.0-95.3 lb.-in.)
F	M10 (3/8 in.)	19.6-23.5 N-m (173.6-208.3 lb.-in.)

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

Maximum Surrounding Air Temperature

Frame	Enclosure Rating	Temperature Range	Minimum Mounting Clearances
C	IP 20/UL Open-Type	-10° to 45°C (14° to 113°F)	See Figure 1.1, Mounting Option A
	IP 30/NEMA 1/UL Type 1[1]	-10° to 45°C (14° to 113°F)	See Figure 1.1, Mounting Option B
	IP 20/UL Open-Type	-10° to 50°C (14° to 122°F)	See Figure 1.1, Mounting Option B
D	IP 30/NEMA 1/UL Type 1	-10° to 45°C (14° to 113°F)	See Figure 1.2
E			
F			

[1] Frame C drives require installation of the PowerFlex 400 IP 30/NEMA 1/UL Type 1 option kit to achieve this rating.

Minimum Mounting Clearances

Refer to Appendix B for mounting dimensions.

Figure 1.1 Frame C Mounting Clearances

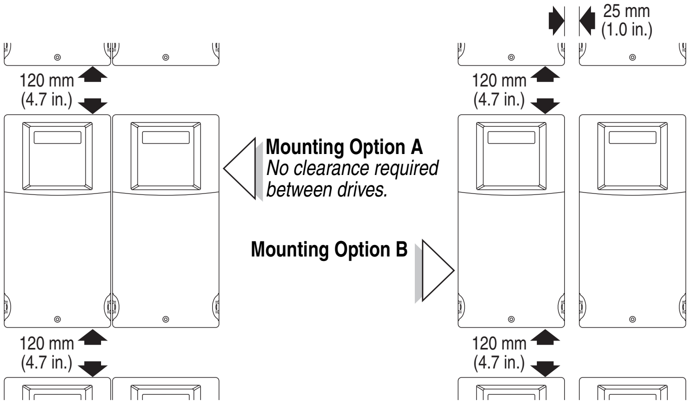
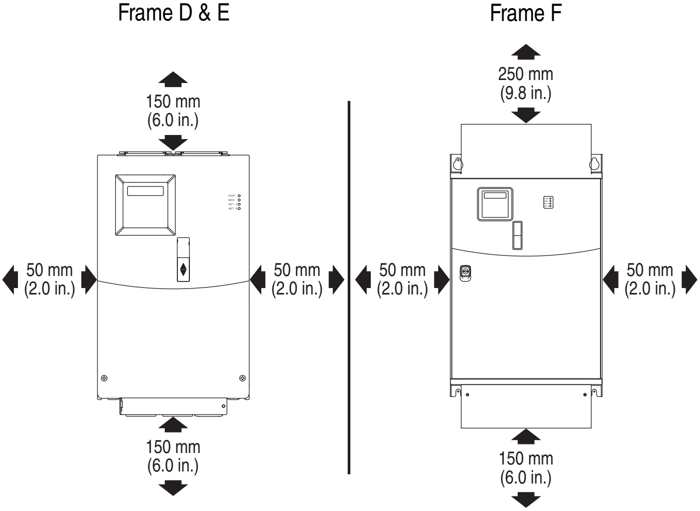


Figure 1.2 Frames D, E and F Mounting Clearances



Debris Protection

Frame C Drives – A plastic top panel is included with the drive. Install the panel to prevent debris from falling through the vents of the drive housing during installation. Remove the panel for IP 20/Open Type applications.

Frame D, E and F Drives – These drives have built-in debris protection. Installation of a protective panel is not required.

Storage

- Store within an ambient temperature range of -40° to +85°C.
- Store within a relative humidity range of 0% to 95%, non-condensing.
- Do not expose to a corrosive atmosphere.

AC Supply Source Considerations

Ungrounded Distribution Systems

ATTENTION: PowerFlex 400 drives contain protective MOVs that are referenced to ground. These devices must be disconnected if the drive is installed on an ungrounded or resistive grounded distribution system.

Disconnecting MOVs (Drive Frames C, E and F only.)

To prevent drive damage, the MOVs connected to ground shall be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. To disconnect these devices, remove the jumper shown in Figure 1.4.

Figure 1.3 Phase to Ground MOV Removal

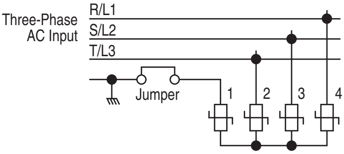
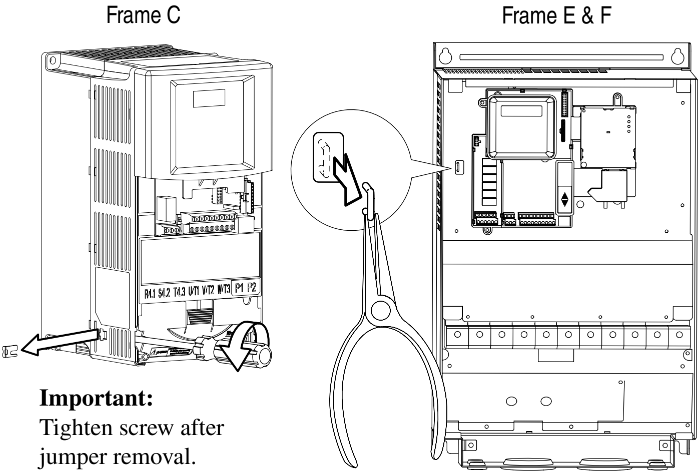


Figure 1.4 Jumper Location



Important:
Tighten screw after
jumper removal.

Note: Frame D drives do not contain a MOV to ground connection and are suitable for operation in both grounded and ungrounded distribution systems without modification.

Input Power Conditioning

The drive is suitable for direct connection to input power within the rated voltage of the drive (see Appendix A). Listed in Table 1.A are certain input power conditions which may cause component damage or reduction in product life. If any of the conditions exist, as described in Table 1.A, install one of the devices listed under the heading *Corrective Action* on the line side of the drive.

Important: Only one device per branch circuit is required. The device should be mounted closest to the branch and sized to handle the total current of the branch circuit.

Table 1.A Input Power Conditions

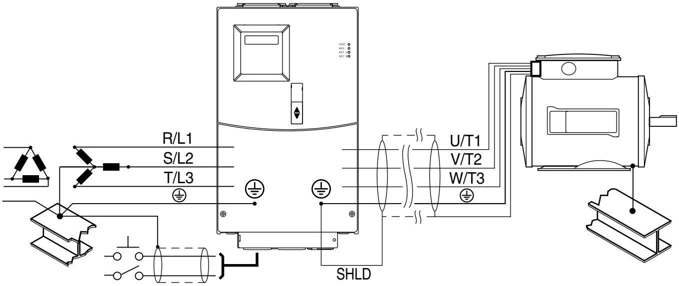
Input Power Condition	Corrective Action
Low Line Impedance (less than 1% line reactance)	• Install Line Reactor(1) • or Isolation Transformer
Line has power factor correction capacitors	• Install Line Reactor(1) • or Isolation Transformer
Line has frequent power interruptions	
Line has intermittent noise spikes in excess of 6000V (lightning)	
Phase to ground voltage exceeds 125% of normal line to line voltage	• Remove MOV jumper to ground (Frame C, E & F drives only) • or Install Isolation Transformer with grounded secondary if necessary
Ungrounded distribution system	

(1) Refer to Appendix B for accessory ordering information.

General Grounding Requirements

The drive Safety Ground - ⏚ (PE) must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

Figure 1.5 Typical Grounding



Ground Fault Monitoring

If a system ground fault monitor (RCD) is to be used, only Type B (adjustable) devices should be used to avoid nuisance tripping.

Safety Ground - ⏚ (PE)

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

Shield Termination - SHLD

Either of the safety ground terminals located on the power terminal block provides a grounding point for the motor cable shield. The **motor cable** shield connected to one of these terminals (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal. The conduit box may be used with a cable clamp for a grounding point for the cable shield.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

RFI Filter Grounding

Using an external filter with any drive rating, may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked.

Fuses and Circuit Breakers

The PowerFlex 400 does not provide branch short circuit protection. This product should be installed with either input fuses or an input circuit breaker. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations.

Fusing

The ratings in the table that follows are the recommended values for use with each drive rating. The devices listed in this table are provided to serve as a guide.

Bulletin 140M (Self-Protected Combination Controller)/UL489 Circuit Breakers

When using Bulletin 140M or UL489 rated circuit breakers, the guidelines listed below must be followed in order to meet the NEC requirements for branch circuit protection.

- Bulletin 140M can be used in single and group motor applications.
- Bulletin 140M can be used up stream from the drive **without** the need for fuses.

Table 1.B Recommended Branch Circuit Protective Devices

Voltage Rating	Drive Rating *kW (HP)*	Fuse Rating[1] *Amps*	140M Motor Protectors[2] *Catalog No.*	Recommended MCS Contactors *Catalog No.*
200-240V AC – 3-Phase	2.2 (3.0)	20	140M-D8E-C16	100-C23
	3.7 (5.0)	30	140M-F8E-C25	100-C37
	5.5 (7.5)	35	140M-F8E-C32	100-C37
	7.5 (10)	45	140M-F8E-C45	100-C45
	11 (15)	70	140-CMN-6300	100-C60
	15 (20)	90	140-CMN-9000	100-C85
	18.5 (25)	100	140-CMN-9000	100-D95
	22 (30)	125	–	100-D110
	30 (40)	175	–	100-D180
	37 (50)	200	–	100-D180
380-480V AC – 3-Phase	2.2 (3.0)	10	140M-D8E-C10	100-C09
	4.0 (5.0)	20	140M-D8E-C16	100-C16
	5.5 (7.5)	20	140M-D8E-C16	100-C23
	7.5 (10)	25	140M-D8E-C20	100-C23
	11 (15)	30	140M-F8E-C32	100-C30
	15 (20)	40	140M-F8E-C32	100-C37
	18.5 (25)	50	140M-F8E-C45	100-C60
	22 (30)	60	140-CMN-6300	100-C60
	30 (40)	80	140-CMN-9000	100-C85
	37 (50)	100	140-CMN-9000	100-C85
	45 (60)	125	–	100-D110
	55 (75)	150	–	100-D140
	75 (100)	200	–	100-D180
	90 (125)	250	–	100-D210
	110 (150)	250	–	100-D250

[1] Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.

[2] Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001… to determine the frame and breaking capacity required for your application.

Power Wiring

ATTENTION: National Codes and standards (NEC, VDE, BSI, etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from "cross coupled" power leads.

Motor Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than 15 mils (0.4 mm/0.015 in.). Do not route more than three sets of motor leads in a single conduit to minimize "cross talk". If more than three drive/motor connections per conduit are required, shielded cable must be used.
UL installations must use 600V, 75°C or 90°C wire.
Use copper wire only.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas**. Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations or a high degree of communications / networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks. Refer to Reflected Wave in "Wiring and Grounding Guidelines for PWM AC Drives," publication DRIVES-IN001A-EN-P.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden® 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.
Standard (Option 2)	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	• Three tinned copper conductors with XLPE insulation. • 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield. • PVC jacket.
Class I & II; Division I & II	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	• Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor. • Black sunlight resistant PVC jacket overall. • Three copper grounds on #10 AWG and smaller.

Reflected Wave Protection

The drive should be installed as close to the motor as possible. Installations with long motor cables may require the addition of external devices to limit voltage reflections at the motor (reflected wave phenomena). See Table 1.C for recommendations.

The reflected wave data applies to all frequencies 2 to 10 kHz.

For 240V ratings, reflected wave effects do not need to be considered.

Table 1.C Maximum Cable Length Recommendations

Reflected Wave		
380-480V Ratings	**Motor Insulation Rating**	**Motor Cable Only**[1]
	1000 Vp-p	7.6 meters (25 feet)
	1200 Vp-p	22.9 meters (75 feet)
	1600 Vp-p	152.4 meters (500 feet)

(1) Longer cable lengths can be achieved by installing devices on the output of the drive. Consult factory for recommendations.

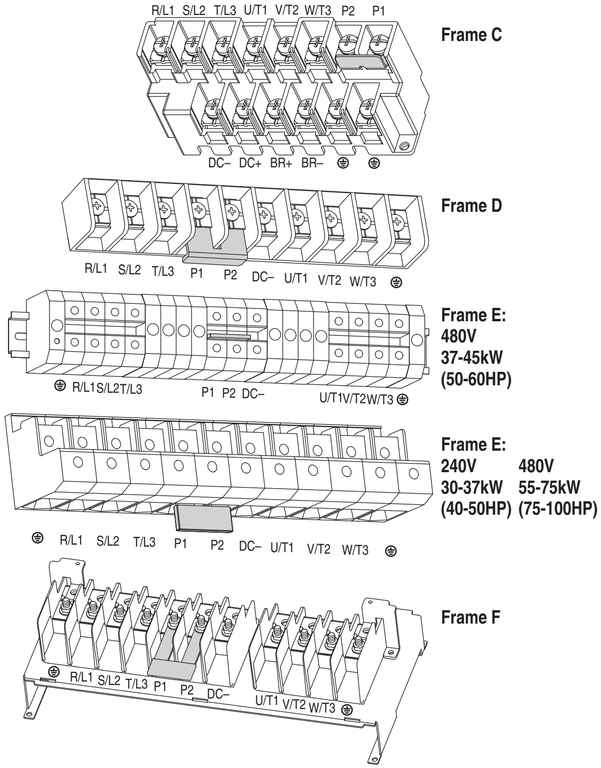
Output Disconnect

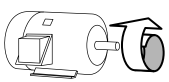
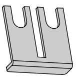
The drive is intended to be commanded by control input signals that will start and stop the motor. A device that routinely disconnects then reapplies output power to the motor for the purpose of starting and stopping the motor should not be used. If it is necessary to disconnect power to the motor with the drive outputting power, an auxiliary contact should be used to simultaneously disable drive control run commands.

Power Terminal Block

Frame C, D, and F drives utilize a finger guard over the power wiring terminals. Replace the finger guard when wiring is complete.

Figure 1.6 Power Terminal Blocks



Terminal [1]	Description
R/L1, S/L2, T/L3	3-Phase Input
U/T1	To Motor U/T1 =  Switch any two motor leads to change forward direction.
V/T2	To Motor V/T2
W/T3	To Motor W/T3
P2, P1	DC Bus Inductor Connection Drives are shipped with a jumper between Terminals P2 and P1. Remove this jumper only when a DC Bus Inductor will be connected. Drive will not power up without a jumper or inductor connected. 
DC–, DC+	DC Bus Connection (Frame C Drives)
P2, DC–	DC Bus Connection (Frame D, E, and F Drives)
BR+, BR–	Not Used
⏚	Safety Ground - PE

[1] **Important:** Terminal screws may become loose during shipment. Ensure that all terminal screws are tightened to the recommended torque before applying power to the drive.

Table 1.D Power Terminal Block Specifications

Frame	Maximum Wire Size (1)	Minimum Wire Size (1)	Recommended Torque
C	8.4 mm^2 (8 AWG)	1.3 mm^2 (16 AWG)	2.9 N-m (26 lb.-in.)
D	33.6 mm^2 (2 AWG)	8.4 mm^2 (8 AWG)	5.1 N-m (45 lb.-in.)
E 480V 37-45 kW (50-60 HP)	33.6 mm^2 (2 AWG)	3.5 mm^2 (12 AWG)	5.6 N-m (49.5 lb.-in.)
E 240V 30-37 kW (40-50 HP) 480V 55-75 kW (75-100 HP)	107.2 mm^2 (4/0 AWG)	53.5 mm^2 (1/0 AWG)	19.5 N-m (173 lb.-in.)
F	152.5 mm^2 (300 MCM)	85.0 mm^2 (3/0 AWG)	19.5 N-m (173 lb.-in.)

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations. If national or local codes require sizes outside this range, lugs may be used.

I/O Wiring Recommendations

Motor Start/Stop Precautions

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If used, the input device must not exceed one operation per minute or drive damage can occur.

ATTENTION: The drive start/stop control circuitry includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. When the AC line is removed, there will be a loss of any inherent regenerative braking effect that might be present - the motor will coast to a stop. An auxiliary braking method may be required.

Important points to remember about I/O wiring:

- Always use copper wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

ATTENTION: Driving the 4-20mA analog input from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

Control Wire Types

Table 1.E Recommended Control and Signal Wire(1)

Wire Type(s)	Description	Minimum Insulation Rating
Belden 8760/9460 (or equiv.)	0.8 mm^2 (18 AWG), twisted pair, 100% shield with drain.	300V 60 degrees C (140 degrees F)
Belden 8770 (or equiv.)	0.8 mm^2 (18 AWG), 3 conductor, shielded for remote pot only.	

(1) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

I/O Terminal Block

Table 1.F I/O Terminal Block Specifications

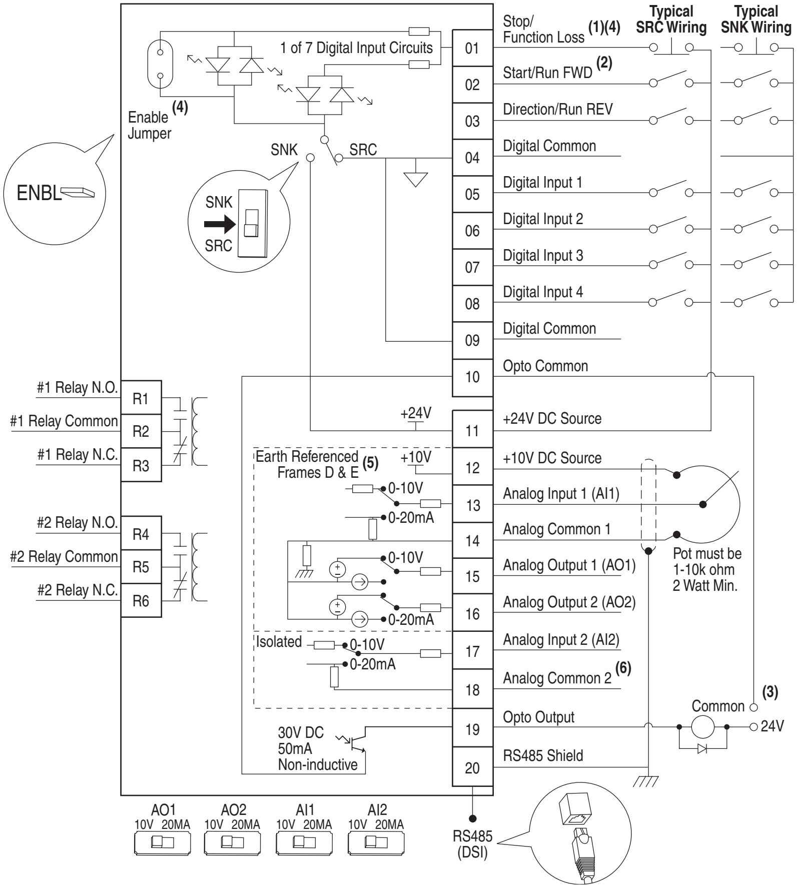
Frame	Maximum Wire Size (2)	Minimum Wire Size (2)	Torque
C, D, E, F	1.3 mm^2 (16 AWG)	0.13 mm^2 (26 AWG)	0.5-0.8 N-m (4.4-7 lb.-in.)

(2) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

Maximum Control Wire Recommendations

Do not exceed control wiring length of 30 meters (100 feet). Control signal cable length is highly dependent on electrical environment and installation practices. To improve noise immunity, the I/O terminal block Common must be connected to ground terminal/protective earth. If using the RS485 (DSI) port, I/O Terminal 20 should also be connected to ground terminal/protective earth.

Figure 1.7 Control Wiring Block Diagram



P036 [Start Source]	Stop	I/O Terminal 01 Stop
Keypad	Per P037	Coast
3-Wire	Per P037	Per P037(4)
2-Wire	Per P037	Coast
RS485 Port	Per P037	Coast

(1)**Important:** I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set to option 1 “3-Wire” or 6 “2-W Lvl/Enbl”. In three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. All other stop sources are controlled by P037 [Stop Mode].

Important: The drive is shipped with a jumper installed between I/O Terminals 01 and 11. Remove this jumper when using I/O Terminal 01 as a stop or enable input.

(2) Two wire control shown. For three wire control use a momentary input on I/O Terminal 02 to command a start. If reverse is enabled by A166, use a maintained input for I/O Terminal 03 to change direction.

(3) When using an opto output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown, to prevent damage to the output.

(4) When the ENBL enable jumper is removed, I/O Terminal 01 will always act as a hardware enable, causing a coast to stop without software interpretation.

(5) Most I/O terminals labeled “Common” are not referenced to the safety ground (PE) terminal and are designed to greatly reduce common mode interference. On Frame D and E drives, Analog Common 1 is referenced to ground.

(6) Common for Analog Input 2 (AI2). Electronically isolated from digital I/O and opto output. Not to be used with Analog Input 1 (AI1), Analog Output 1 (AO1) or Analog Output 2 (AO2). With Analog Input 2, provides one fully isolated analog input channel.

Table 1.G Control I/O Terminal Designations

No.	Signal	Default	Description	Param.
01	Stop (1) / Function Loss	Coast	Factory installed jumper or a normally closed input must be present for the drive to start. Program with P036 [Start Source].	P036 (1)
02	Start/Run FWD	–	HAND Mode: Command comes from Integral Keypad. AUTO Mode: I/O Terminal 02 is active. Program with P036 [Start Source].	P036, P037
03	Direction/Run REV	Rev Disabled	To enable reverse operation, program with A166 [Reverse Disable]. Program with P036 [Start Source].	P036, P037, A166
04	Digital Common	–	For digital inputs. Tied to I/O Terminal 09. Electronically isolated with digital inputs from analog I/O and opto output.	
05	Digital Input 1	Purge (2)	Program with T051 [Digital In1 Sel].	T051
06	Digital Input 2	Local	Program with T052 [Digital In2 Sel].	T052
07	Digital Input 3	Clear Fault	Program with T053 [Digital In3 Sel].	T053
08	Digital Input 4	Comm Port	Program with T054 [Digital In4 Sel].	T054
09	Digital Common	–	For digital inputs. Tied to I/O Terminal 04. Electronically isolated with digital inputs from analog I/O and opto output.	
10	Opto Common	–	For opto-coupled outputs. Electronically isolated with opto output from analog I/O and digital inputs.	
11	+24V DC	–	Drive supplied power for digital inputs. Referenced to Digital Common. Max. Output: 100mA.	
12	+10V DC	–	Drive supplied power for 0-10V external potentiometer. Referenced to Analog Common. Max. Output: 15mA.	P038
13	Analog Input 1	0-10V	External 0-10V (unipolar), 0-20mA or 4-20mA input supply or potentiometer wiper. Default input is 0-10V. For current (mA) input, set AI1 DIP Switch to 20mA. Program with T069 [Analog In 1 Sel]. Input Impedance: 100k ohm (Voltage Mode) 250 ohm (Current Mode)	T069, T070, T071, T072
14	Analog Common 1	–	Common for Analog Input 1 and Analog Output 1 and 2. Electrically isolated from digital I/O and opto output.	
15	Analog Output 1	OutFreq 0-10	Default analog output is 0-10V. For current (mA) value, set AO1 DIP Switch to 20mA. Program with T082 [Analog Out1 Sel]. Maximum Load: 4-20mA = 525 ohm (10.5V) 0-10V = 1k ohm (10mA)	P038, T051-T054, A152
16	Analog Output 2	OutCurr 0-10	Default analog output is 0-10V. For a current (mA) value, set AO2 DIP Switch to 20mA. Program with T085 [Analog Out2 Sel]. Maximum Load: 4-20mA = 525 ohm (10.5V) 0-10V = 1k ohm (10mA)	T082, T084, T085, T086, T087
17	Analog Input 2	0-10V	Optically isolated external 0-10V (unipolar), ±10V (bipolar), 0-20mA or 4-20mA input supply or potentiometer wiper. Default input is 0-10V. For current (mA) input, set AI2 DIP Switch to 20mA. Program with T073 [Analog In 2 Sel]. Input Impedance: 100k ohm (Voltage Mode) 250 ohm (Current Mode)	T073, T074, T075, T076
18	Analog Common 2	–	For Analog Input 2. Electronically isolated from digital I/O and opto output. With Analog Input 2, provides one fully isolated analog input channel.	
19	Opto Output	At Frequency	Program with T065 [Opto Out Sel].	T065, T066, T068
20	RS485 (DSI) Shield	–	Terminal connected to Safety Ground - PE when using the RS485 (DSI) Communication Port.	

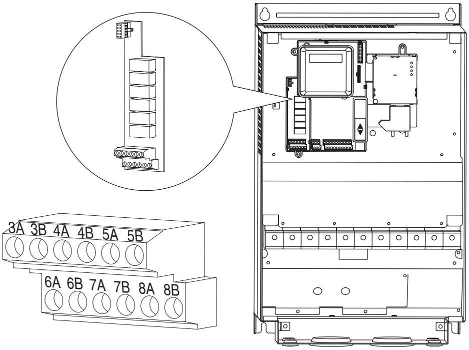
(1) See Footnotes (1) and (4) on page 1-17.

(2) **Important** information regarding Stop commands and the [Digital Inx Sel] Purge option is provided on page 3-12.

Table 1.H Relay Terminal Designations and DIP Switches

No.	Signal	Default	Description	Param.
R1	#1 Relay N.O.	Ready/Fault	Normally open contact for No. 1 output relay.	T055
R2	#1 Relay Common	–	Common for output relay.	
R3	#1 Relay N.C.	Ready/Fault	Normally closed contact for No. 1 output relay.	T055
R4	#2 Relay N.O.	Motor Running	Normally open contact for No. 2 output relay.	T060
R5	#2 Relay Common	–	Common for output relay.	
R6	#2 Relay N.C.	Motor Running	Normally closed contact for No. 2 output relay.	T060
Selection DIP Switches: Analog Input (AI1 & AI2) Analog Output (AO1 & AO2)		0-10V	Sets analog output to either voltage or current. Settings must match: AI1 & T069 [Analog In 1 Sel] AI2 & T073 [Analog In 2 Sel] AO1 & T082 [Analog Out1 Sel] AO2 & T085 [Analog Out2 Sel]	
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.	

Figure 1.8 User Installed Auxiliary Relay Card (Frames D, E, & F Only)

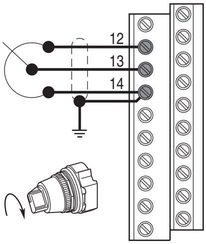
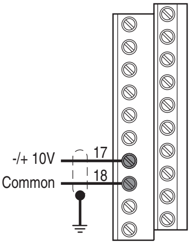
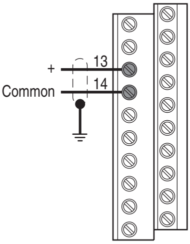
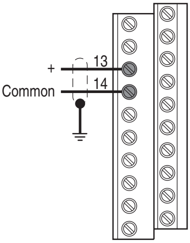
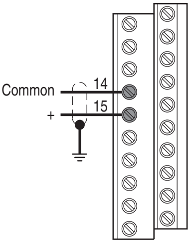


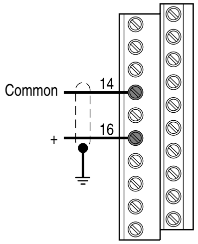
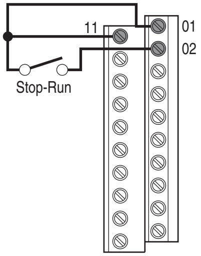
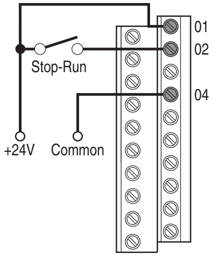
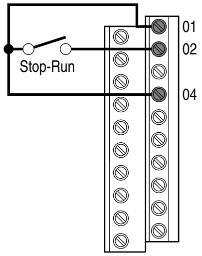
Important: If using auxiliary motor control, ensure that wiring and parameter configuration are correct before wiring contactor outputs. All relays on the Auxiliary Relay Card will energize on power-up by default. Failure to verify proper wiring and parameter configuration can result in improper motor operation or drive damage. Refer to Appendix D for more details.

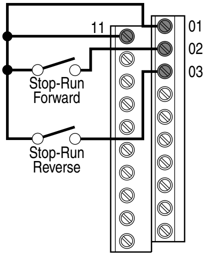
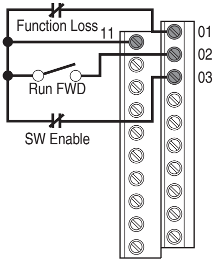
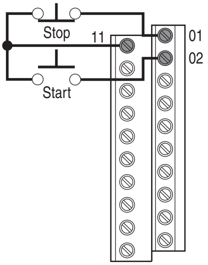
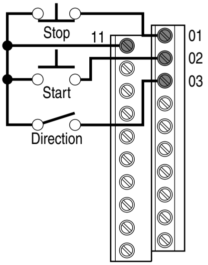
Table 1.I User Installed Relay Board Terminal Designations

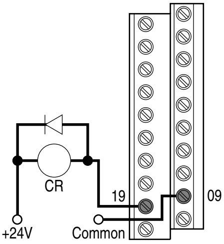
No.	Signal	Default	Description	Param.
3A	#3 Relay N.O.	Ready/Fault	Normally open contact for Number 3 Output Relay	R221
3B	#3 Relay Common	–	Common for Number 3 Output Relay	
4A	#4 Relay N.O.	Ready/Fault	Normally open contact for Number 4 Output Relay	R224
4B	#4 Relay Common	–	Common for Number 4 Output Relay	
5A	#5 Relay N.O.	Ready/Fault	Normally open contact for Number 5 Output Relay	R227
5B	#5 Relay Common	–	Common for Number 5 Output Relay	
6A	#6 Relay N.O.	Ready/Fault	Normally open contact for Number 6 Output Relay	R230
6B	#6 Relay Common	–	Common for Number 6 Output Relay	
7A	#7 Relay N.O.	Ready/Fault	Normally open contact for Number 7 Output Relay	R233
7B	#7 Relay Common	–	Common for Number 7 Output Relay	
8A	#8 Relay N.O.	Ready/Fault	Normally open contact for Number 8 Output Relay	R236
8B	#8 Relay Common	–	Common for Number 8 Output Relay	

I/O Wiring Examples

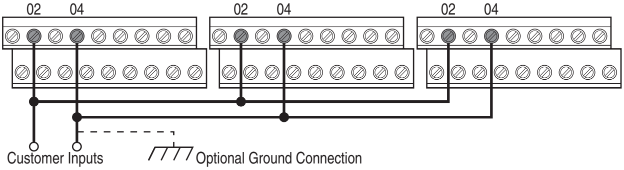
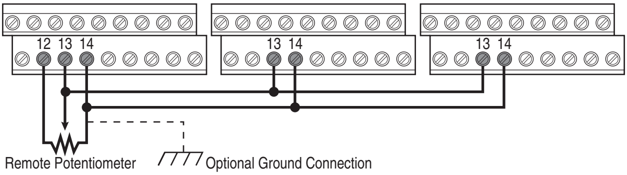
Input/Output	Connection Example	Required Settings
Potentiometer 1-10k Ohm Potentiometer Recommended (2 Watt Minimum)		DIP Switch AI1 = 10V Parameters P038 [Speed Reference] = 2 “Analog In1” T069 [Analog In 1 Sel] = 2 “0-10V” Scaling T070 [Analog In 1 Lo] T071 [Analog In 1 Hi] Check Results d305 [Analog In 1]
Analog Input Bipolar Speed Reference, ±10V Input		DIP Switch AI2 = 10V Parameters P038 [Speed Reference] = 3 “Analog In2” T073 [Analog In 2 Sel] = 3 “-10 to +10V” Scaling T074 [Analog In 2 Lo] T075 [Analog In 2 Hi] Check Results d306 [Analog In 2]
Analog Input Unipolar Speed Reference, 0 to +10V Input		DIP Switch AI1 = 10V Parameters P038 [Speed Reference] = 2 “Analog In1” T069 [Analog In 1 Sel] = 2 “0-10V” Scaling T070 [Analog In 1 Lo] T071 [Analog In 1 Hi] Check Results d305 [Analog In 1]
Analog Input Unipolar Speed Reference, 4-20 mA Input		DIP Switch AI1 = 20MA Parameters P038 [Speed Reference] = 2 “Analog In1” T069 [Analog In 1 Sel] = 1 “4-20 mA” Scaling T070 [Analog In 1 Lo] T071 [Analog In 1 Hi] Check Results d305 [Analog In 1]
Analog Output Unipolar, 0 to +10V Output • 1k Ohm Minimum		DIP Switch AO1 = 10V Parameters T082 [Analog Out1 Sel] = 0 through 6 Scaling T083 [Analog Out1 High] T084 [Analog Out1 Setpt]

Input/Output	Connection Example	Required Settings
Analog Output Unipolar, 4-20 mA Output • 525 Ohm Maximum		DIP Switch AO1 = 20MA Parameters T082 [Analog Out1 Sel] = 14 through 20 Scaling T083 [Analog Out1 High] T084 [Analog Out1 Setpt]
2 Wire Control Sourcing (SRC), Internal Supply, Non-Reversing • Input must be active for the drive to run. • When input is opened, the drive will stop as specified by P037 [Stop Mode]. • Drive will not run if I/O Terminal 01 is open. Drive will coast to stop if opened while running.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 2, 3, 4 P037 [Stop Mode] = 0 through 7
2 Wire Control Sourcing (SRC), External Supply, Non-Reversing • Input must be active for the drive to run. • When input is opened, the drive will stop as specified by P037 [Stop Mode]. • User supplied 24V DC power source must be used. • Each digital input draws 6 mA. • Drive will not run if I/O Terminal 01 is open. Drive will coast to stop if opened while running.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 2, 3, 4 P037 [Stop Mode] = 0 through 7
2 Wire Control Sinking (SNK), Internal Supply, Non-Reversing • Input must be active for the drive to run. • When input is opened, the drive will stop as specified by P037 [Stop Mode]. • Drive will not run if I/O Terminal 01 is open. Drive will coast to stop if opened while running.		DIP Switch SNK/SRC = SNK Parameters P036 [Start Source] = 2, 3, 4 P037 [Stop Mode] = 0 through 7

Input/Output	Connection Example	Required Settings
2 Wire Control Sourcing (SRC), Internal Supply, Run FWD/Run REV • Input must be active for the drive to run. • When input is opened, the drive will stop as specified by P037 [Stop Mode]. • If both Run FWD and Run REV inputs are closed at the same time, an undetermined state could occur. • Drive will not run if I/O Terminal 01 is open. Drive will coast to stop if opened while running.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 2, 3, 4 P037 [Stop Mode] = 0 through 7 A166 [Reverse Disable] = 0 “Enabled”
2 Wire Control with Function Loss and SW Enable Sourcing (SRC), Internal Supply, Non-Reversing • Input must be active for the drive to run. • When input is opened, the drive will stop as specified by P037 [Stop Mode]. • Drive will not run if I/O Terminal 03 is open. Drive will coast to stop if opened while running. • Drive will fault if I/O Terminal 01 is open. Drive will coast to stop if opened while running. Requires drive reset once terminal is closed.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 6 “2-W Lvl/Enbl” P037 [Stop Mode] = 0 through 7
3 Wire Control Sourcing (SRC), Internal Supply, Non-Reversing • A momentary input will start the drive. • A stop input to I/O Terminal 01 will stop the drive as specified by P037 [Stop Mode].		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 1 “3-Wire” P037 [Stop Mode] = 0 through 7
3 Wire Control Sourcing (SRC), Internal Supply, Reversing • A momentary input will start the drive. • A stop input to I/O Terminal 01 will stop the drive as specified by P037 [Stop Mode]. • I/O Terminal 03 determines direction.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 1 “3-Wire” P037 [Stop Mode] = 0 through 7 A166 [Reverse Disable] = 0 “Rev Enabled”

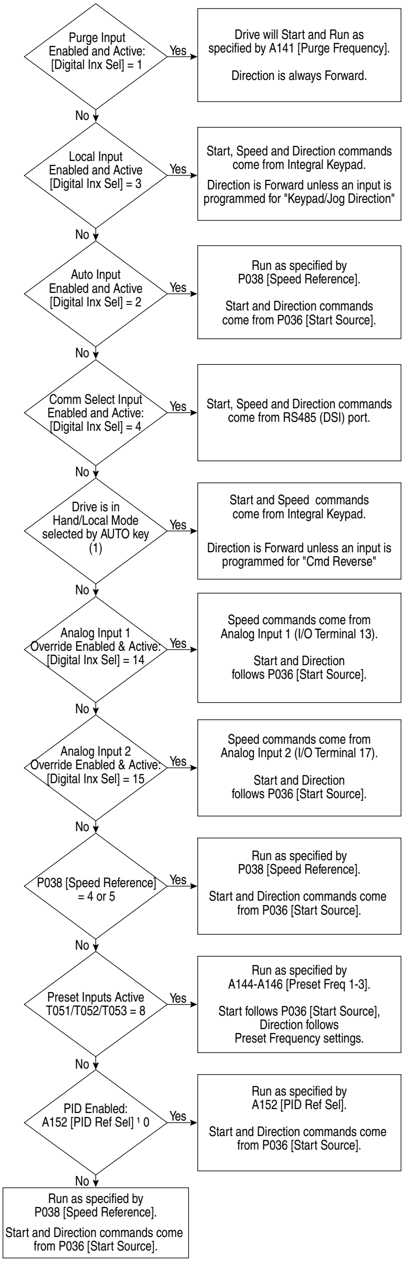
Input/Output	Connection Example	Required Settings
Opto Output • When using Opto Output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown to prevent damage to the output. • Opto Output is rated 30V DC, 50 mA (non-inductive).		Parameters T065 [Opto Out Sel] = 0 through 15 T066 [Opto Out Level] T068 [Opto Out Logic]

Typical Multiple Drive Connection Examples

Input/Output	Connection Example
Multiple Digital Input Connections Customer Inputs can be wired per External Supply (SRC).	 When connecting a single input such as Run, Stop, Reverse or Preset Speeds to multiple drives, it is important to connect I/O Terminal 04 common together for all drives. If they are to be tied into another common (such as earth ground or separate apparatus ground) only one point of the daisy chain of I/O Terminal 04 should be connected. **ATTENTION:** I/O Common terminals should **not** be tied together when using SNK (Internal Supply) mode. In SNK mode, if power is removed from one drive, inadvertent operation of other drives that share the same I/O Common connection may occur.
Multiple Analog Connections	 When connecting a single potentiometer to multiple drives it is important to connect I/O Terminal 14 common together for all drives. I/O Terminal 14 common and I/O Terminal 13 (potentiometer wiper) should be daisy-chained to each drive. All drives must be powered up for the analog signal to be read correctly.

Start and Speed Reference Control

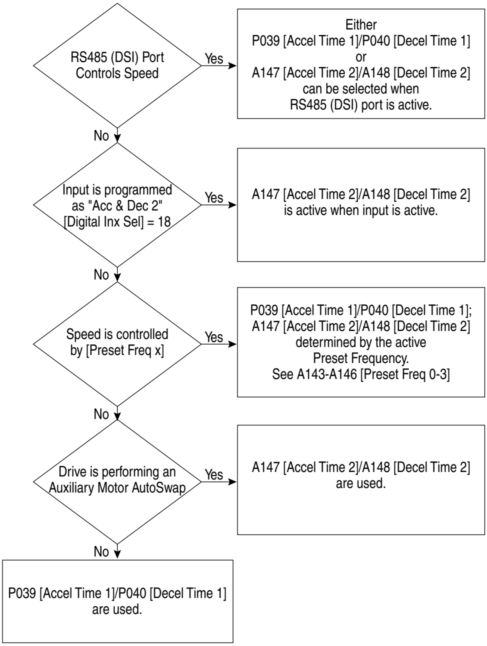
The drive speed command can be obtained from a number of different sources. The source is normally determined by P038 [Speed Reference]. The drive Start command is normally determined by P036 [Start Source]. However, the settings for these parameters can be overridden by a variety of methods. See the chart below for the override priority.



(1) Refer to page 2-6 for additional information on the operation of the Hand/Auto Mode.

Accel/Decel Selection

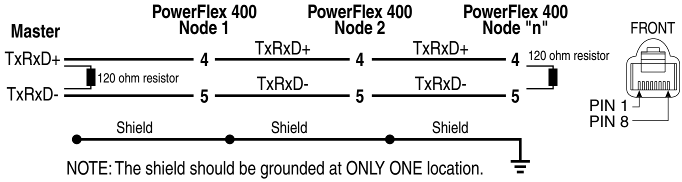
The Accel/Decel rate can be obtained by a variety of methods. The default rate is determined by P039 [Accel Time 1] and P040 [Decel Time 1]. Alternative Accel/Decel rates can be made through digital inputs, RS485 (DSI) communications and/or parameters. See the chart below for the override priority.



RS485 Network Wiring

Network wiring consists of a shielded 2-conductor cable that is daisy-chained from node to node.

Figure 1.9 Network Wiring Diagram



NOTE: The shield should be grounded at ONLY ONE location.

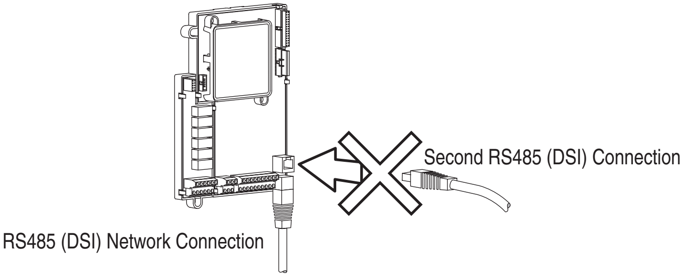
Only pins 4 and 5 on the RJ45 plug should be wired. The other pins on the PowerFlex 400 RJ45 socket contain power, etc. for other Rockwell Automation peripheral devices and must not be connected.

Wiring terminations on the master controller will vary depending on the master controller used and “TxRxD+” and “TxRxD-” are shown for illustration purposes only. Refer to the master controller’s user manual for network terminations. Note that there is no standard for the “+” and “-” wires, and consequently Modbus device manufacturers interpret them differently. If you have problems with initially establishing communications, try swapping the two network wires at the master controller.

On Drive Connections

PowerFlex 400 Frame D, E, and F drives are equipped with two RS485 (DSI) ports. One is accessible via an access door when the cover is on and one is only accessible with the cover off. When one of these ports has a Rockwell DSI device connected, the second port cannot be used.

Figure 1.10 Frame D, E, and F RS485 Ports



EMC Instructions

CE Conformity

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. PowerFlex Drives comply with the EN standards listed below when installed according to the User Manual.

CE Declarations of Conformity are available online at: **http://www.ab.com/certification/ce/docs**.

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

EMC Directive (89/336/EEC)

- EN61800-3 Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods.

General Notes

All Drive Frames

- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.
- Use of line filters in ungrounded systems is not recommended.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.

Frame C Drives Only

- If the plastic top panel is removed or the optional conduit box is not installed, the drive must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.

Essential Requirements for CE Compliance

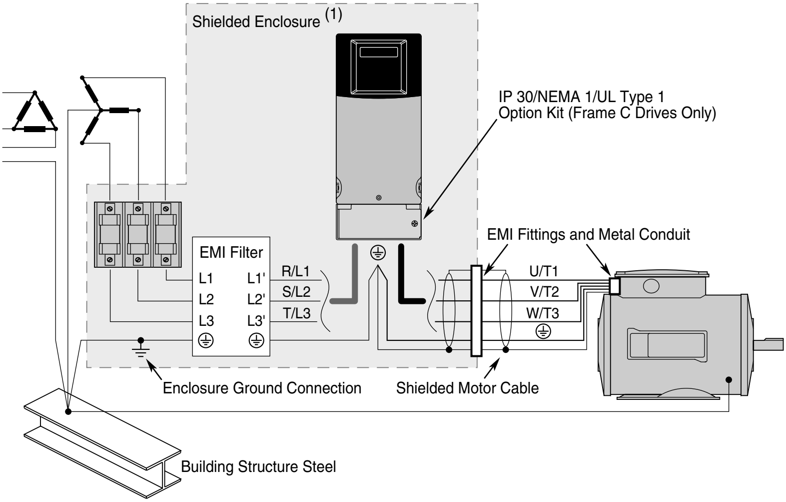
Conditions 1-4 listed below **must be** satisfied for PowerFlex drives to meet the requirements of **EN61800-3**.

1. Grounding as described in Figure 1.11. Refer to page 1-9 for additional grounding recommendations.
2. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
3. All shielded cables should terminate with the proper shield connector.
4. Conditions in Table 1.J.

Table 1.J PowerFlex 400 – EN61800-3 Compliance

PowerFlex 400 Drive		First Environment Restricted			First Environment Unrestricted		
kW (HP)	Cat. No. 22C-...	Required Filter (Allen-Bradley)	Restrict Motor Cable to (Meters)	Install Drive and Filter in Shielded Enclosure	Required Filter	Restrict Motor Cable to (Meters)	Install Drive and Filter in Shielded Enclosure
200-240 Volts							
2.2 (3.0)	B012N103	22-RF034-CS	10	No	22-RF034-CS	1	Required
3.7 (5.0)	B017N103	22-RF034-CS	10	No	22-RF034-CS	1	Required
5.5 (7.5)	B024N103	22-RF034-CS	10	No	22-RF034-CS	1	Required
7.5 (10)	B033N103	22-RF034-CS	10	No	22-RF034-CS	1	Required
11 (15)	B049A103	22-RFD070	150	Required	Deltron MIF Series	50	Required
15 (20)	B065A103	22-RFD100	150	Required	Deltron MIF Series	50	Required
18.5 (25)	B075A103	22-RFD100	150	Required	Deltron MIF Series	50	Required
22 (30)	B090A103	22-RFD150	150	Required	Deltron MIF Series	50	Required
30 (40)	B120A103	22-RFD150	150	No	Deltron MIF Series	50	Required
37 (50)	B145A103	22-RFD180	150	No	Deltron MIF Series	75	Required
380-480 Volts							
2.2 (3.0)	D6P0N103	22-RF018-CS	10	No	22-RF018-CS	1	Required
4.0 (5.0)	D010N103	22-RF018-CS	10	No	22-RF018-CS	1	Required
5.5 (7.5)	D012N103	22-RF018-CS	10	No	22-RF018-CS	1	Required
7.5 (10)	D017N103	22-RF018-CS	10	No	22-RF018-CS	1	Required
11 (15)	D022N103	22-RF026-CS	10	No	22-RF026-CS	1	Required
15 (20)	D030N103	22-RFD036	100	No	Deltron MIF Series	5	Required
18.5 (25)	D038A103	22-RFD050	150	No	Deltron MIF Series	5	Required
22 (30)	D045A103	22-RFD050	150	No	Deltron MIF Series	5	Required
30 (40)	D060A103	22-RFD070	50	No	Deltron MIF Series	5	Required
37 (50)	D072A103	22-RFD100	50	No	Deltron MIF Series	5	Required
45 (60)	D088A103	22-RFD100	50	No	Deltron MIF Series	5	Required
55 (75)	D105A103	22-RFD150	150	No	Deltron MIF Series	5	Required
75 (100)	D142A103	22-RFD180	50	No	Deltron MIF Series	5	Required
90 (125)	D170A103	Consult Factory			Consult Factory		
110 (150)	D208A103	Consult Factory			Consult Factory		

Figure 1.11 Connections and Grounding



(1) Shielded Enclosure required to meet EN61800-3 First Environment Restricted for 200-240V AC 11-22 kW (15-30 HP) PowerFlex 400 drives and to meet EN61800-3 First Environment Unrestricted for all PowerFlex 400 ratings.

FCC Instructions

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules when installed according to the User Manual. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the User Manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

Essential Requirements for FCC Compliance

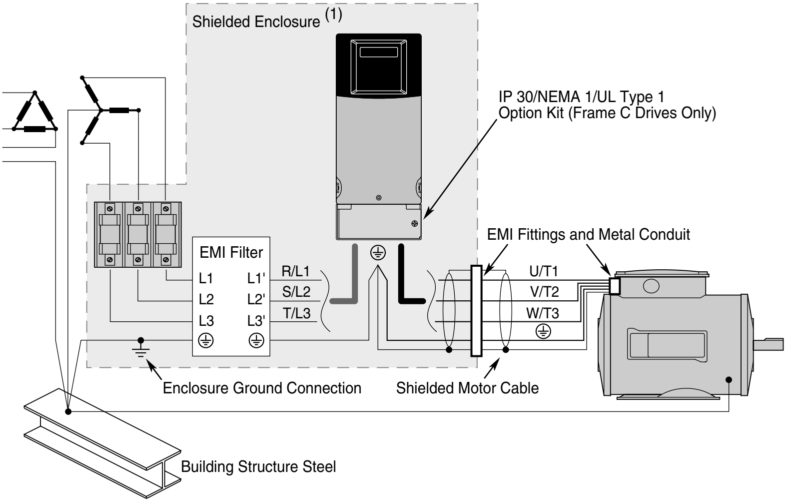
Conditions 1-4 listed below must be satisfied for PowerFlex 400 drives to meet the requirements of FCC Part 15 Subpart B.

1. Grounding as described in Figure 1.11. Refer to page 1-9 for additional grounding recommendations.
2. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
3. All shielded cables should terminate with the proper shield connector.
4. Conditions in Table 1.K.

Table 1.K PowerFlex 400 – FCC Part 15 Subpart B Compliance

PowerFlex 400 Drive		Required Filter	Restrict Motor Cable to (Meters)	Install Drive and Filter in Enclosure
kW (HP)	Cat. No.			
200-240 Volts				
2.2 (3.0)	22C-B012N103	22-RF034-CS	10	No
3.7 (5.0)	22C-B017N103	22-RF034-CS	10	No
5.5 (7.5)	22C-B024N103	22-RF034-CS	10	No
7.5 (10)	22C-B033N103	22-RF034-CS	10	No
11 (15)	22C-B049A103	22-RFD070	150	Required
15 (20)	22C-B065A103	22-RFD100	150	Required
18.5 (25)	22C-B075A103	22-RFD100	150	Required
22 (30)	22C-B090A103	22-RFD150	150	Required
30 (40)	22C-B120A103	22-RFD150	150	No
37 (50)	22C-B145A103	22-RFD180	150	No
380-480 Volts				
2.2 (3.0)	22C-D6P0N103	22-RF018-CS	10	No
4.0 (5.0)	22C-D010N103	22-RF018-CS	10	No
5.5 (7.5)	22C-D012N103	22-RF018-CS	10	No
7.5 (10)	22C-D017N103	22-RF018-CS	10	No
11 (15)	22C-D022N103	22-RF026-CS	10	No
15 (20)	22C-D030N103	22-RFD036	100	No
18.5 (25)	22C-D038A103	22-RFD050	150	No
22 (30)	22C-D045A103	22-RFD050	150	No
30 (40)	22C-D060A103	22-RFD070	50	No
37 (50)	22C-D072A103	22-RFD100	50	No
45 (60)	22C-D088A103	22-RFD100	50	No
55 (75)	22C-D105A103	22-RFD150	150	No
75 (100)	22C-D142A103	22-RFD180	50	No
90 (125)	22C-D170A103	Consult Factory		
110 (150)	22C-D208A103	Consult Factory		

Figure 1.12 Connections and Grounding



(1) Shielded Enclosure required for 200-240V AC 11-22 kW (15-30 HP) PowerFlex 400 drives.

Notes:

Start Up

This chapter describes how to start up the PowerFlex 400 Drive. To simplify drive setup, the most commonly programmed parameters are organized in a single Basic Program Group.

Important: Read the *General Precautions* section before proceeding.

ATTENTION: Power must be applied to the drive to perform the following start-up procedures. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed**. **Remove All Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

Prepare For Drive Start-Up

Before Applying Power to the Drive

☐ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

☐ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

☐ **3.** Verify that any digital control power is 24 volts.

☐ **4.** Verify that the Sink (SNK)/Source (SRC) Setup DIP Switch is set to match your control wiring scheme. See Table 1.G on page 1-18 for location.

Important: The default control scheme is Source (SRC). The Stop terminal is jumpered (I/O Terminals 01 and 11) to allow starting from the keypad. If the control scheme is changed to Sink (SNK), the jumper must be removed from I/O Terminals 01 and 11 and installed between I/O Terminals 01 and 04.

☐ **5.** Verify that the Stop input is present or the drive will not start.

Important: If I/O Terminal 01 is used as a stop input, the jumper between I/O Terminals 01 and 11 must be removed.

☐ **6.** Verify that the Analog I/O DIP Switches are set to 10 volts.

Applying Power to the Drive

☐ **7.** Apply AC power and control voltages to the drive.

☐ **8.** Familiarize yourself with the integral keypad features (see page 2-3) before setting any Program Group parameters.

Start, Stop, Direction and Speed Control

Factory default parameter values allow the drive to be controlled from the integral keypad. No programming is required to start, stop, and control speed directly from the integral keypad.

If a fault appears on power up, refer to Fault Descriptions on page 4-3 for an explanation of the fault code.

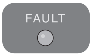
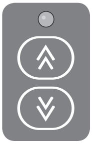
Integral Keypad

Operator Keys

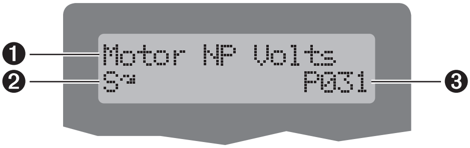
Key	Name	Description
ESC	Escape	Back one step in programming menu. Cancel a change to a parameter value and exit Program Mode.
SEL	Select	Advance one step in programming menu. Select a digit when viewing parameter value.
▲ ▼	Up Arrow Down Arrow	Scroll through groups and parameters. Increase/decrease the value of a flashing digit.
↵	Enter	Advance one step in programming menu. Save a change to a parameter value.
⩓ ⩔	Digital Speed Increment and Decrement Arrows	Used to control speed of drive. Default is active. Control is activated by parameter P038 [Speed Reference] or P042 [Auto Mode].
I HAND	Run/Start & Hand (1)	Used to start the drive. Default is Hand mode as controlled by parameter P042 [Auto Mode]. Control is activated by parameter P036 [Start Source] or P042 [Auto Mode].
AUTO AUTO	Auto (1)	Used to select Auto control mode. Controlled by parameter P042 [Auto Mode].
○ OFF	Stop/Off	Used to stop the drive or clear a fault. This key is always active. Controlled by parameter P037 [Stop Mode].

(1) **Important:** Certain digital input settings can override drive operation. Refer to Start and Speed Reference Control on page 1-24 for details.

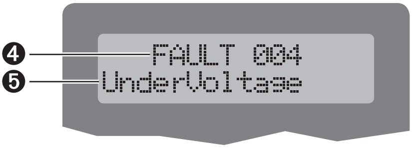
LED Status Indicators

LED	LED State	Description
Program Status 	Steady Red	Indicates parameter value can be changed. Selected digit will flash.
Fault Status 	Flashing Red	Indicates that the drive is faulted.
Speed Status 	Steady Green	Indicates that the digital speed control keys are enabled.
Hand Status 	Steady Green	Indicates that the Run/Start key is enabled.
Auto Status 	Steady Yellow	Indicates that the drive is in Auto mode.

LCD Display



No.	Description
❶	Parameter Name
❷	**Run/Stop Status:** S→ & S← = Stopped / R→ & R← = Running R→ or R← flashes to indicate that the drive is stopping, but is still decelerating. R→ or R← flashes when DC Injection is commanded. **Direction Indication:** The Direction Arrow → & ← indicates the commanded direction of rotation. If the Arrow is flashing, the drive has been commanded to change direction, but is still decelerating. **Sleep Mode Indication:** R→ or R← flashes to indicate that the drive is in sleep mode.
❸	Parameter Group and Number: b = Basic Display C = Communications d = Advanced Display P = Basic Program A = Advanced Program T = Terminal Block R = Aux Relay Card



❹	Fault Indication and Fault Number
❺	Fault Name

Viewing and Editing Parameters

The last user-selected Basic Display Group parameter is saved when power is removed and is displayed by default when power is reapplied.

The following is an example of basic integral keypad and display functions. This example provides basic navigation instructions and illustrates how to program the first Basic Program Group parameter.

Step	Key(s)	Example Displays
1. When power is applied, the last user-selected Basic Display Group parameter number is displayed with flashing characters. The display then defaults to that parameter's current value. (Example shows the value of b001 [Output Freq] with the drive stopped.)		Output Freq 0.00 Hz
2. Press the Up Arrow or Down Arrow to scroll through the Basic Display Group parameters. (Only in Display Groups)	▲ or ▼	
3. Press Esc once to display the Basic Display Group parameter number shown on power-up. The parameter number will flash.	ESC	Output Freq b001
4. Press Esc again to enter the group menu. The group menu letter will flash.	ESC	Basic Display b001
5. Press the Up Arrow or Down Arrow to scroll through the group menu (b, P, T, C, A and d).	▲ or ▼	Basic Program P031
6. Press Enter or Sel to enter a group. The right digit of the last viewed parameter in that group will flash.	↵ or SEL	Basic Program P031
7. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the group.	▲ or ▼	
8. Press Enter or Sel to view the value of a parameter. If you do not want to edit the value, press Esc to return to the parameter number.	↵ or SEL	Motor NP Volts 230 Vac
9. Press Enter or Sel to enter program mode to edit the parameter value. The right digit will flash and the Program LED will illuminate if the parameter can be edited.	↵ or SEL	Motor NP Volts 230 Vac
10. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash.	SEL	Motor NP Volts 230 Vac
11. Press the Up Arrow or Down Arrow to change the parameter value.	▲ or ▼	
12. Press Esc to cancel a change. The digit will stop flashing, the previous value is restored and the Program LED will turn off.	ESC	
Or		
Press Enter to save a change. The digit will stop flashing and the Program LED will turn off.	↵	Motor NP Volts 220 Vac
13. Press Esc to return to the parameter list. Continue to press Esc to back out of the programming menu.	ESC	Basic Program P031
If pressing Esc does not change the display, then b001 [Output Freq] is displayed. Press Enter or Sel to enter the last group menu viewed.		

The Basic Program Group (page 3-7) contains the most commonly changed parameters.

Keypad Hand-Off-Auto Functions

Parameter P042 [Auto Mode] defines the operation mode of the control keys on the integral keypad.

Hand-Off-Auto Mode

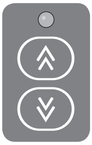
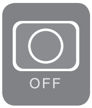
In HAND mode:

- Control keys operate as Hand-Off-Auto.
- Start command and speed reference come from the integral keypad Start/Hand and Digital Speed Increment and Decrement keys.
- Auto key switches control from HAND mode to AUTO mode in a bumpless transfer as long as there is an active Run command.

In AUTO mode:

- Auto key LED is illuminated.
- Start command is defined by P036 [Start Source].
- Speed Reference command is defined by P038 [Speed Reference].
- Start/Hand key switches control to the integral keypad in a bumpless transfer and switches the speed reference to the integral keypad.
- Stop key stops the drive and the drive switches to HAND mode.

**Table 2.A P042 [Auto Mode] = 1 "Hnd-Off-Auto" (Default)
T051-T054 [Digital Inx Sel] ≠ 2 "Auto Mode" or 3 "Local"**

	HAND Mode		AUTO Mode	
Key	**LED**	**Key Function**	**LED**	**Key Function**
	On	Starts drive. Runs according to Speed Increment/ Decrement keys.	On	Changes to HAND Mode and Starts drive. Runs according to Speed Increment/ Decrement keys.
	On	Changes speed.	Off	Not active. Keys are only active if P038 [Speed Source] = 0 "Drive Pot".
	Off	Changes to AUTO Mode.	On	Not active.
	N/A	Stops drive.	N/A	Changes to HAND Mode and Stops drive.

Important: Certain digital input settings can override drive operation. Refer to Start and Speed Reference Control on page 1-24 for details.

Local/Remote Mode

In Local mode:

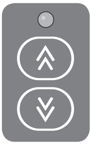
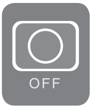
- Start command and speed reference come from the integral keypad Start/Hand and Digital Speed Increment and Decrement keys.
- Auto key stops the drive and the drive switches to Remote mode.

Important: If the drive is running and P036 [Start Source] = 3 or 6 (2-Wire Control), the drive will continue to run at reference defined by P038 [Speed Reference] if a valid start command is present.

In Remote mode:

- Auto key LED is illuminated.
- Start command is defined by P036 [Start Source].
- Speed Reference command is defined by P038 [Speed Reference].
- Auto key stops the drive and the drive switches to Local mode.

Table 2.B P042 [Auto Mode] = 2 "Local/Remote"
T051-T054 [Digital Inx Sel] ≠ 2 "Auto Mode" or 3 "Local"

	Local Mode		Remote Mode	
Key	LED	Key Function	LED	Key Function
	On	Starts drive. Runs according to Speed Increment/ Decrement keys.	Off	Not active. Only active if P036 [Start Source] = 0 "Keypad". Starts drive.
	On	Changes speed.	Off	Not active. Keys are only active if P038 [Speed Source] = 0 "Drive Pot".
	Off	Stops drive and changes to Remote Mode.	On	Stops drive and changes to Local Mode.
	N/A	Stops drive.	N/A	Stops drive.

Important: Certain digital input settings can override drive operation. Refer to Start and Speed Reference Control on page 1-24 for details.

Auto/Manual Mode

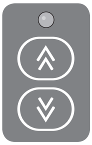
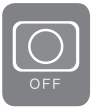
In Manual mode:

- Start command is defined by P036 [Start Source].
- Speed Reference command is defined by the Digital Speed Increment and Decrement keys.
- Auto key toggles frequency control to AUTO in a bumpless transfer.

In AUTO mode:

- Auto key LED is illuminated.
- Start command is defined by P036 [Start Source].
- Speed Reference command is defined by P038 [Speed Reference].
- Auto key switches frequency control to the integral keypad in a bumpless transfer.

Table 2.C P042 [Auto Mode] = 3 “Auto/Manual”
T051-T054 [Digital Inx Sel] ≠ 2 “Auto Mode” or 3 “Local”

	Manual Mode		AUTO Mode	
Key	LED	Key Function	LED	Key Function
 HAND	Off ●	Not active. Only active if P036 [Start Source] = 0 “Keypad”. Starts drive. Runs according to Speed Increment/Decrement keys.	Off ●	Not active. Only active if P036 [Start Source] = 0 “Keypad”. Starts drive.
	On ☼	Changes speed.	Off ●	Not active. Keys are only active if P038 [Speed Reference] = 0 “Drive Pot”.
 AUTO	Off ●	Changes to AUTO Mode. If running, drive will continue to run at reference defined by P038 [Speed Reference].	On ☼	Changes to Manual Mode. If running, drive will continue to run according to Digital Speed Increment and Decrement keys.
 OFF	N/A	Stops drive.	N/A	Stops drive.

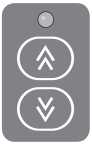
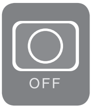
Important: Certain digital input settings can override drive operation. Refer to Start and Speed Reference Control on page 1-24 for details.

No Function Mode

In No Function mode:

- The Auto key has no function
- Start command is defined by P036 [Start Source]
- Speed Reference command is defined by P038 [Speed Reference]

Table 2.D P042 [Auto Mode] = 0 “No Function”
T051-T054 [Digital Inx Sel] ≠ 2 “Auto Mode” or 3 “Local”

Key	LED	Key Function
	Off	Not active. Only active if P036 [Start Source] = 0 “Keypad”. Starts drive.
	On	Not active. Only active if P038 [Speed Reference] = 0 “Drive Pot”. Changes drive speed.
	Off	Not active.
	N/A	Stops drive.

Important: Certain digital input settings can override drive operation. Refer to Start and Speed Reference Control on page 1-24 for details.

Notes:

Chapter 3

Programming and Parameters

Chapter 3 provides a complete listing and description of the PowerFlex 400 parameters. Parameters are programmed (viewed/edited) using the integral keypad. As an alternative, programming can also be performed using DriveExplorer™ or DriveExecutive™ software, a personal computer and a serial converter module. Refer to Appendix B for catalog numbers.

About Parameters

To configure a drive to operate in a specific way, drive parameters may have to be set. Three types of parameters exist:

- **ENUM**
  ENUM parameters allow a selection from 2 or more items. Each item is represented by a number.
- **Numeric Parameters**
  These parameters have a single numerical value (i.e. 0.1 Volts).
- **Bit Parameters**
  Bit parameters have four or more individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.

Some parameters are marked as follows.

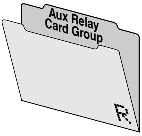
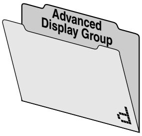
○ = Stop drive before changing this parameter.

32 = 32 bit parameter. Parameters marked 32 bit will have two parameter numbers when using RS485 communications and programming software.

Parameter Organization

Refer to page 3-58 for an alphabetical listing of parameters.

Group	Parameters					
Basic Display	Output Freq	b001	Drive Status	b006	Elapsed MWh	b011
	Commanded Freq	b002	Fault 1 Code	b007	Elapsed Run Time	b012
	Output Current	b003	Process Display	b008	Torque Current	b013
	Output Voltage	b004	Output Power	b010	Drive Temp	b014
	DC Bus Voltage	b005			Elapsed kWh	b015
Basic Program	Motor NP Volts	P031	Maximum Freq	P035	Accel Time 1	P039
	Motor NP Hertz	P032	Start Source	P036	Decel Time 1	P040
	Motor OL Current	P033	Stop Mode	P037	Reset To Defalts	P041
	Minimum Freq	P034	Speed Reference	P038	Auto Mode	P042
					Motor OL Ret	P043
Terminal Block	Digital In1 Sel	T051	Opto Out Sel	T065	Sleep-Wake Sel	T077
	Digital In2 Sel	T052	Opto Out Level	T066	Sleep Level	T078
	Digital In3 Sel	T053	Opto Out Logic	T068	Sleep Time	T079
	Digital In4 Sel	T054	Analog In 1 Sel	T069	Wake Level	T080
	Relay Out1 Sel	T055	Analog In 1 Lo	T070	Wake Time	T081
	Relay Out1 Level	T056	Analog In 1 Hi	T071	Analog Out1 Sel	T082
	Relay 1 On Time	T058	Analog In 1 Loss	T072	Analog Out1 High	T083
	Relay 1 Off Time	T059	Analog In 2 Sel	T073	Analog Out1 Setpt	T084
	Relay Out2 Sel	T060	Analog In 2 Lo	T074	Analog Out2 Sel	T085
	Relay Out2 Level	T061	Analog In 2 Hi	T075	Analog Out2 High	T086
	Relay 2 On Time	T063	Analog In 2 Loss	T076	Analog Out2 Setpt	T087
	Relay 2 Off Time	T064			Anlg Loss Delay	T088
Communications	Language	C101	Comm Format	C102	Start Source 2	C108
			Comm Data Rate	C103	Speed Ref 2	C109
			Comm Node Addr	C104		
			Comm Loss Action	C105		
			Comm Loss Time	C106		
			Comm Write Mode	C107		
Advanced Program	Purge Frequency	A141	Process Factor	A160	Motor OL Select	A181
	Internal Freq	A142	Auto Rstrt Tries	A163	Drive OL Mode	A182
	Preset Freq 0	A143	Auto Rstrt Delay	A164	SW Current Trip	A183
	Preset Freq 1	A144	Start At PowerUp	A165	Load Loss Level	A184
	Preset Freq 2	A145	Reverse Disable	A166	Load Loss Time	A185
	Preset Freq 3	A146	Flying Start En	A167	Stall Fault Time	A186
	Accel Time 2	A147	PWM Frequency	A168	Bus Reg Mode	A187
	Decel Time 2	A148	PWM Mode	A169	Skip Frequency 1	A188
	S Curve %	A149	Boost Select	A170	Skip Freq Band 1	A189
	PID Trim Hi	A150	Start Boost	A171	Skip Frequency 2	A190
	PID Trim Lo	A151	Break Voltage	A172	Skip Freq Band 2	A191
	PID Ref Sel	A152	Break Frequency	A173	Skip Frequency 3	A192
	PID Feedback Sel	A153	Maximum Voltage	A174	Skip Freq Band 3	A193
	PID Prop Gain	A154	Slip Hertz @ FLA	A175	Compensation	A194
	PID Integ Time	A155	DC Brake Time	A176	Reset Meters	A195
	PID Diff Rate	A156	DC Brake Level	A177	Testpoint Sel	A196
	PID Setpoint	A157	DC Brk Time@Strt	A178	Fault Clear	A197
	PID Deadband	A158	Current Limit 1	A179	Program Lock	A198
	PID Preload	A159	Current Limit 2	A180	Motor NP Poles	A199
					Motor NP FLA	A200

Group	Parameters					
Aux Relay Card	Relay Out3 Sel	R221	Aux Motor Mode	R239	Aux Start Delay	R250
	Relay Out3 Level	R222	Aux Motor Qty	R240	Aux Stop Delay	R251
	Relay Out4 Sel	R224	Aux 1 Start Freq	R241	Aux Prog Delay	R252
	Relay Out4 Level	R225	Aux 1 Stop Freq	R242	Aux AutoSwap Tme	R253
	Relay Out5 Sel	R227	Aux 1 Ref Add	R243	Aux AutoSwap Lvl	R254
	Relay Out5 Level	R228	Aux 2 Start Freq	R244		
	Relay Out6 Sel	R230	Aux 2 Stop Freq	R245		
	Relay Out6 Level	R231	Aux 2 Ref Add	R246		
	Relay Out7 Sel	R233	Aux 3 Start Freq	R247		
	Relay Out7 Level	R234	Aux 3 Stop Freq	R248		
	Relay Out8 Sel	R236	Aux 3 Ref Add	R249		
	Relay Out8 Level	R237				
Advanced Display	Control Source	d301	Fault 1 Time-hr	d310	Output Powr Fctr	d318
	Contrl In Status	d302	Fault 1 Time-min	d311	Testpoint Data	d319
	Comm Status	d303	Fault 2 Time-hr	d312	Control SW Ver	d320
	PID Setpnt Displ	d304	Fault 2 Time-min	d313	Drive Type	d321
	Analog In 1	d305	Fault 3 Time-hr	d314	Output Speed	d322
	Analog In 2	d306	Fault 3 Time-min	d315	Output RPM	d323
	Fault 1 Code	d307	Elapsed Time-hr	d316	Fault Frequency	d324
	Fault 2 Code	d308	Elapsed Time-min	d317	Fault Current	d325
	Fault 3 Code	d309			Fault Bus Volts	d326
					Status @ Fault	d327

Basic Display Group

b001 [Output Freq]

Related Parameter(s): b002, b008, P034, P035, P038

Output frequency present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.00/P035 [Maximum Freq]
	Display:	0.01 Hz

b002 [Commanded Freq]

Related Parameter(s): b001, P034, P035, P038, d302

Value of the active frequency command. Displays the commanded frequency even if the drive is not running.

Important: The frequency command can come from a number of sources. Refer to Start and Speed Reference Control on page 1-24 for details.

Values	Default:	Read Only
	Min/Max:	0.00/P035 [Maximum Freq]
	Display:	0.01 Hz

b003 [Output Current]

The output current present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

b004 [Output Voltage]

Related Parameter(s): P031, A170, A174

Output voltage present at terminals T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0/510
	Display:	1 VAC

b005 [DC Bus Voltage]

Present DC bus voltage level.

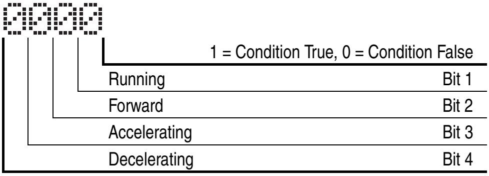
Values	Default:	Read Only
	Min/Max:	0/820
	Display:	1 VDC

Basic Display Group *(continued)*

b006 [Drive Status]

Related Parameter(s): A166

Present operating condition of the drive.



Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

b007 [Fault 1 Code]

Related Parameter(s): A186, A197, d307-d315

A code that represents a drive fault. [Fault 1 Code] is the most recent fault. Repetitive faults will only be recorded once.

Refer to Chapter 4 for fault code descriptions.

Values	Default:	Read Only
	Min/Max:	0/122
	Display:	1

b008 [Process Display]

Related Parameter(s): b001, A160

32 32 bit parameter.

The output frequency scaled by A160 [Process Factor].

Output Freq x Process Factor = Process Display

Values	Default:	Read Only
	Min/Max:	0.00/9999.99
	Display:	0.01 – 1

b010 [Output Power]

Output power present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.0/999.9
	Display:	0.1 kW

Basic Display Group *(continued)*

b011 [Elapsed MWh]

Related Parameter(s): b015, A195

Accumulated output energy of the drive.

Values	Default:	Read Only
	Min/Max:	0/3276.7
	Display:	0.1 MWh

b012 [Elapsed Run Time]

Related Parameter(s): A195

Displays the accumulated time that the drive has output power since the last A195 [Reset Meter]. Time is displayed in 10 hour increments.

Values	Default:	Read Only
	Min/Max:	0/9999 Hrs
	Display:	1 = 10 Hrs

b013 [Torque Current]

Displays the torque portion of the output current.

Values	Default:	Read Only
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

b014 [Drive Temp]

Present operating temperature of the drive power section.

Values	Default:	Read Only
	Min/Max:	0/120 degC
	Display:	1 degC

b015 [Elapsed kWh]

Related Parameter(s): b011, A195

Accumulated output energy of the drive. This parameter works in conjunction with [Elapsed MWh]. When the maximum value of this parameter is reached, this parameter resets to zero and [Elapsed MWh] is incremented.

Values	Default:	Read Only
	Min/Max:	0.0/100.0 kWh
	Display:	0.1 kWh

Basic Program Group

P031 [Motor NP Volts]

Related Parameter(s): b004, A170, A171, A172, A173

Stop drive before changing this parameter.

Set to the motor nameplate rated volts.

Values	Default:	Based on Drive Rating
	Min/Max:	20/Drive Rated Volts
	Display:	1 VAC

P032 [Motor NP Hertz]

Related Parameter(s): A170, A171, A172, A173, A181, A182

Stop drive before changing this parameter.

Set to the motor nameplate rated frequency.

Values	Default:	60 Hz
	Min/Max:	15/320 Hz
	Display:	1 Hz

P033 [Motor OL Current]

Related Parameter(s): P042, T055, T060, T065, A175, A179, A180, A181, A183

Set to the maximum allowable motor current.

The drive will fault on an F7 Motor Overload if the value of this parameter is exceeded by 150% for 60 seconds.

Values	Default:	Drive Rated Amps
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

P034 [Minimum Freq]

Related Parameter(s): b001, b002, P035, T070, T074, A171, A172, A173, d302

Sets the lowest frequency the drive will output continuously.

Values	Default:	0.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

P035 [Maximum Freq]

Related Parameter(s): b001, b002, P034, T071, T075, T082, T083, T085, T086, A171, A172, A173, d302

Stop drive before changing this parameter.

Sets the highest frequency the drive will output.

Values	Default:	60.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Basic Program Group *(continued)*

P036 [Start Source]

Related Parameter(s): P037, P042, A166, d301

Stop drive before changing this parameter.

Sets the control scheme used to start the drive when in Auto/Remote mode.

Refer to Start and Speed Reference Control on page 1-24 for details about how other drive settings can override the setting of this parameter.

Important: For all settings except options 3 and 6, the drive must receive a leading edge from the start input for the drive to start after a stop input, loss of power or fault condition.

Options	**0**	“Keypad”	Integral keypad controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Not Used • I/O Terminal 03 = Not Used
	1	“3-Wire”	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Per P037 [Stop Mode] • I/O Terminal 02 = Start • I/O Terminal 03 = Direction
	2	“2-Wire”	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV
	3	“2-W Lvl Sens” (Default) See Attention Below	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV Drive will restart after a “Stop” command when: • Stop is removed and Run FWD is held active
	4	“2-W Hi Speed”	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV Outputs are kept in a ready-to-run state. The drive will respond to a “Start” command within 10 ms. **Important:** There is greater potential voltage on the output terminals when using this option.
	5	“Comm Port”	Remote communications controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Not Used • I/O Terminal 03 = Not Used
	6	“2-W Lvl/Enbl” See Attention Below	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Function Loss: Fault and Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = SW Enable Drive will restart after a “Stop” command when: • Stop is removed and Run FWD is held active

ATTENTION: Hazard of injury exists due to unintended operation. When P036 [Start Source] is set to option 3 or option 6, and the Run input is maintained, the Run inputs do not need to be toggled after a Stop input or a fault clear for the drive to run again. The drive will stop only when the stop command is maintained or the drive is faulted.

Basic Program Group *(continued)*

P037 [Stop Mode]

Related Parameter(s): P036, C105, A176, A177, A178

Active stop mode for all stop sources [e.g. keypad, run forward (I/O Terminal 02), run reverse (I/O Terminal 03), RS485 port] except as noted below.

Important: I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set for "3-Wire" control. When in three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode].

Hardware Enable Circuitry

By default, I/O Terminal 01 is a coast to stop input. The status of the input is interpreted by drive software. If the application requires the drive to be disabled without software interpretation, a "dedicated" hardware enable configuration can be utilized. This is accomplished by removing the ENBL enable jumper on the control board. See page 1-17 for details. In this case, the drive will always coast to a stop regardless of the settings of P036 [Start Source] and P037 [Stop Mode].

Options	**0**	"Ramp, CF"[1]	Ramp to Stop. "Stop" command clears active fault.
	1	"Coast, CF"[1] (Default)	Coast to Stop. "Stop" command clears active fault.
	2	"DC Brake, CF"[1]	DC Injection Braking Stop. "Stop" command clears active fault.
	3	"DCBrkAuto,CF"[1]	DC Injection Braking Stop with Auto Shutoff. • Standard DC Injection Braking for value set in A176 [DC Brake Time]. OR • Drive shuts off if the drive detects that the motor is stopped. "Stop" command clears active fault.
	4	"Ramp"	Ramp to Stop.
	5	"Coast"	Coast to Stop.
	6	"DC Brake"	DC Injection Braking Stop.
	7	"DC BrakeAuto"	DC Injection Braking Stop with Auto Shutoff. • Standard DC Injection Braking for value set in A176 [DC Brake Time]. OR • Drive shuts off if the drive detects that the motor is stopped.

---

(1) Stop input also clears active fault.

Basic Program Group *(continued)*

P038 [Speed Reference]

Related Parameter(s): b001, b002, P038, P040, P042, T051-T054, T070, T071, T073, T074, T075, C102, A141, A142, A143-A146, A152, d301

Sets the source of the speed reference to the drive.

The drive speed command can be obtained from a number of different sources. The source is normally determined by P038 [Speed Reference]. However, when T051 - T054 [Digital Inx Sel] is set to option 1, 2, 3, 4, 5, 8, 14, 15, 16, 17 and the digital input is active, or if A152 [PID Ref Sel] is not set to option 0, the speed reference commanded by P038 [Speed Reference] will be overridden. Refer to the flowchart on page 1-24 for more information on speed reference control priority.

Options	**0**	"Drive Keypad"	Internal frequency command from the digital speed keys on the integral keypad.
	1	"InternalFreq"	Internal frequency command from A142 [Internal Freq]. Must be set when using MOP function.
	2	"Analog In 1" (Default)	External frequency command from an analog source as determined by T069 [Analog In 1 Sel] and DIP Switch AI1 on the control board. Default Dip Switch setting is 10V.
	3	"Analog In 2"	External frequency command from an analog source as determined by T073 [Analog In 2 Sel] and DIP Switch AI2 on the control board. Default Dip Switch setting is 10V.
	4	"Preset Freq"	External frequency command as defined by A143 - A146 [Preset Freq x] when T051 - T054 [Digital Inx Sel] are programmed as "Preset Frequencies" and the digital inputs are active.
	5	"Comm Port"	External frequency command from the communications port. Refer to Appendix D and Appendix E for details. Parameter C102 [Comm Format] is used to select a communications protocol.

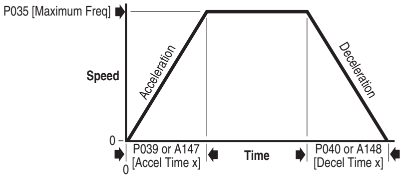
P039 [Accel Time 1]

Related Parameter(s): P038, P040, T051-T054, A141, A143-A146, A147

Sets the rate of acceleration for all speed increases.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

Values	Default:	20.00 Secs
	Min/Max:	0.00/600.00 Secs
	Display:	0.01 Secs



Basic Program Group *(continued)*

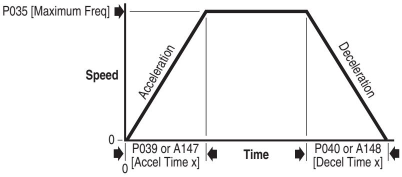
P040 [Decel Time 1]

Related Parameter(s): P038, P039, T051-T054, A141, A143-A146, A148

Sets the rate of deceleration for all speed decreases.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

Values	Default:	20.00 Secs
	Min/Max:	0.00/600.00 Secs
	Display:	0.01 Secs



P041 [Reset To Defalts]

Stop drive before changing this parameter.

Resets all parameter values to factory defaults.

Options	**0**	"Ready/Idle" (Default)	
	1	"Factory Rset"	• After the reset function is complete, this parameter will set itself back to "0". • Causes an F48 Params Defaulted fault.

Important: Drives packaged for fan and pump applications ship with custom default settings that differ from Factory Defaults. Setting this parameter to option 1 will require reprogramming of select parameters. Refer to publication 22C-IN002 for packaged drive default settings.

P042 [Auto Mode]

Related Parameter(s): P036, P038

Stop drive before changing this parameter.

Determines the operation of the "Auto" key on the integral keypad. Refer to page 2-6 for details.

Options	**0**	"No function"	LED above "Auto" key is always dark
	1	"Hnd-Off-Auto" (Default)	Toggles control start and frequency to and from keypad; starts drive.
	2	"Local/Remote"	Toggles control start and frequency to and from keypad.
	3	"Auto/Manual"	Toggles only the frequency control to and from keypad.

P043 [Motor OL Ret]

Related Parameter(s): P033, A181

Enables/disables the Motor Overload Retention function. When Enabled, the value held in the motor overload counter is saved at power-down and restored at power-up.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

Terminal Block Group

Related Parameter(s): P036, P038, P039, P040
A141, A142 A143-A146, A147
A148, A166, A177, A180, d301, d302

T051 [Digital In1 Sel]
(I/O Terminal 05)

T052 [Digital In2 Sel]
(I/O Terminal 06)

T053 [Digital In3 Sel]
(I/O Terminal 07)

T054 [Digital In4 Sel]
(I/O Terminal 08)

Stop drive before changing this parameter.

Selects the function for the digital inputs. Refer to the flowchart on page 1-24 for more information on speed reference control priority.

Options	**0**	“Not Used”	Terminal has no function but can be read over network communications via d302 [Contrl In Status].
	1	“Purge” (1) (T051 Default)	Starts the drive at Purge speed regardless of the selected start source. Purge can occur, and is operational, at any time whether the drive is running or stopped. If a valid stop condition is present, other than from the Comm Port or SW Enable input (I/O Terminal 03), the drive will not start on the Purge Input Transition.

ATTENTION: A Purge command will take precedence over a stop command from the Comm Port/Network and over a SW Enable command from the terminal block. Insure that another stop method is available, such as I/O Terminal 01 of the control terminal block, if stopping is necessary during a purge.

	2	“Auto Mode” (1)	When active, forces drive into “Auto” control mode. Start source determined by P036 [Start Source] and speed reference determined by P038 [Speed Reference].
	3	“Local” (1) (T052 Default)	When active, sets integral keypad as start source and digital speed keys on the integral keypad as speed source.
	4	“Comm Port” (1) (T054 Default)	When active, sets communication device as default start/speed command source.
	5	“PID Disable”	Disables PID function. Drive uses the next valid non-PID speed reference.
	6	“PID Hold”	Drive output remains at current value.The integrator for Process PID loop is also clamped at current value.
	7	“PID Reset”	The integrator for the Process PID loop is reset to zero and drive output is set to Preload value.
	8	“Preset Freq”	Preset speed inputs that enable the use of preset speeds.
	9	“Aux Fault”	If input is enable but not active, the drive will immediately fault.
	10	“Clear Fault” (T053 Default)	Clears an active fault.
	11	“RampStop,CF”	The drive immediately ramps to stop. Can also be used to clear a fault.
	12	“CoastStop,CF”	The drive immediately coasts to stop. Can also be used to clear a fault.
	13	“DCInjStop,CF”	The drive immediately begins a DC Injection stop. Can also be used to clear a fault.

T051-T054 Options (Cont.)	**14** “Anlg1 InCtrl” (1)	Selects Analog Input 1 control for the frequency reference.
	15 “Anlg2 InCtrl” (1)	Selects Analog Input 2 control for the frequency reference.
	16 “MOP Up”	Increases the value of A142 [Internal Freq] at the current Accel rate if P038 [Speed Reference] is set to 1 “InternalFreq”. Default for A142 is 60 Hz.
	17 “MOP Down”	Decreases the value of A142 [Internal Freq] at the current Decel rate if P038 [Speed Reference] is set to 1 “InternalFreq”. Default for A142 is 60 Hz.
	18 “Acc & Dec 2” (1)	• When active, A147 [Accel Time 2] and A148 [Decel Time 2] are used for all ramp rates. • Can only be tied to one input. Refer to the flowchart on page 1-25 for more information on Accel/Decel selection.
	19 “Current Lmt2”	When active, A180 [Current Limit 2] determines the drive current limit level.
	20 “Force DC”	If the drive is not running, applying this input causes the drive to apply a DC Holding current (use A177 [DC Brake Level], ignoring A176 [DC Brake Time] while the input is applied.
	21 “Mtr I-Lock 1”	Can be used as a protective motor interlock in Auxiliary Motor Control mode. When programmed but not active, input will prevent corresponding motor from operating. Refer to Appendix C for details.
	22 “Mtr I-Lock 2”	
	23 “Mtr I-Lock 3”	
	24 “Mtr I-Lock 4”	
	25 “Cmd Reverse”	When programmed and active the drive will run in the reverse direction when started from the integral keypad.
	31 “Logic In 1”	Input 1 used by digital output settings.
	32 “Logic In 2”	Input 2 used by digital output settings.
	36 “Damper Input”	• When active, drive is allowed to run normally. • When inactive, drive is forced into sleep mode and is prevented from accelerating to commanded speed.

---

(1) This function may be tied to one input only.

Terminal Block Group *(continued)*

T055 [Relay Out1 Sel]

Related Parameter(s): P033, T056, T058, T059, T069 T072, T073, T076, A163, d318

Sets the condition that changes the state of the output relay contacts.

Options	**0**	"Ready/Fault" (Default)	Relay changes state when power is applied. This indicates that the drive is ready for operation. Relay returns drive to shelf state when power is removed or a fault occurs.
	1	"At Frequency"	Drive reaches commanded frequency.
	2	"MotorRunning"	Motor is receiving power from the drive.
	3	"Hand Active"	Active when drive is in local control.
	4	"Motor Overld"	Motor overload condition exists.
	5	"Ramp Reg"	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	6	"Above Freq"	• Drive exceeds the frequency (Hz) value set in T056 [Relay Out1 Level]. • Use T056 to set threshold.
	7	"Above Cur"	• Drive exceeds the current (% Amps) value set in T056 [Relay Out1 Level]. • Use T056 to set threshold. **Important:** Value for T056 [Relay Out1 Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	• Drive exceeds the DC bus voltage value set in T056 [Relay Out1 Level]. • Use T056 to set threshold.
	9	"Above Anlg 2"	• Analog input voltage (I/O Terminal 17) exceeds the value set in T056 [Relay Out1 Level]. • Do not use if T073 [Analog In 2 Sel] is set to 3 "Voltage Mode - Bipolar". • This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 17) is wired to a PTC and external resistor. • Use T056 to set threshold.
	10	"Above PF Ang"	• Power Factor angle has exceeded the value set in T056 [Relay Out1 Level]. • Use T056 to set threshold.
	11	"Anlg In Loss"	Analog input loss has occurred. Program T072 [Analog In 1 Loss] and/or T076 [Analog In 2 Loss] for desired action when input loss occurs.
	12	"ParamControl"	Enables the output to be controlled over network communications by writing to T056 [Relay Out1 Level]. (0 = Off, 1 = On.)
	13	"Retries Exst"	Value set in A163 [Auto Rstrt Tries] is exceeded.
	14	"NonRec Fault"	• Number of retries for [Restart Tries] is exceeded OR • Non-resettable fault occurs OR • Auto-retries is not enabled.
	15	"Reverse"	Drive is commanded to run in reverse direction.
	16	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	17	"Logic In 2"	An input is programmed as "Logic In 2" and is active.
	23	"Aux Motor"	Auxiliary Motor is commanded to run. Refer to Appendix C for details.

Terminal Block Group *(continued)*

T056 [Relay Out1 Level]

Related Parameter(s): T055, T058, T059, d318

32 32 bit parameter.

Sets the trip point for the digital output relay if the value of T055 [Relay Out1 Sel] is 6, 7, 8, 9, 10 or 12.

T055 Setting	T056 Min/Max
6	0/320 Hz
7	0/180%
8	0/815 Volts
9	0/100%
10	1/180 degs
12	0/1

Values	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

T058 [Relay 1 On Time]

Related Parameter(s): T055, T056, T059

Sets delay time before Relay energizes after required condition testing.

Values	Default:	0.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

T059 [Relay 1 Off Time]

Related Parameter(s): T055, T056, T058

Sets delay time before Relay de-energizes after required condition testing ceases.

Important: Do not use this parameter with Auxiliary Motor Control mode AutoSwap enabled.

Values	Default:	0.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

Terminal Block Group *(continued)*

T060 [Relay Out2 Sel]

Related Parameter(s): P033, T061, T063, T064, T076
A163, d318

Sets the condition that changes the state of the output relay contacts.

Options	**0**	"Ready/Fault"	Relay changes state when power is applied. This indicates that the drive is ready for operation. Relay returns drive to shelf state when power is removed or a fault occurs.
	1	"At Frequency"	Drive reaches commanded frequency.
	2	"MotorRunning" (Default)	Motor is receiving power from the drive.
	3	"Hand Active"	Active when drive is in local control.
	4	"Motor Overld"	Motor overload condition exists.
	5	"Ramp Reg"	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	6	"Above Freq"	• Drive exceeds the frequency (Hz) value set in T061 [Relay Out2 Level]. • Use T061 to set threshold.
	7	"Above Cur"	• Drive exceeds the current (% Amps) value set in T061 [Relay Out2 Level]. • Use A061 to set threshold. **Important:** Value for T061 [Relay Out2 Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	• Drive exceeds the DC bus voltage value set in T061 [Relay Out2 Level]. • Use T061 to set threshold.
	9	"Above Anlg 2"	• Analog input voltage (I/O Terminal 17) exceeds the value set in T061 [Relay Out2 Level]. • Do not use if T073 [Analog In 2 Sel] is set to 3 "Voltage Mode - Bipolar". • This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 17) is wired to a PTC and external resistor. • Use T061 to set threshold.
	10	"Above PF Ang"	• Power Factor angle has exceeded the value set in T061 [Relay Out2 Level]. • Use T061 to set threshold.
	11	"Anlg In Loss"	Analog input loss has occurred. Program T072 [Analog In 1 Loss] and/or T076 [Analog In 2 Loss] for desired action when input loss occurs.
	12	"ParamControl"	Enables the output to be controlled over network communications by writing to T061 [Relay Out2 Level]. (0 = Off, 1 = On.)
	13	"Retries Exst"	Value set in A163 [Auto Rstrt Tries] is exceeded.
	14	"NonRec Fault"	• Number of retries for A163 [Auto Rstrt Tries] is exceeded OR • Non-resettable fault occurs OR • A163 [Auto Rstrt Tries] is not enabled.
	15	"Reverse"	Drive is commanded to run in reverse direction.
	16	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	17	"Logic In 2"	An input is programmed as "Logic In 2" and is active.
	23	"Aux Motor"	Auxiliary Motor is commanded to run. Refer to Appendix C for details.

Terminal Block Group *(continued)*

T061 [Relay Out2 Level]

Related Parameter(s): T060, T063, T064, d318

32 32 bit parameter.

Sets the trip point for the digital output relay if the value of T060 [Relay Out2 Sel] is 6, 7, 8, 9, 10 or 12.

T060 Setting	T061 Min/Max
6	0/320 Hz
7	0/180%
8	0/815 Volts
9	0/100%
10	1/180 degs
12	0/1

Values	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

T063 [Relay 2 On Time]

Related Parameter(s): T060, T061, T064

Sets delay time before Relay energizes after required condition testing.

Values	Default:	0.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

T064 [Relay 2 Off Time]

Related Parameter(s): T060, T061, T063

Sets delay time before Relay de-energizes after required condition testing ceases.

Important: Do not use this parameter with Auxiliary Motor Control mode AutoSwap enabled.

Values	Default:	0.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

Terminal Block Group *(continued)*

T065 [Opto Out Sel]

Related Parameter(s): P033, T066, T068, T072 T076, A163, d318

Determines the operation of the programmable opto output.

Options	**0**	"Ready/Fault"	Opto output is active when power is applied. This indicates that the drive is ready for operation. Opto output is inactive when power is removed or a fault occurs.
	1	"At Frequency" (Default)	Drive reaches commanded frequency.
	2	"MotorRunning"	Motor is receiving power from the drive.
	3	"Hand Active"	Active when drive is in local control.
	4	"Motor Overld"	Motor overload condition exists.
	5	"Ramp Reg"	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	6	"Above Freq"	• Drive exceeds the frequency (Hz) value set in T066 [Opto Out Level]. • Use T066 to set threshold.
	7	"Above Cur"	• Drive exceeds the current (% Amps) value set in T066 [Opto Out Level]. • Use T066 to set threshold. **Important:** Value for T066 [Opto Out Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	• Drive exceeds the DC bus voltage value set in T066 [Opto Out Level]. • Use T066 to set threshold.
	9	"Above Anlg 2"	• Analog input voltage (I/O Terminal 17) exceeds the value set in T066 [Opto Out Level]. • Do not use if T073 [Analog In 2 Sel] is set to 3 "Voltage Mode - Bipolar". • This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 17) is wired to a PTC and external resistor. • Use T066 to set threshold.
	10	"Above PF Ang"	• Power Factor angle has exceeded the value set in T066 [Opto Out Level]. • Use T066 to set threshold.
	11	"Anlg In Loss"	Analog input loss has occurred. Program T072 [Analog In 1 Loss] and/or T076 [Analog In 2 Loss] for desired action when input loss occurs.
	12	"ParamControl"	Enables the output to be controlled over network communications by writing to T066 [Opto Out Level]. (0 = Off, 1 = On.)
	13	"Retries Exst"	Value set in A163 [Auto Rstrt Tries] is exceeded.
	14	"NonRec Fault"	• Number of retries for A163 [Auto Rstrt Tries] is exceeded OR • Non-resettable fault occurs OR • A163 [Auto Rstrt Tries] is not enabled.
	15	"Reverse"	Drive is commanded to run in reverse direction.
	16	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	17	"Logic In 2"	An input is programmed as "Logic In 2" and is active.

Terminal Block Group *(continued)*

T066 [Opto Out Level]

Related Parameter(s): T065, T068, A163, d318

32 32 bit parameter.

Determines the on/off point for the opto output when T065 [Opto Out Sel] is set to option 6, 7, 8, 9, 10 or 12.

T065 Setting	T066 Min/Max
6	0/400 Hz
7	0/180%
8	0/815 Volts
9	0/100%
10	1/180 degs
12	0/1

Values	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

T068 [Opto Out Logic]

Related Parameter(s): T065, T066

Determines the logic (Normally Open/NO or Normally Closed/NC) of the opto output.

T068 Option	Opto Out Logic
0	NO (Normally Open)
1	NC (Normally Closed)

Note: Setting output to NC may cause output to “glitch” on power-up. The off/reset state of all outputs is open.

Values	Default:	0
	Min/Max:	0/1
	Display:	1

T069 [Analog In 1 Sel]

Related Parameter(s): T055, T070, T071, T072

Sets the analog input signal mode (0-20mA, 4-20mA, or 0-10V). This parameter must match DIP Switch AI1 setting on the control board.

T069 Option	Setting	Input Range	DIP Switch AI1 Setting
0	Current Mode	0-20 mA	20 mA
1	Current Mode	4-20 mA	20 mA
2	Voltage Mode - Unipolar	0-10V	10V
4	Current Mode (Square Root)	0-20 mA	20 mA
5	Current Mode (Square Root)	4-20 mA	20 mA
6	Voltage Mode - Unipolar (Square Root)	0-10V	10V

Values	Default:	2
	Min/Max:	0/6
	Display:	1

Terminal Block Group *(continued)*

T070 [Analog In 1 Lo]

Related Parameter(s): P034, P038, T069, T071, T072
A152, A153

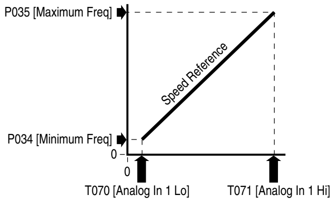
Stop drive before changing this parameter.

Sets the analog input level that corresponds to P034 [Minimum Freq].

Analog inversion can be accomplished by setting this value larger than T071 [Analog In 1 Hi].

Important: If analog inversion is implemented the drive will go to maximum frequency in the event the analog input is lost. It is strongly recommended to activate T072 [Analog In 1 Loss] to protect from this potential occurrence.

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%



T071 [Analog In 1 Hi]

Related Parameter(s): P035, P038, T069, T070, T072
A152, A153

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P035 [Maximum Freq].

Analog inversion can be accomplished by setting this value smaller than T070 [Analog In 1 Lo].

Values	Default:	100.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

Terminal Block Group *(continued)*

T072 [Analog In 1 Loss]

Related Parameter(s): T055, T060, T065, T069, T070
T071, A152

Stop drive before changing this parameter.

Selects drive action when an input signal loss is detected. Signal loss is defined as an analog signal less than 1V or 2mA. The signal loss event ends and normal operation resumes when the input signal level is greater than or equal to 1.5V or 3mA. If using a 0-10V analog input, set T070 [Analog In 1 Lo] to a minimum of 20% (i.e. 2 volts).

The drive will fault on an F29 Analog Input Loss when the analog signal is lost if this parameter and A152 [PID Ref Sel] are both set to an option other than 0 "Disabled".

Options	**0**	"Disabled" (Default)	
	1	"Fault (F29)"	F29 Analog Input Loss
	2	"Stop"	Uses P037 [Stop Mode]
	3	"Zero Ref"	Drive runs at zero speed reference.
	4	"Min Freq Ref"	Drive runs at minimum frequency.
	5	"Max Freq Ref"	Drive runs at maximum frequency.
	6	"Int Freq Ref"	Drive runs at A143 [Preset Freq 0].

T073 [Analog In 2 Sel]

Related Parameter(s): P038, T055, T065, T074, T075, T076
A152

Sets the analog input signal mode (0-20mA, 4-20mA, 0-10V, -10 to +10V). This parameter must match DIP Switch AI2 setting on the control board.

T073 Option	Setting	Input Range	DIP Switch AI2 Setting
0	Current Mode	0-20 mA	20 mA
1	Current Mode	4-20 mA	20 mA
2	Voltage Mode - Unipolar	0-10V	10V
3 [1]	Voltage Mode - Bipolar	-10 to +10V	10V
4	Current Mode (Square Root)	0-20 mA	20 mA
5	Current Mode (Square Root)	4-20 mA	20 mA
6	Voltage Mode - Unipolar (Square Root)	0-10V	10V
7 [1]	Voltage Mode - Bipolar (Square Root)	-10 to +10V	10V

[1] Setting 3 is only available on [Analog In 2 Sel]. Input 2 is isolated and supports a bi-polar input, so that setting 3 determines if the voltage input is enabled for bipolar control. If bipolar is selected, P034 [Minimum Freq] and T074 [Analog In 2 Lo] are ignored. If input 2 is set up for current control, Bipolar mode is not possible. If the analog input is inverted ([Analog In 2 Lo] > [Analog In 2 Hi]), Bipolar mode is disabled and this input uses unipolar control only (negative values are treated like zero).

Values	Default:	2
	Min/Max:	0/7
	Display:	1

Terminal Block Group *(continued)*

T074 [Analog In 2 Lo]

Related Parameter(s): P034, P038, T072, T073, T075
T076, A152, A153

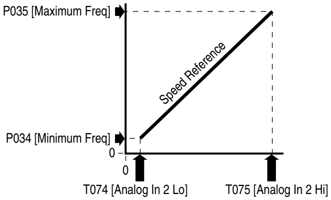
Stop drive before changing this parameter.

Sets the analog input level that corresponds to P034 [Minimum Freq].

Analog inversion can be accomplished by setting this value larger than T075 [Analog In 2 Hi].

Important: If analog inversion is implemented the drive will go to maximum frequency in the event the analog input is lost. It is strongly recommended to activate T072 [Analog In 1 Loss] to protect from this potential occurrence.

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%



T075 [Analog In 2 Hi]

Related Parameter(s): P035, P038, T073, T074, T076
A152, A153

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P035 [Maximum Freq].

Analog inversion can be accomplished by setting this value smaller than T074 [Analog In 2 Lo].

Values	Default:	100.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

T076 [Analog In 2 Loss]

Related Parameter(s): T055, T060, T065, T073, T074, T075

Stop drive before changing this parameter.

Selects drive action when an input signal loss is detected. Signal loss is defined as an analog signal less than 1V or 2mA. The signal loss event ends and normal operation resumes when the input signal level is greater than or equal to 1.5V or 3mA. If using a 0-10V analog input, set T074 [Analog In 2 Lo] to a minimum of 20% (i.e. 2 volts).

Options	**0**	"Disabled" (Default)	
	1	"Fault (F29)"	F29 Analog Input Loss
	2	"Stop"	Uses P037 [Stop Mode]
	3	"Zero Ref"	Drive runs at zero speed reference.
	4	"Min Freq Ref"	Drive runs at minimum frequency.
	5	"Max Freq Ref"	Drive runs at maximum frequency.
	6	"Int Freq Ref"	Drive runs at A143 [Preset Freq 0].

Terminal Block Group *(continued)*

T077 [Sleep-Wake Sel]

Related Parameter(s): T078, T079, T080, T081

The drive "sleeps" if the appropriate analog input drops below the set [Sleep Level] for the time set in [Sleep Time] and the drive is running. When entering sleep mode the drive will ramp to zero and the run indicator (R→ or R←) on the keypad display will flash indicating the drive is in "sleep" mode. When the appropriate analog input rises above the set [Sleep Level] the drive will "wake" and ramp to the commanded frequency.

Inversion can be accomplished by setting T078 [Sleep Level] to a higher setting than T080 [Wake Level].

ATTENTION: Enabling the Sleep-Wake function can cause unexpected machine operation during the Wake mode. Equipment damage and/or personal injury can result if this parameter is used in an inappropriate application. In addition, all applicable local, national & international codes, standards, regulations or industry guidelines must be considered.

Options	**0**	"Disabled" (Default)	
	1	"Analog In 1"	Sleep enabled from Analog Input 1.
	2	"Analog In 2"	Sleep enabled from Analog Input 2.
	3	"Command Freq"	Sleep enabled based on drive commanded frequency.

T078 [Sleep Level]

Related Parameter(s): T077, T079, T080, T081

Sets the analog input level the drive must reach to enter sleep mode.

Values	Default:	10.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

T079 [Sleep Time]

Related Parameter(s): T077, T078, T080, T081

Sets the analog input time the drive must stay below to enter sleep mode.

Values	Default:	0.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

T080 [Wake Level]

Related Parameter(s): T077, T078, T079, T081

Sets the analog input level the drive must reach to wake from sleep mode.

Values	Default:	15.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

T081 [Wake Time]

Related Parameter(s): T077, T078, T079, T080

Sets the analog input time the drive must stay above to wake from sleep mode.

Values	Default:	0.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

Terminal Block Group *(continued)*

T082 [Analog Out1 Sel]

Related Parameter(s): P035, T083, T084

Sets the analog output signal mode (0-20 mA, 4-20 mA, or 0-10V). The output is used to provide a signal that is proportional to several drive conditions. This parameter must match DIP Switch AO1 setting.

Setting		Output Range	Min. Output Value	Max. Output Value = [Analog Output Hi]	Filter[1]	DIP Switch AO1 Setting	Related Parameter
0	OutFreq 0-10	0-10V	0V = 0 Hz	[Maximum Frequency]	None	10V	b001
1	OutCurr 0-10	0-10V	0V = 0 Amps	200% Drive Rated FLA	Filter A	10V	b003
2	OutTorq 0-10	0-10V	0V = 0 Amps	200% Drive Rated FLA	Filter A	10V	b013
3	OutVolt 0-10	0-10V	0V = 0 Volts	120% Drive Rated Output V	None	10V	b004
4	OutPowr 0-10	0-10V	0V = 0 kW	200% Drive Rated Power	Filter A	10V	b010
5	Setpnt 0-10	0-10V	0V = 0.0%	100.0% Setting	None	10V	T084
6	TstData 0-10	0-10V	0V = 0000	65535 (Hex FFFF)	None	10V	A196
7	OutFreq 0-20	0-20 mA	0 mA = 0 Hz	[Maximum Frequency]	None	20 mA	b001
8	OutCurr 0-20	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b003
9	OutTorq 0-20	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b013
10	OutVolt 0-20	0-20 mA	0 mA = 0 Volts	120% Drive Rated Output V	None	20 mA	b004
11	OutPowr 0-20	0-20 mA	0 mA = 0 kW	200% Drive Rated Power	Filter A	20 mA	b010
12	Setpnt 0-20	0-20 mA	0 mA = 0.0%	100.0% Setting	None	20 mA	T084
13	TstData 0-20	0-20 mA	0 mA = 0000	65535 (Hex FFFF)	None	20 mA	A196
14	OutFreq 4-20	4-20 mA	4 mA = 0 Hz	[Maximum Frequency]	None	20 mA	b001
15	OutCurr 4-20	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b003
16	OutTorq 4-20	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b013
17	OutVolt 4-20	4-20 mA	4 mA = 0 Volts	120% Drive Rated Output V	None	20 mA	b004
18	OutPowr 4-20	4-20 mA	4 mA = 0 kW	200% Drive Rated Power	Filter A	20 mA	b010
19	Setpnt 4-20	4-20 mA	4 mA = 0.0%	100.0% Setting	None	20 mA	T084
20	TstData 4-20	4-20 mA	4 mA = 0000	65535 (Hex FFFF)	None	20 mA	A196

(1) For settings with the filter enabled, if a 0-100% step change occurs, the output will reach 95% in 500 milliseconds, 99% in 810 milliseconds and 100% in 910 milliseconds.

Values	Default:	0
	Min/Max:	0/20
	Display:	1

T083 [Analog Out1 High]

Related Parameter(s): P035, T082, T084

Scales the Maximum Output Value for the T082 [Analog Out1 Sel] source setting.

Examples:

T083 Setting	T082 Setting	T082 Max. Output Value
50%	1 "OutCurr 0-10"	5V for 200% Drive Rated Output Current
90%	11 "OutPowr 0-20"	18mA for 200% Drive Rated Power

Values	Default:	100%
	Min/Max:	0/800%
	Display:	1%

Terminal Block Group *(continued)*

T084 [Anlg Out1 Setpt]

Related Parameter(s): T082, T083

Sets direct parameter control over the analog output. If enabled, this sets the percent value of analog output.

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

T085 [Analog Out2 Sel]

Related Parameter(s): P035, T086, T087

Sets the analog output signal mode (0-20 mA, 4-20 mA, or 0-10V). The output is used to provide a signal that is proportional to several drive conditions. This parameter must match DIP Switch AO2 setting.

Setting		Output Range	Min. Output Value	Max. Output Value = [Analog Output Hi]	Filter[1]	DIP Switch AO2 Setting	Related Parameter
0	OutFreq 0-10	0-10V	0V = 0 Hz	[Maximum Frequency]	None	10V	b001
1	OutCurr 0-10	0-10V	0V = 0 Amps	200% Drive Rated FLA	Filter A	10V	b003
2	OutTorq 0-10	0-10V	0V = 0 Amps	200% Drive Rated FLA	Filter A	10V	b013
3	OutVolt 0-10	0-10V	0V = 0 Volts	120% Drive Rated Output V	None	10V	b004
4	OutPowr 0-10	0-10V	0V = 0 kW	200% Drive Rated Power	Filter A	10V	b010
5	Setpnt 0-10	0-10V	0V = 0.0%	100.0% Setting	None	10V	T084
6	TstData 0-10	0-10V	0V = 0000	65535 (Hex FFFF)	None	10V	A196
7	OutFreq 0-20	0-20 mA	0 mA = 0 Hz	[Maximum Frequency]	None	20 mA	b001
8	OutCurr 0-20	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b003
9	OutTorq 0-20	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b013
10	OutVolt 0-20	0-20 mA	0 mA = 0 Volts	120% Drive Rated Output V	None	20 mA	b004
11	OutPowr 0-20	0-20 mA	0 mA = 0 kW	200% Drive Rated Power	Filter A	20 mA	b010
12	Setpnt 0-20	0-20 mA	0 mA = 0.0%	100.0% Setting	None	20 mA	T084
13	TstData 0-20	0-20 mA	0 mA = 0000	65535 (Hex FFFF)	None	20 mA	A196
14	OutFreq 4-20	4-20 mA	4 mA = 0 Hz	[Maximum Frequency]	None	20 mA	b001
15	OutCurr 4-20	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b003
16	OutTorq 4-20	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b013
17	OutVolt 4-20	4-20 mA	4 mA = 0 Volts	120% Drive Rated Output V	None	20 mA	b004
18	OutPowr 4-20	4-20 mA	4 mA = 0 kW	200% Drive Rated Power	Filter A	20 mA	b010
19	Setpnt 4-20	4-20 mA	4 mA = 0.0%	100.0% Setting	None	20 mA	T084
20	TstData 4-20	4-20 mA	4 mA = 0000	65535 (Hex FFFF)	None	20 mA	A196

(1) For settings with the filter enabled, if a 0-100% step change occurs, the output will reach 95% in 500 milliseconds, 99% in 810 milliseconds and 100% in 910 milliseconds.

Values	Default:	1
	Min/Max:	0/20
	Display:	1

Terminal Block Group *(continued)*

T086 [Analog Out2 High]

Related Parameter(s): P035, T085, T087

Scales the Maximum Output Value for the A065 [Analog Out Sel] source setting.

Examples:

T086 Setting	T085 Setting	T085 Max. Output Value
50%	1 “OutCurr 0-10”	5V for 200% Drive Rated Output Current
90%	11 “OutPowr 0-20”	18mA for 200% Drive Rated Power

Values	Default:	100%
	Min/Max:	0/800%
	Display:	1%

T087 [Anlg Out2 Setpt]

Related Parameter(s): T085, T086

Sets direct parameter control over the analog output. If enabled, this sets the percent value of analog output.

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

T088 [Anlg Loss Delay]

Related Parameter(s): T069, T070, T071, T072
T073, T074, T075, T076

Sets the length of time after power-up during which the drive will not detect an analog signal loss. The drive response to an analog signal loss is set in T072 or T076 [Analog In x Loss].

Values	Default:	0.0 Secs
	Min/Max:	0.0/20.0 Secs
	Display:	0.1 Secs

Communications Group

C101 [Language]

Selects the language displayed by the integral LCD display and remote communications option.

Options	**1**	"English" (Default)
	2	"Français"
	3	"Español"
	4	"Italiano"
	5	"Deutsch"
	6	"Reserved"
	7	"Português"
	8	"Reserved"
	9	"Reserved"
	10	"Nederlands"

C102 [Comm Format]

Related Parameter(s): d303-d306

Selects the protocol data bits (8 data bits only), parity (None, Even, Odd), and stop bits (1 or 2) used by the RS485 port on the drive.

Refer to Appendix D and Appendix E for details on using the drive communication features.

Important: Power to drive must be cycled before any changes will affect drive operation.

Options	**0**	"RTU 8-N-1" (Default)	
	1	"RTU 8-E-1"	
	2	"RTU 8-O-1"	
	3	"RTU 8-N-2"	
	4	"RTU 8-E-2"	
	5	"RTU 8-O-2"	
	6	"MetaSys N2"	
	7	"P1 8-N-1"	Floor Level Network (FLN)
	8	"P1 8-E-1"	Floor Level Network (FLN)
	9	"P1 8-O-1"	Floor Level Network (FLN)

C103 [Comm Data Rate]

Related Parameter(s): d303

Sets the serial port rate for the RS485 (DSI) port.

Important: Power to drive must be cycled before any changes will affect drive operation.

Options	**0**	"1200"
	1	"2400"
	2	"4800"
	3	"9600" (Default)
	4	"19.2K"
	5	"38.4K"

Communications Group *(continued)*

C104 [Comm Node Addr]

Related Parameter(s): d303

Sets the drive node address for the RS485 (DSI) port if using a network connection.

Important: Power to drive must be cycled before any changes will affect drive operation.

Values	Default:	100
	Min/Max:	1/247
	Display:	1

C105 [Comm Loss Action]

Related Parameter(s): d303, P037, C106

Selects the drive's response to a loss of the communication connection or excessive communication errors.

Options	**0**	"Fault" (Default)	Drive will fault on an F81 Comm Loss and coast to stop.
	1	"Coast Stop"	Stops drive via coast to stop.
	2	"Stop"	Stops drive via P037 [Stop Mode] setting.
	3	"Continu Last"	Drive continues operating at communication commanded speed saved in RAM.
	4	"Run Preset 0"	Drive will run at preset speed.
	5	"Kypd Inc/Dec"	Drive will run at keypad (digital pot) speed

C106 [Comm Loss Time]

Related Parameter(s): d303, C105

Sets the time that the drive will remain in communication loss before implementing the option selected in C105 [Comm Loss Action].

Values	Default:	5.0 Secs
	Min/Max:	0.1/60.0 Secs
	Display:	0.1 Secs

C107 [Comm Write Mode]

Determines whether parameter changes made over communication port are saved or stored in RAM only. If they are stored in RAM, the values will be lost at power-down.

Options	**0**	"Save" (Default)
	1	"RAM Only"

ATTENTION: Risk of equipment damage exists. If configurable outputs are programmed to write parameter data to Non-Volatile Storage (NVS) frequently, the NVS will quickly exceed its life cycle and cause the drive to malfunction. Do not create a program that frequently uses configurable outputs to write parameter data to NVS.

Communications Group *(continued)*

C108 [Start Source 2]

Related Parameter(s): P037, P042, A166, d301

Stop drive before changing this parameter.

Sets the control scheme used to start the drive when in Comm Control and the communication network commands the drive to run from Local Control. This function is normally used by Point 79 of a P1-FLN.

Refer to Start and Speed Reference Control on page 1-24 for details about how other drive settings can override the setting of this parameter.

Important: For all settings except options 3 and 6, the drive must receive a leading edge from the start input for the drive to start after a stop input, loss of power or fault condition.

Options	**0**	"Keypad"	Integral keypad controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Not Used • I/O Terminal 03 = Not Used
	1	"3-Wire"	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Per P037 [Stop Mode] • I/O Terminal 02 = Start • I/O Terminal 03 = Direction
	2	"2-Wire"	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV
	3	"2-W Lvl Sens" (Default) ⚠ See Attention Below	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV Drive will restart after a "Stop" command when: • Stop is removed and Run FWD is held active
	4	"2-W Hi Speed"	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV Outputs are kept in a ready-to-run state. The drive will respond to a "Start" command within 10 ms. **Important:** There is greater potential voltage on the output terminals when using this option.
	5	"Comm Port"	Remote communications controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Not Used • I/O Terminal 03 = Not Used
	6	"2-W Lvl/Enbl" ⚠ See Attention Below	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Function Loss: Fault and Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = SW Enable Drive will restart after a "Stop" command when: • Stop is removed and Run FWD is held active

⚠ **ATTENTION:** Hazard of injury exists due to unintended operation. When P036 [Start Source] is set to option 3 or option 6, and the Run input is maintained, the Run inputs do not need to be toggled after a Stop input or a fault clear for the drive to run again. The drive will stop only when the stop command is maintained or the drive is faulted.

Communications Group *(continued)*

C109 [Speed Ref 2]

Related Parameter(s): b001, b002, P038, P040, P042, T051-T054, T070, T071, T073, T074, T075, C102, A141, A142, A143-A146, A152, d301

Sets the source of the speed reference to the drive when in Comm Control and the communication network commands the drive to run from Local Control.

Refer to the flowchart on page 1-24 for more information on speed reference control priority.

Options	**0**	"Drive Keypad"	Internal frequency command from the digital speed keys on the integral keypad.
	1	"InternalFreq"	Internal frequency command from A142 [Internal Freq]. Must be set when using MOP function.
	2	"Analog In 1" (Default)	External frequency command from an analog source as determined by T069 [Analog In 1 Sel] and DIP Switch AI1 on the control board. Default Dip Switch setting is 10V.
	3	"Analog In 2"	External frequency command from an analog source as determined by T073 [Analog In 2 Sel] and DIP Switch AI2 on the control board. Default Dip Switch setting is 10V.
	4	"Preset Freq"	External frequency command as defined by A143 - A146 [Preset Freq x] when T051 - T054 [Digital Inx Sel] are programmed as "Preset Frequencies" and the digital inputs are active.
	5	"Comm Port"	External frequency command from the communications port. Refer to Appendix D and Appendix E for details. Parameter C102 [Comm Format] is used to select a communications protocol.

Advanced Program Group

A141 [Purge Frequency]

Related Parameter(s): P038, P039, P040, T051-T054

Provides a fixed frequency command value when T051-T054 [Digital Inx Sel] is set to 1 “Purge”. An active purge input will override speed command as shown in the flowchart on page 1-24.

Values	Default:	5.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	1.0 Hz

A142 [Internal Freq]

Related Parameter(s): P038, T051-T054

Provides the frequency command to the drive when P038 [Speed Reference] is set to 1 “Internal Freq”. When enabled, this parameter will change the frequency command in “real time” using the digital speed keys when in program mode.

Important: Once the desired command frequency is reached, the Enter key must be pressed to store this value to EEPROM memory. If the ESC key is used before the Enter key, the frequency will return to the original value following the normal accel/decel curve.

If T051 - T054 [Digital Inx Sel] is set to 16 “MOP Up” or 17 “MOP Down” this parameter acts as the MOP frequency reference if P038 [Speed Reference] is set to 1 “InternalFreq”.

Values	Default:	60.00 Hz
	Min/Max:	0.00/320.00 Hz
	Display:	0.01 Hz

A143 [Preset Freq 0](1)
A144 [Preset Freq 1]
A145 [Preset Freq 2]
A146 [Preset Freq 3]

Related Parameter(s): P038, P039, P040, T051-T052, A147, A148

Values	A143 Default:(1) A144 Default: A145 Default: A146 Default:	0.0 Hz 5.0 Hz 10.0 Hz 20.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Provides a fixed frequency command value when T051 - T052 [Digital Inx Sel] is set to 8 “Preset Freq”.

An active preset input will override speed command as shown in the flowchart on page page 1-24.

(1) To activate A143 [Preset Freq 0] set P038 [Speed Reference] to option 4 “Preset Freq”.

Input State of Digital In 1 (I/O Terminal 05 when T051 = 8)	Input State of Digital In 2 (I/O Terminal 06 when T052 = 8)	Frequency Source	Accel / Decel Parameter Used(2)
0	0	A143 [Preset Freq 0]	[Accel Time 1] / [Decel Time 1]
1	0	A144 [Preset Freq 1]	[Accel Time 1] / [Decel Time 1]
0	1	A145 [Preset Freq 2]	[Accel Time 2] / [Decel Time 2]
1	1	A146 [Preset Freq 3]	[Accel Time 2] / [Decel Time 2]

(2) When a Digital Input is set to “Accel 2 & Decel 2”, and the input is active, that input overrides the settings in this table.

Advanced Program Group *(continued)*

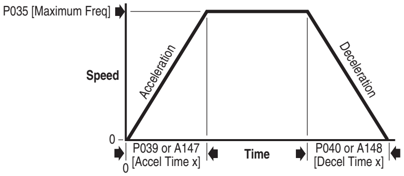
A147 [Accel Time 2]

Related Parameter(s): P039, T051-T054, A143-A146

When active, sets the rate of acceleration for all speed increases. Refer to the flowchart on page 1-25 for details.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

Values	Default:	30.00 Secs
	Min/Max:	0.00/600.00 Secs
	Display:	0.01 Secs



A148 [Decel Time 2]

Related Parameter(s): P040, T051-T054, A143-A146

When active, sets the rate of deceleration for all speed decreases. Refer to the flowchart on page 1-25 for details.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

Values	Default:	30.00 Secs
	Min/Max:	0.01/600.00 Secs
	Display:	0.01 Secs

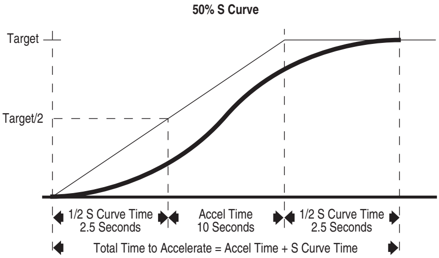
Advanced Program Group *(continued)*

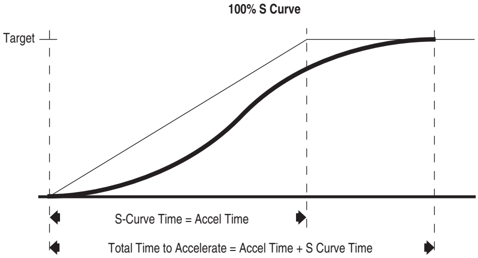
A149 [S Curve %]

Sets the percentage of acceleration or deceleration time that is applied to the ramp as S Curve. Time is added, 1/2 at the beginning and 1/2 at the end of the ramp.

Values	Default:	20%
	Min/Max:	0/100% (A setting of 0% disables this parameter.)
	Display:	1%

Example:
Accel Time = 10 Seconds
S Curve Setting = 50%
S Curve Time = 10 × 0.5 = 5 Seconds
Total Time = 10 + 5 = 15 Seconds





A150 [PID Trim Hi]

Sets the maximum positive value that is added to a PID reference when PID trim is used.

Values	Default:	60.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

A151 [PID Trim Lo]

Sets the minimum positive value that is added to a PID reference when PID trim is used.

Values	Default:	0.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Advanced Program Group *(continued)*

A152 [PID Ref Sel]

Related Parameter(s): P038, T070, T071, T072, T074, T075

Stop drive before changing this parameter.

Enables/disables PID mode and selects the source of the PID reference. Refer to Appendix D for details.

Options	**0**	"PID Disabled" (Default)	
	1	"PID Setpoint"	
	2	"Analog In 1"	
	3	"Analog In 2"	
	4	"Comm Port"	
	5	"Setpnt, Trim"	Use PID output as Trim on [Frequency Select]
	6	"A-In 1, Trim"	Use PID output as Trim on [Frequency Select]
	7	"A-In 2, Trim" (1)	Use PID output as Trim on [Frequency Select]
	8	"Comm, Trim"	Use PID output as Trim on [Frequency Select]

(1) The PID will not function with bipolar input. It will ignore any negative voltages and treat them like zero.

Note: PID analog reference is scaled through the [Analog In x Hi/Lo] parameters. The invert operation is obtained through programming these two parameters. If A152 [PID Ref Sel] is not set to zero, PID can be disabled by programming a digital input.

A153 [PID Feedback Sel]

Related Parameter(s): T070, T071, T074, T075

Select the source of the PID feedback. Refer to Appendix D for details.

Options	**0**	"Analog In 1" (Default)	The PID will not function with a bipolar input. Negative voltages are treated as 0 volts.
	1	"Analog In 2" (1)	
	2	"Comm Port"	

(1) The PID will not function with bipolar input. It will ignore any negative voltages and treat them like zero.

Note: PID analog reference is scaled through the [Analog In x Hi/Lo] parameters. The invert operation is obtained through programming these two parameters.

A154 [PID Prop Gain]

Sets the value for the PID proportional component when the PID mode is enabled by A152 [PID Ref Sel].

Values	Default:	1.00
	Min/Max:	0.00/99.99
	Display:	0.01

A155 [PID Integ Time]

Sets the value for the PID integral component when the PID mode is enabled by A152 [PID Ref Sel].

Values	Default:	2.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

Advanced Program Group *(continued)*

A156 [PID Diff Rate]

Sets the value for the PID differential component when the PID mode is enabled by A152 [PID Ref Sel].

Values	Default:	0.00 (1/Secs)
	Min/Max:	0.00/99.99 (1/Secs)
	Display:	0.01 (1/Secs)

A157 [PID Setpoint]

Provides an internal fixed value for process setpoint when the PID mode is enabled by A152 [PID Ref Sel].

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A158 [PID Deadband]

Sets the lower limit of the PID output.

Values	Default:	0.0%
	Min/Max:	0.0/10.0%
	Display:	0.1%

A159 [PID Preload]

Sets the value used to preload the integral component on start or enable.

Values	Default:	0.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

A160 [Process Factor]

Related Parameter(s): b008

Scales the output frequency value displayed by b008 [Process Display].

Output Freq x Process Factor = Process Display

Values	Default:	30.0
	Min/Max:	0.1/999.9
	Display:	0.1

Advanced Program Group *(continued)*

A163 [Auto Rstrt Tries]

Related Parameter(s): T055, T060, T065, T066, A164

Sets the maximum number of times the drive attempts to reset a fault and restart.

Clear a Type 1 fault and restart the drive.

1. Set A163 [Auto Rstrt Tries] to a value other than "0".
2. Set A164 [Auto Rstrt Delay] to a value other than "0".

Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.

1. Set A163 [Auto Rstrt Tries] to a value other than "0".
2. Set A164 [Auto Rstrt Delay] to "0".

Note: If the parameter is not set to zero and [Auto Rstrt Time] is set to zero, auto fault clear is enabled. This feature automatically clears faults, but does not restart the drive.

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

Values	Default:	0
	Min/Max:	0/9
	Display:	1

A164 [Auto Rstrt Delay]

Related Parameter(s): A163

Sets the time between restart attempts when A163 [Auto Rstrt Tries] is set to a value other than zero.

Note: If the parameter is not set to zero and [Auto Rstrt Time] is set to zero, auto fault clear is enabled. This feature automatically clears faults, but does not restart the drive.

Values	Default:	1.0 Secs
	Min/Max:	0.0/160.0 Secs
	Display:	0.1 Secs

A165 [Start At PowerUp]

Related Parameter(s): P036

Stop drive before changing this parameter.

Enables/disables a feature that allows a Start or Run command to automatically cause the drive to resume running at commanded speed after drive input power is restored. Requires a digital input configured for Run or Start and a valid start contact.

This parameter will not function if parameter P036 [Start Source] is set to 4 "2-W Hi Speed".

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

Advance Program Group *(continued)*

A166 [Reverse Disable]

Related Parameter(s): b006, P036, T051-T054

Stop drive before changing this parameter.

Enables/disables the function that allows the direction of motor rotation to be changed. The reverse command may come from a digital or a serial command. All reverse inputs including two-wire Run Reverse will be ignored with reverse disabled.

Options	**0**	"Rev Enabled"
	1	"Rev Disabled" (Default)

A167 [Flying Start En]

Related Parameter(s): A200

Sets the condition that allows the drive to reconnect to a spinning motor at actual RPM.

Important: When this parameter is enabled, verify that A200 [Motor NP FLA] is set to the motor's actual full load amp value.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

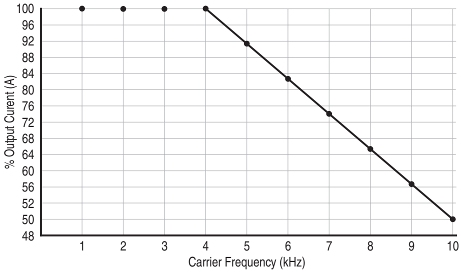
A168 [PWM Frequency]

Related Parameter(s): A169

Sets the carrier frequency for the PWM output waveform. The chart below provides derating guidelines based on the PWM frequency setting.

Important: Ignoring derating guidelines can cause reduced drive performance.

Values	Default:	4.0 kHz
	Min/Max:	2.0/10.0 kHz (Frame C and D drives) 2.0/8.0 kHz (Frame E and F drives)
	Display:	0.1 kHz



A169 [PWM Mode]

Related Parameter(s): A168

Selects the PWM algorithm used.

Options	**0**	"Space Vector"	3-Phase Modulation: Provides quiet operation and produces less motor losses.
	1	"2-Phase" (Default)	2-Phase Modulation: Provides less drive losses and best performance with long motor cable runs.

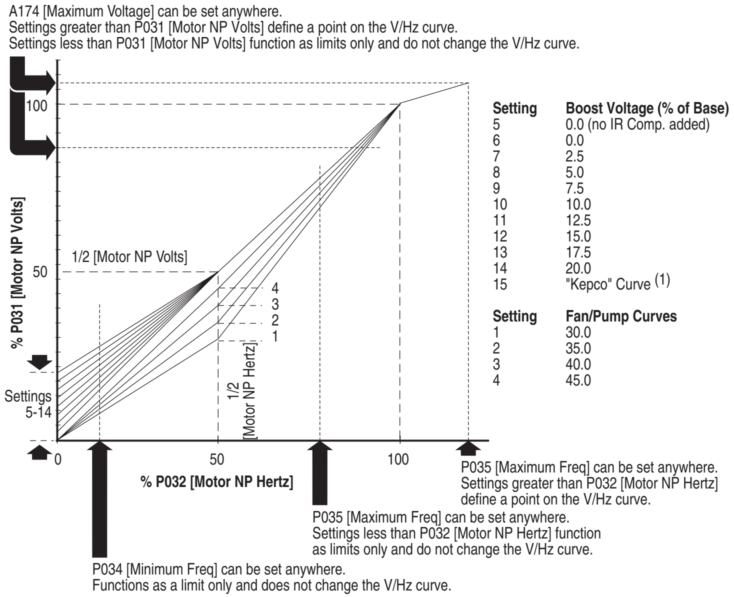
Advance Program Group *(continued)*

A170 [Boost Select]

Related Parameter(s): b004, P031, P032, A171, A172, A173

Sets the boost voltage (% of P031 [Motor NP Volts]) and redefines the Volts per Hz curve.
Drive may add additional voltage unless Option 5 is selected.

Options	**0**	"Custom V/Hz"	
	1	"30.0, VT"	Typical Fan/Pump Curves
	2	"35.0, VT"	
	3	"40.0, VT"	
	4	"45.0, VT" (Default)	
	5	"0.0 no IR"	Boost Curves
	6	"0.0"	
	7	"2.5"	
	8	"5.0"	
	9	"7.5"	
	10	"10.0"	
	11	"12.5"	
	12	"15.0"	
	13	"17.5"	
	14	"20.0"	
	15	"Kepco" Curve[1]	



A174 [Maximum Voltage] can be set anywhere.
Settings greater than P031 [Motor NP Volts] define a point on the V/Hz curve.
Settings less than P031 [Motor NP Volts] function as limits only and do not change the V/Hz curve.

Setting	Boost Voltage (% of Base)
5	0.0 (no IR Comp. added)
6	0.0
7	2.5
8	5.0
9	7.5
10	10.0
11	12.5
12	15.0
13	17.5
14	20.0
15	"Kepco" Curve (1)

Setting	Fan/Pump Curves
1	30.0
2	35.0
3	40.0
4	45.0

P035 [Maximum Freq] can be set anywhere.
Settings greater than P032 [Motor NP Hertz] define a point on the V/Hz curve.

P035 [Maximum Freq] can be set anywhere.
Settings less than P032 [Motor NP Hertz] function as limits only and do not change the V/Hz curve.

P034 [Minimum Freq] can be set anywhere.
Functions as a limit only and does not change the V/Hz curve.

---

(1) Kepco Curve is used in specific systems to meet requirements of the Korean Electric Power Company.

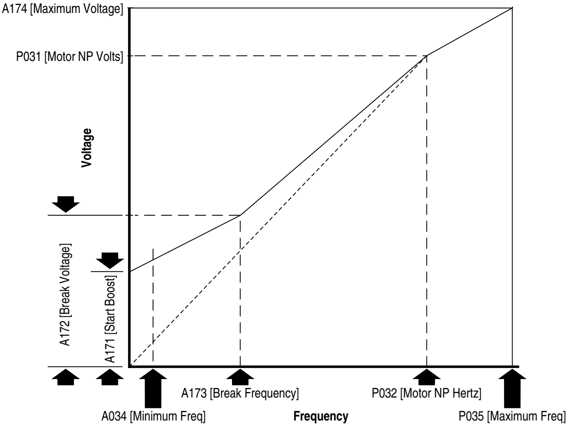
Advance Program Group *(continued)*

A171 [Start Boost]

Related Parameter(s): P031, P032, P034, P035, A170, A172, A173, A174

Sets the boost voltage (% of P031 [Motor NP Volts]) and redefines the Volts per Hz curve when A170 [Boost Select] = 0 "Custom V/Hz".

Values	Default:	2.5%
	Min/Max:	0.0/25.0%
	Display:	1.1%



A172 [Break Voltage]

Related Parameter(s): P031, P032, P034, P035, A170, A171, A173, A174

Sets the break voltage applied at the break frequency when A170 [Boost Select] = 0 "Custom V/Hz".

Values	Default:	25.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A173 [Break Frequency]

Related Parameter(s): P031, P032, P034, P035, A170, A171, A172, A174

Sets the frequency where break frequency is applied when A170 [Boost Select] = 0 "Custom V/Hz".

Values	Default:	15.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Advance Program Group *(continued)*

A174 [Maximum Voltage]

Related Parameter(s): b004, A171, A172, A173

Sets the highest voltage the drive will output.

Values	Default:	Drive Rated Volts
	Min/Max:	20/Drive Rated Volts
	Display:	1 VAC

A175 [Slip Hertz @ FLA]

Related Parameter(s): P033

Compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency based on motor current.

Values	Default:	2.0 Hz
	Min/Max:	0.0/10.0 Hz
	Display:	0.1 Hz

A176 [DC Brake Time]

Related Parameter(s): P037, A177

Sets the length of time that DC brake current is “injected” into the motor when P037 [Stop Mode] is set to either 4 “Ramp” or 6 “DC Brake”. Refer to parameter A177 [DC Brake Level].

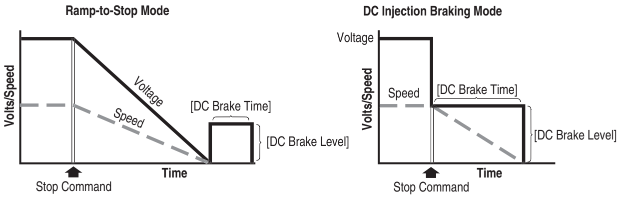
Values	Default:	0.0 Secs
	Min/Max:	0.0/99.9 Secs (A setting of 99.9 = Continuous)
	Display:	0.1 Secs

A177 [DC Brake Level]

Related Parameter(s): P037, T051-T054, A176, A178

Defines the maximum DC brake current, in amps, applied to the motor.

Values	Default:	Drive Rated Amps × 0.05
	Min/Max:	0.0/(Drive Rated Amps × 1.5)
	Display:	0.1 Amps



ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.

ATTENTION: This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking.

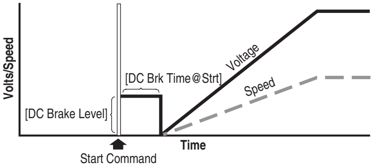
Advance Program Group *(continued)*

A178 [DC Brk Time@Strt]

Related Parameter(s): P037, A177

Sets the length of time that DC brake current is "injected" into the motor after a valid start command is received. Parameter A177 [DC Brake Level] controls the level of braking current used.

Values	Default:	0.0 Secs
	Min/Max:	0.0/99.9 Secs (A setting of 99.9 = Continuous)
	Display:	0.1 Secs



A179 [Current Limit 1]

Related Parameter(s): P033

Maximum output current allowed before current limiting occurs.

Values	Default:	Drive Rated Amps × 1.1
	Min/Max:	0.0/(Drive Rated Amps × 1.5)
	Display:	0.1 Amps

A180 [Current Limit 2]

Related Parameter(s): P033

Maximum output current allowed before current limiting occurs.

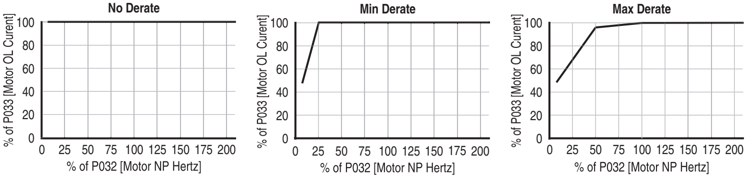
Values	Default:	Drive Rated Amps × 1.1
	Min/Max:	0.0/(Drive Rated Amps × 1.5)
	Display:	0.1 Amps

A181 [Motor OL Select]

Related Parameter(s): P032, P033, P043

Drive provides Class 10 motor overload protection. Settings 0-2 select the derating factor for the I^2t overload function.

Options	**0**	"No Derate" (Default)
	1	"Min Derate"
	2	"Max Derate"



Advance Program Group *(continued)*

A182 [Drive OL Mode]

Related Parameter(s): P032, P033

Determines how the drive handles overload conditions that would otherwise cause the drive to fault.

Options	**0**	"DIsabled"
	1	"Reduce CLim"
	2	"Reduce PWM"
	3	"Both-PWM 1st" (Default)

A183 [SW Current Trip]

Related Parameter(s): P033

Enables/disables a software instantaneous (within 100 ms) current trip.

Values	Default:	0.0 (Disabled)
	Min/Max:	0.0/(Drive Rated Amps × 1.8)
	Display:	0.1 Amps

A184 [Load Loss Level]

Related Parameter(s): P033

Provides a software trip (Load Loss fault) when the current drops below this level for the time specified in [Load Loss Time].

Values	Default:	0.0 (Disabled)
	Min/Max:	0.0/Drive Rated Amps
	Display:	0.1 Amps

A185 [Load Loss Time]

Related Parameter(s): P033

Sets the required time for the current to be below [Load Loss Level] before a Load Loss fault occurs.

Values	Default:	0 Secs (Disabled)
	Min/Max:	0/9999 Secs
	Display:	1 Secs

A186 [Stall Fault Time]

Sets the time that the drive will remain in stall mode before a fault is issued.

Options	**0**	"60 Seconds" (Default)
	1	"120 Seconds"
	2	"240 Seconds"
	3	"360 Seconds"
	4	"480 Seconds"
	5	"Flt Disabled"

Advance Program Group *(continued)*

A187 [Bus Reg Mode]

Controls the operation of the drive voltage regulation, which is normally operational at decel or when the bus voltage rises.

Refer to the Attention statement on page P-3 for important information on bus regulation.

Options	**0**	"Disabled"
	1	"Enabled" (Default)

A188 [Skip Frequency 1]

Related Parameter(s): A189

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

Values	Default:	0 Hz
	Min/Max:	0/320 Hz
	Display:	1 Hz

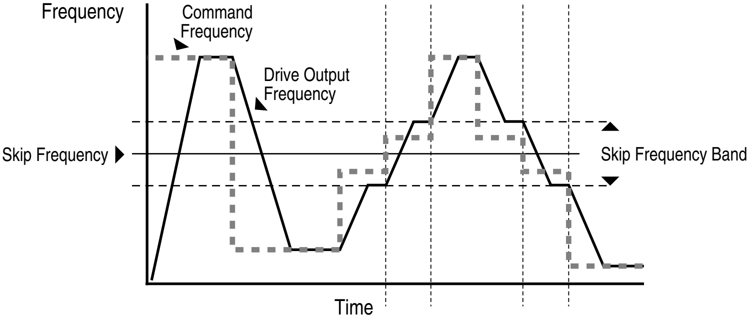
A189 [Skip Freq Band 1]

Related Parameter(s): A188

Determines the bandwidth around A188 [Skip Frequency 1]. A189 [Skip Freq Band 1] is split applying 1/2 above and 1/2 below the actual skip frequency.

A setting of 0.0 disables this parameter.

Values	Default:	0.0 Hz
	Min/Max:	0.0/30.0 Hz
	Display:	0.1 Hz



A190 [Skip Frequency 2]

Related Parameter(s): A191

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

Values	Default:	0 Hz
	Min/Max:	0/320 Hz
	Display:	1 Hz

Advance Program Group *(continued)*

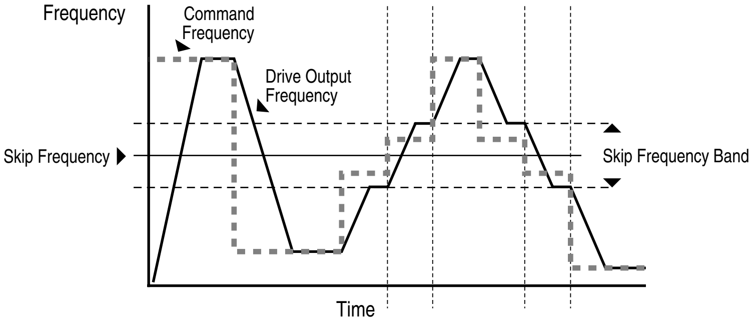
A191 [Skip Freq Band 2]

Related Parameter(s): A190

Determines the bandwidth around A190 [Skip Frequency 2]. A191 [Skip Freq Band 2] is split applying 1/2 above and 1/2 below the actual skip frequency.

A setting of 0.0 disables this parameter.

Values	Default:	0.0 Hz
	Min/Max:	0.0/30.0 Hz
	Display:	0.1 Hz



A192 [Skip Frequency 3]

Related Parameter(s): A193

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

Values	Default:	0 Hz
	Min/Max:	0/320 Hz
	Display:	1 Hz

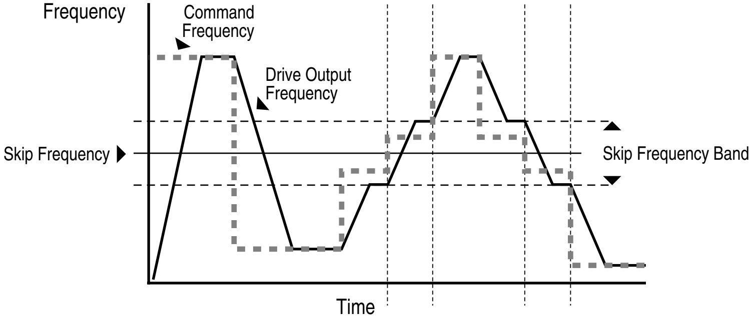
A193 [Skip Freq Band 3]

Related Parameter(s): A192

Determines the bandwidth around A192 [Skip Frequency 3]. A193 [Skip Freq Band 3] is split applying 1/2 above and 1/2 below the actual skip frequency.

A setting of 0.0 disables this parameter.

Values	Default:	0.0 Hz
	Min/Max:	0.0/30.0 Hz
	Display:	0.1 Hz



Advance Program Group *(continued)*

A194 [Compensation]

Enables/disables correction options that may improve problems with motor instability.

Options	**0**	"Disabled"	
	1	"Electrical" (Default) (1)	Some drive/motor combinations have inherent instabilities which are exhibited as non-sinusodial motor currents. This setting attempts to correct this condition.
	2	"Mechanical"	Some motor/load combinations have mechanical resonances which can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition.
	3	"Both" (1)	

(1) Use "Dead Time Compensation" algorithm to minimize flat spots in motor current waveforms. Use this solution also to achieve motor stability.

A195 [Reset Meters]

Related Parameter(s): d310-d317

Resets the marker that indicates Fault Times and Energy usage.

Options	**0**	"Ready/Idle" (Default)	
	1	"Reset MWh"	Also resets kWh marker.
	2	"Reset Time"	min, hr, and x10hr

A196 [Testpoint Sel]

Related Parameter(s): d319

Used by Rockwell Automation field service personnel.

Values	Default:	1024
	Min/Max:	1024/65535
	Display:	1

A197 [Fault Clear]

Related Parameter(s): b007, d307, d308, d309

Stop drive before changing this parameter.

Resets a fault and clears the fault queue. Used primarily to clear a fault over network communications.

Options	**0**	"Ready/Idle" (Default)	
	1	"Reset Fault"	
	2	"Clear Buffer"	Clears all fault buffers.

Advance Program Group *(continued)*

A198 [Program Lock]

Protects parameters against change by unauthorized personnel. Enter a user-selected password to lock the parameters via Option 1. Enter the same password to unlock the parameters.

Options	**0**	"Unlocked" (Default)	
	1	"Locked"	Locks all parameters.
	2	"Locked"	Parameter edits allowed over communications network.
	3	"Locked"	Locks P035 [Maximum Freq] and A170 [Boost Select].

A199 [Motor NP Poles]

Related Parameter(s): d323

Sets the motor poles. This is used to calculate d323 [Output RPM].

Values	Default:	4
	Min/Max:	2/40
	Display:	1

A200 [Motor NP FLA]

Related Parameter(s): A167

Set to the motor nameplate rated full load amps.

Values	Default:	Drive Rated Amps
	Min/Max:	0.1/(Drive Rated Amps × 2)
	Display:	0.1 Amps

Aux Relay Card Group

R221 [Relay Out3 Sel]
R224 [Relay Out4 Sel]
R227 [Relay Out5 Sel]
R230 [Relay Out6 Sel]
R233 [Relay Out7 Sel]
R236 [Relay Out8 Sel]

Related Parameters for the Aux Relay Card Group:
Aux Parameters
PID Parameters
Digital Inputs
Relays 1 and 2

Sets the condition that changes the state of the output relay contacts.

Options	**0**	"Ready/Fault" (Default)	Relay changes state when power is applied. This indicates that the drive is ready for operation. Relay returns drive to shelf state when power is removed or a fault occurs.
	1	"At Frequency"	Drive reaches commanded frequency.
	2	"MotorRunning"	Motor is receiving power from the drive.
	3	"Hand Active"	Active when drive is in local control.
	4	"Motor Overld"	Motor overload condition exists.
	5	"Ramp Reg"	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	6	"Above Freq"	• Drive exceeds the frequency (Hz) value set in [Relay OutX Level]. • Use T056 to set threshold.
	7	"Above Cur"	• Drive exceeds the current (% Amps) value set in [Relay OutX Level]. • Use T056 to set threshold. **Important:** Value for [Relay OutX Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	• Drive exceeds the DC bus voltage value set in [Relay OutX Level]. • Use T056 to set threshold.
	9	"Above Anlg 2"	• Analog input voltage (I/O Terminal 17) exceeds the value set in [Relay OutX Level]. • Do not use if T073 [Analog In 2 Sel] is set to 3 "Voltage Mode - Bipolar". • This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 17) is wired to a PTC and external resistor. • Use T056 to set threshold.
	10	"Above PF Ang"	• Power Factor angle has exceeded the value set in [Relay OutX Level]. • Use T056 to set threshold.
	11	"Anlg In Loss"	Analog input loss has occurred. Program T072 [Analog In 1 Loss] and/or T076 [Analog In 2 Loss] for desired action when input loss occurs.
	12	"ParamControl"	Enables the output to be controlled over network communications by writing to [Relay OutX Level]. (0 = Off, 1 = On.)
	13	"Retries Exst"	Value set in A163 [Auto Rstrt Tries] is exceeded.
	14	"NonRec Fault"	• Number of retries for [Restart Tries] is exceeded OR • Non-resettable fault occurs OR • Auto-retries is not enabled.
	15	"Reverse"	Drive is commanded to run in reverse direction.
	16	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	17	"Logic In 2"	An input is programmed as "Logic In 2" and is active.
	23	"Aux Motor"	Auxiliary Motor is commanded to run. Refer to Appendix C.

Aux Relay Card Group *(continued)*

R222 [Relay Out3 Level]
R225 [Relay Out4 Level]
R228 [Relay Out5 Level]
R231 [Relay Out6 Level]
R234 [Relay Out7 Level]
R237 [Relay Out8 Level]

Sets the trip point for the digital output relay if the value of [Relay OutX Sel] is 6, 7, 8, 9, 10 or 12.

[Relay OutX Select Setting	[Relay OutX Level] Min/Max
6	0/320 Hz
7	0/180%
8	0/815 Volts
9	0/100%
10	1/180 degs
12	0/1

Values	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

Refer to Appendix C for details on the application of parameters R239 through R254.

R239 [Aux Motor Mode]

Enables operation of the auxiliary motor control modes when in PID mode.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

Aux Relay Card Group *(continued)*

R240 [Aux Motor Qty]

Sets the number of auxiliary motors used while in Auxiliary Motor Control mode.

Options	**1**	"1 Aux Mtr" (Default)	1 Auxiliary Motor
	2	"2 Aux Mtr"	2 Auxiliary Motors
	3	"3 Aux Mtr"	3 Auxiliary Motors
	4	"1 Mtr + Swap" (1)	1 Auxiliary Motor and AutoSwap Active
	5	"2 Mtr + Swap" (1)	2 Auxiliary Motors and AutoSwap Active
	6	"3 Mtr + Swap" (1)	3 Auxiliary Motors and AutoSwap Active

R240 Option	Drive Relays		Auxiliary Relay Card Relays					
	#1 Relay	#2 Relay	#3 Relay	#4 Relay	#5 Relay	#6 Relay	#7 Relay	#8 Relay
1	Motor #2 AC Line	–	–	–	–	–	–	–
2	Motor #2 AC Line	Motor #3 AC Line	–	–	–	–	–	–
3	Motor #2 AC Line	Motor #3 AC Line	Motor #4 AC Line	–	–	–	–	–
4	Motor #1 Drive	Motor #1 AC Line	Motor #2 Drive	Motor #2 AC Line	–	–	–	–
5	Motor #1 Drive	Motor #1 AC Line	Motor #2 Drive	Motor #2 AC Line	Motor #3 Drive	Motor #3 AC Line	–	–
6	Motor #1 Drive	Motor #1 AC Line	Motor #2 Drive	Motor #2 AC Line	Motor #3 Drive	Motor #3 AC Line	Motor #4 Drive	Motor #4 AC Line

(1) **Important:** Proper wiring and parameter configuration of Aux Motor Control functions are especially important when using AutoSwap. Improper wiring or configuration could result in line power being applied to the drive outputs. Verify system operation before connecting auxiliary motor contactor outputs.

R241 [Aux 1 Start Freq]
R244 [Aux 2 Start Freq]
R247 [Aux 3 Start Freq]

Sets the frequency that causes the next available auxiliary motor to turn on.

Values	Default:	50.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

R242 [Aux 1 Stop Freq]
R245 [Aux 2 Stop Freq]
R248 [Aux 3 Stop Freq]

Sets the frequency that causes the next running auxiliary motor to turn off.

Values	Default:	25.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Aux Relay Card Group *(continued)*

R243 [Aux 1 Ref Add]
R246 [Aux 2 Ref Add]
R249 [Aux 3 Ref Add]

Sets the amount to add to the PID reference once the next auxiliary motor is turned on to compensate for a drop in the pipe due to the increased flow in a typical pump system.

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

R250 [Aux Start Delay]

Sets the delay time before turning on the next auxiliary motor once the output frequency has risen above the value set in [Aux X Start Freq].

Values	Default:	5.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

R251 [Aux Stop Delay]

Sets the delay time before turning off the next running auxiliary motor once the output frequency has dropped below the value set in [Aux X Stop Freq].

Values	Default:	3.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

R252 [Aux Prog Delay]

Sets the time delay between connecting the drive controlled motor contactor and running the drive controlled motor and starting the auxiliary motor control.

Values	Default:	0.50 Secs
	Min/Max:	0.00/60.00 Secs
	Display:	0.01 Secs

R253 [Aux AutoSwap Tme]

Sets the total running time between automatic motor changes.

Important: Proper wiring and parameter configuration of Aux Motor Control functions are especially important when using AutoSwap. Improper wiring or configuration could result in line power being applied to the drive outputs. Verify system operation before connecting auxiliary motor contactor outputs.

Values	Default:	0.0 Hr
	Min/Max:	0.0/999.9 Hr
	Display:	0.1 Hr

Aux Relay Card Group *(continued)*

R254 [Aux AutoSwap Lvl]

Sets the maximum level allowable for an AutoSwap to occur. If the PID output is above this level, AutoSwap will be delayed until the PID output drops below this parameter setting.

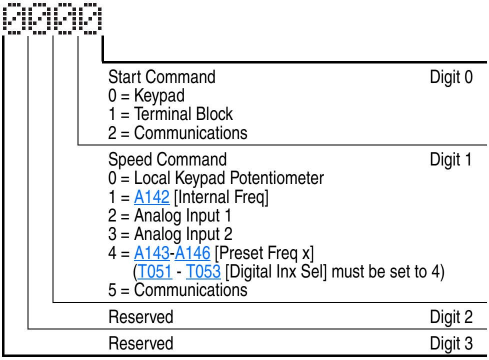
Values	Default:	50.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

Advance Display Group

d301 [Control Source]

Related Parameter(s): P036, P038, T051-T054

Displays the active source of the Start Command and Speed Command which are normally defined by the settings of P036 [Start Source] and P038 [Speed Reference] but may be overridden by digital inputs. Refer to the flowcharts on pages 1-24 and 1-25 for details.



Start Command 0 = Keypad 1 = Terminal Block 2 = Communications	Digit 0
Speed Command 0 = Local Keypad Potentiometer 1 = A142 [Internal Freq] 2 = Analog Input 1 3 = Analog Input 2 4 = A143-A146 [Preset Freq x] (T051 - T053 [Digital Inx Sel] must be set to 4) 5 = Communications	Digit 1
Reserved	Digit 2
Reserved	Digit 3

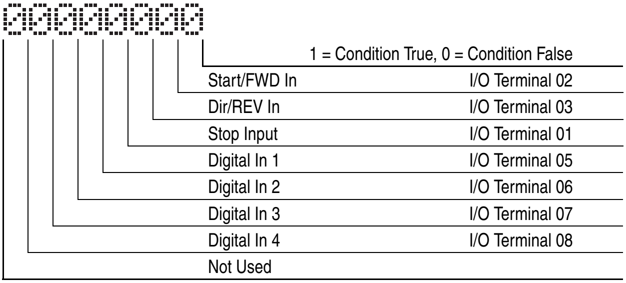
Values	Default:	Read Only
	Min/Max:	0/99
	Display:	1

d302 [Contrl In Status]

Related Parameter(s): b002, P036, T051-T054

Status of the control terminal block control inputs.

Important: Actual control commands may come from a source other than the control terminal block.



1 = Condition True, 0 = Condition False

Start/FWD In	I/O Terminal 02
Dir/REV In	I/O Terminal 03
Stop Input	I/O Terminal 01
Digital In 1	I/O Terminal 05
Digital In 2	I/O Terminal 06
Digital In 3	I/O Terminal 07
Digital In 4	I/O Terminal 08
Not Used	

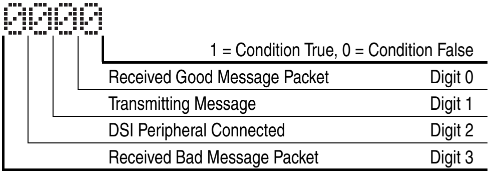
Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

Advance Display Group *(continued)*

d303 [Comm Status]

Related Parameter(s): C102-C103

Status of the communications ports.



Values	Default:	Read Only
	Min/Max:	0/1111
	Display:	1

d304 [PID Setpnt Displ]

Related Parameter(s): C102-C103

Displays the active PID Setpoint value.

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

d305 [Analog In 1]

Related Parameter(s): C102-C103

Displays the status of Analog Input 1.

Values	Default:	0.0%
	Min/Max:	0.0/120.0%
	Display:	0.1%

d306 [Analog In 2]

Related Parameter(s): C102-C103

Displays the status of Analog Input 2.

Values	Default:	0.0%
	Min/Max:	0.0/120.0%
	Display:	0.1%

d307 [Fault 1 Code]

Related Parameter(s): A197

A code that represents a drive fault. The codes will appear in these parameters in the order they occur (b007 [Fault 1 Code] = the most recent fault). Repetitive faults will only be recorded once.

Refer to Chapter 4 for fault code descriptions.

Values	Default:	Read Only
	Min/Max:	0/122
	Display:	1

Advance Display Group *(continued)*

d308 [Fault 2 Code]

Related Parameter(s): A197

A code that represents the second most recent drive fault. The codes will appear in these parameters in the order they occur (b007 [Fault 1 Code] = the most recent fault). Repetitive faults will only be recorded once. As faults occur, this parameter will be overwritten by [Fault 1 Code]. The value of this parameter is then moved to [Fault 3 Code].

Refer to Chapter 4 for fault code descriptions.

Values	Default:	Read Only
	Min/Max:	0/122
	Display:	1

d309 [Fault 3 Code]

Related Parameter(s): A197

A code that represents the second most recent drive fault. The codes will appear in these parameters in the order they occur (b007 [Fault 1 Code] = the most recent fault). Repetitive faults will only be recorded once. As faults occur, this parameter will be overwritten by [Fault 2 Code].

Refer to Chapter 4 for fault code descriptions.

Values	Default:	Read Only
	Min/Max:	0/122
	Display:	1

d310 [Fault 1 Time-hr]

Related Parameter(s): A195, d316

Displays the value of the d316 [Elapsed Time-hr] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0/9999 Hr
	Display:	1 Hr

d311 [Fault 1 Time-min]

Related Parameter(s): A195, d317

Displays the value of the d317 [Elapsed Time-min] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0.0/60.0 Min
	Display:	0.1 Min

d312 [Fault 2 Time-hr]

Related Parameter(s): A195, d316

Displays the value of the d316 [Elapsed Time-hr] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0/9999 Hr
	Display:	1 Hr

Advance Display Group *(continued)*

d313 [Fault 2 Time-min]

Related Parameter(s): A195, d317

Displays the value of the d317 [Elapsed Time-min] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0.0/60.0 Min
	Display:	0.1 Min

d314 [Fault 3 Time-hr]

Related Parameter(s): A195, d316

Displays the value of the d316 [Elapsed Time-hr] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0/9999 Hr
	Display:	1 Hr

d315 [Fault 3 Time-min]

Related Parameter(s): A195, d317

Displays the value of the d317 [Elapsed Time-min] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0.0/60.0 Min
	Display:	0.1 Min

d316 [Elapsed Time-hr]

Related Parameter(s): A195, d310, d312, d314

Displays the total elapsed powered-up time (in hours) since timer reset. The timer stops when it reaches maximum.

Values	Default:	Read Only
	Min/Max:	0/32767 Hr
	Display:	1 Hr

d317 [Elapsed Time-min]

Related Parameter(s): A195, d311, d313, d315

Displays the total elapsed powered-up time (in minutes) since timer reset. The timer will increment the hour parameter when appropriate.

Values	Default:	Read Only
	Min/Max:	0.0/60.0 Min
	Display:	0.1 Min

d318 [Output Powr Fctr]

Related Parameter(s): T055, T056, T060, T061, T065, T066

The angle in electrical degrees between motor voltage and motor current.

Values	Default:	Read Only
	Min/Max:	0.0/180.0 deg
	Display:	0.1 deg

Advance Display Group *(continued)*

d319 [Testpoint Data]

Related Parameter(s): A196

The present value of the function selected in A196 [Testpoint Sel].

Values	Default:	Read Only
	Min/Max:	0/FFFF
	Display:	1 Hex

d320 [Control SW Ver]

Main Control Board software version.

Values	Default:	Read Only
	Min/Max:	1.00/99.99
	Display:	0.01

d321 [Drive Type]

Used by Rockwell Automation field service personnel.

d322 [Output Speed]

Related Parameter(s): P034

Displays current output frequency in percent (%). The scale is 0% at 0.00 Hz to 100.0% at P034 [Maximum Freq].

Values	Default:	Read Only
	Min/Max:	0.0/100.0%
	Display:	0.1%

d323 [Output RPM]

Related Parameter(s): A199

Displays current output frequency in RPM. The scale is based on A199 [Motor NP Poles].

Values	Default:	Read Only
	Min/Max:	0/24000 RPM
	Display:	1 RPM

d324 [Fault Frequency]

Related Parameter(s): b001

Displays the value of b001 [Output Freq] when the last fault occurred.

Values	Default:	Read Only
	Min/Max:	0.00/320.00 Hz
	Display:	0.01 Hz

d325 [Fault Current]

Related Parameter(s): b003

Displays the value of b003 [Output Current] when the last fault occurred.

Values	Default:	Read Only
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

Advance Display Group *(continued)*

d326 [Fault Bus Volts]

Related Parameter(s): b005

Displays the value of b005 [DC Bus Voltage] when the last fault occurred.

Values	Default:	Read Only
	Min/Max:	0/820 VDC
	Display:	1 VDC

d327 [Status @ Fault]

Related Parameter(s): b006

Displays the value of b006 [Drive Status] when the last fault occurred.

Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

Parameter Cross-Reference – by Name

Parameter Name	Number	Group	Page
Accel Time 1	P039	Basic Program	3-10
Accel Time 2	A147	Advanced Program	3-32
Analog In 1	d305	Advanced Display	3-53
Analog In 1 Hi	T071	Terminal Block	3-20
Analog In 1 Lo	T070	Terminal Block	3-20
Analog In 1 Loss	T072	Terminal Block	3-21
Analog In 1 Sel	T069	Terminal Block	3-19
Analog In 2	d306	Advanced Display	3-53
Analog In 2 Hi	T075	Terminal Block	3-22
Analog In 2 Lo	T074	Terminal Block	3-22
Analog In 2 Loss	T076	Terminal Block	3-22
Analog In 2 Sel	T073	Terminal Block	3-21
Analog Out1 High	T083	Terminal Block	3-24
Analog Out1 Sel	T082	Terminal Block	3-24
Analog Out2 High	T086	Terminal Block	3-26
Analog Out2 Sel	T085	Terminal Block	3-25
Anlg Loss Delay	T088	Terminal Block	3-26
Anlg Out1 Setpt	T084	Terminal Block	3-25
Anlg Out2 Setpt	T087	Terminal Block	3-26
Auto Mode	P042	Basic Program	3-11
Auto Rstrt Delay	A164	Advanced Program	3-36
Auto Rstrt Tries	A163	Advanced Program	3-36
Aux 1 Ref Add	R243	Relay Card	3-50
Aux 2 Ref Add	R246	Relay Card	3-50
Aux 3 Ref Add	R249	Relay Card	3-50
Aux 1 Start Freq	R241	Relay Card	3-49
Aux 2 Start Freq	R244	Relay Card	3-49
Aux 3 Start Freq	R247	Relay Card	3-49
Aux 1 Stop Freq	R242	Relay Card	3-49
Aux 2 Stop Freq	R245	Relay Card	3-49
Aux 3 Stop Freq	R248	Relay Card	3-49
Aux AutoSwap Lvl	R254	Relay Card	3-51
Aux AutoSwap Tme	R253	Relay Card	3-50
Aux Motor Mode	R239	Relay Card	3-48
Aux Motor Qty	R240	Relay Card	3-49
Aux Prog Delay	R252	Relay Card	3-50
Aux Start Delay	R250	Relay Card	3-50
Aux Stop Delay	R251	Relay Card	3-50
Boost Select	A170	Advanced Program	3-38
Break Frequency	A173	Advanced Program	3-39
Break Voltage	A172	Advanced Program	3-39
Bus Reg Mode	A187	Advanced Program	3-43
Comm Data Rate	C103	Communications	3-27
Comm Format	C102	Communications	3-27
Comm Loss Action	C105	Communications	3-28
Comm Loss Time	C106	Communications	3-28
Comm Node Addr	C104	Communications	3-28
Comm Status	d303	Advanced Display	3-53
Comm Write Mode	C107	Communications	3-28
Commanded Freq	b002	Basic Display	3-4

Parameter Name	Number	Group	Page
Compensation	A194	Advanced Program	3-45
Contrl In Status	d302	Advanced Display	3-52
Control Source	d301	Advanced Display	3-52
Control SW Ver	d320	Advanced Display	3-56
Current Limit 1	A179	Advanced Program	3-41
Current Limit 2	A180	Advanced Program	3-41
DC Brake Level	A177	Advanced Program	3-40
DC Brake Time	A176	Advanced Program	3-40
DC Bus Voltage	b005	Basic Display	3-4
DC Brk Time@Strt	A178	Advanced Program	3-41
Decel Time 1	P040	Basic Program	3-11
Decel Time 2	A148	Advanced Program	3-32
Digital In1 Sel	T051	Terminal Block	3-12
Digital In2 Sel	T052	Terminal Block	3-12
Digital In3 Sel	T053	Terminal Block	3-12
Digital In4 Sel	T054	Terminal Block	3-12
Drive OL Mode	A182	Advanced Program	3-42
Drive Status	b006	Basic Display	3-5
Drive Temp	b014	Basic Display	3-6
Drive Type	d321	Advanced Display	3-56
Elapsed MWh	b011	Basic Display	3-6
Elapsed Run Time	b012	Basic Display	3-6
Elapsed Time-hr	d316	Advanced Display	3-55
Elapsed Time-min	d317	Advanced Display	3-55
Fault 1 Code	b007	Basic Display	3-5
Fault 1 Code	d307	Advanced Display	3-53
Fault 1 Time-hr	d310	Advanced Display	3-54
Fault 1 Time-min	d311	Advanced Display	3-54
Fault 2 Code	d308	Advanced Display	3-54
Fault 2 Time-hr	d312	Advanced Display	3-54
Fault 2 Time-min	d313	Advanced Display	3-55
Fault 3 Code	d309	Advanced Display	3-54
Fault 3 Time-hr	d314	Advanced Display	3-55
Fault 3 Time-min	d315	Advanced Display	3-55
Fault Bus Volts	d326	Advanced Display	3-57
Fault Clear	A197	Advanced Program	3-45
Fault Current	d325	Advanced Display	3-56
Fault Frequency	d324	Advanced Display	3-56
Flying Start En	A167	Advanced Program	3-37
Internal Freq	A142	Advanced Program	3-31
Language	C101	Communications	3-27
Load Loss Level	A184	Advanced Program	3-42
Load Loss Time	A185	Advanced Program	3-42
Maximum Freq	P035	Basic Program	3-7
Maximum Voltage	A174	Advanced Program	3-40
Minimum Freq	P034	Basic Program	3-7
Motor NP FLA	A200	Advanced Program	3-46
Motor NP Hertz	P032	Basic Program	3-7
Motor NP Poles	A199	Advanced Program	3-46
Motor NP Volts	P031	Basic Program	3-7

Parameter Name	Number	Group	Page
Motor OL Current	P033	Basic Program	3-7
Motor OL Ret	P043	Basic Display	3-11
Motor OL Select	A181	Advanced Program	3-41
Opto Out Level	T066	Terminal Block	3-19
Opto Out Logic	T068	Terminal Block	3-19
Opto Out Sel	T065	Terminal Block	3-18
Output Current	b003	Basic Display	3-4
Output Freq	b001	Basic Display	3-4
Output Power	b010	Basic Display	3-5
Output Powr Fctr	d318	Advanced Display	3-55
Output RPM	d323	Advanced Display	3-56
Output Speed	d322	Advanced Display	3-56
Output Voltage	b004	Basic Display	3-4
PID Deadband	A158	Advanced Program	3-35
PID Diff Rate	A156	Advanced Program	3-15
PID Feedback Sel	A153	Advanced Program	3-34
PID Integ Time	A155	Advanced Program	3-34
PID Preload	A159	Advanced Program	3-35
PID Prop Gain	A154	Advanced Program	3-34
PID Ref Sel	A152	Advanced Program	3-34
PID Setpnt Displ	d304	Advanced Display	3-53
PID Setpoint	A157	Advanced Program	3-35
PID Trim Hi	A150	Advanced Program	3-33
PID Trim Lo	A151	Advanced Program	3-33
Preset Freq 0	A143	Advanced Program	3-31
Preset Freq 1	A144	Advanced Program	3-31
Preset Freq 2	A145	Advanced Program	3-31
Preset Freq 3	A146	Advanced Program	3-31
Process Display	b008	Basic Display	3-5
Process Factor	A160	Advanced Program	3-35
Program Lock	A198	Advanced Program	3-46
Purge Frequency	A141	Advanced Program	3-31
PWM Frequency	A168	Advanced Program	3-37
PWM Mode	A169	Advanced Program	3-37
Relay 1 Off Time	T059	Terminal Block	3-15
Relay 1 On Time	T058	Terminal Block	3-15
Relay 2 Off Time	T064	Terminal Block	3-17
Relay 2 On Time	T063	Terminal Block	3-17
Relay Out1 Level	T056	Terminal Block	3-15
Relay Out1 Sel	T055	Terminal Block	3-14
Relay Out2 Level	T061	Terminal Block	3-17
Relay Out2 Sel	T060	Terminal Block	3-16
Relay Out3 Level	R222	Relay Card	3-48
Relay Out3 Sel	R221	Relay Card	3-47
Relay Out4 Level	R225	Relay Card	3-48
Relay Out4 Sel	R224	Relay Card	3-47
Relay Out5 Level	R228	Relay Card	3-48
Relay Out5 Sel	R227	Relay Card	3-47
Relay Out6 Level	R231	Relay Card	3-48
Relay Out6 Sel	R230	Relay Card	3-47
Relay Out7 Level	R233	Relay Card	3-47
Relay Out7 Sel	R234	Relay Card	3-48
Relay Out8 Level	R237	Relay Card	3-48
Relay Out8 Sel	R236	Relay Card	3-47
Reset Meters	A195	Advanced Program	3-45
Reset To Defalts	P041	Basic Program	3-11
Reverse Disable	A166	Advanced Program	3-37
S Curve %	A149	Advanced Program	3-33
Skip Freq Band 1	A189	Advanced Program	3-43
Skip Freq Band 2	A191	Advanced Program	3-44
Skip Freq Band 3	A193	Advanced Program	3-44
Skip Frequency 1	A188	Advanced Program	3-43
Skip Frequency 2	A190	Advanced Program	3-43
Skip Frequency 3	A192	Advanced Program	3-44
Sleep Level	T078	Terminal Block	3-23
Sleep Time	T079	Terminal Block	3-23
Sleep-Wake Sel	T077	Terminal Block	3-23
Slip Hertz @ FLA	A175	Advanced Program	3-40
Speed Ref 2	C109	Communications	3-30
Speed Reference	P038	Basic Program	3-10
Stall Fault Time	A186	Advanced Program	3-42
Start At PowerUp	A165	Advanced Program	3-36
Start Boost	A171	Advanced Program	3-39
Start Source	P036	Basic Program	3-8
Start Source 2	C108	Communications	3-29
Status @ Fault	d327	Advanced Display	3-57
Stop Mode	P037	Basic Program	3-9
SW Current Trip	A183	Advanced Program	3-42
Testpoint Data	d319	Advanced Display	3-56
Testpoint Sel	A196	Advanced Program	3-45
Torque Current	b013	Basic Display	3-6
Wake Level	T080	Terminal Block	3-23
Wake Time	T081	Terminal Block	3-23

Notes:

Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the PowerFlex 400 drive. Included is a listing and description of drive faults (with possible solutions, when applicable).

For information on…	See page…	For information on…	See page…
Drive Status	4-1	Fault Descriptions	4-3
Faults	4-1	Common Symptoms and Corrective Actions	4-5

Drive Status

The condition or state of your drive is constantly monitored. Any changes will be indicated through the integral keypad.

LED Indications

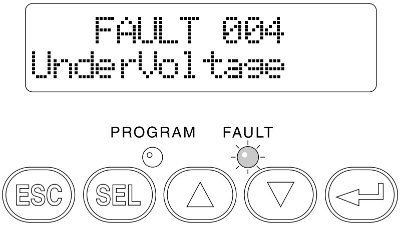
See page 2-3 for information on drive status indicators and controls.

Faults

A fault is a condition that stops the drive. There are two fault types.

Type	Fault Description	
①	Auto-Reset/Run	When this type of fault occurs, and A163 [Auto Rstrt Tries] is set to a value greater than "0," a user-configurable timer, A164 [Auto Rstrt Delay], begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
②	Non-Resetable	This type of fault may require drive or motor repair, or is caused by wiring or programing errors. The cause of the fault must be corrected before the fault can be cleared.

Fault Indication

Condition	
Drive is indicating a fault. The integral keypad provides visual notification of a fault condition by displaying the following. • Flashing fault number • Flashing fault indicator Press the Escape key to regain control of the integral keypad.	

Manually Clearing Faults

Step	Key(s)
1. Press Esc to acknowledge the fault. The fault information will be removed so that you can use the integral keypad. Access b007 [Fault 1 Code] to view the most recent fault information.	ESC
2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared. See Table 4.A.	
3. After corrective action has been taken, clear the fault by one of these methods.	
• Press Stop if P037 [Stop Mode] is set to a value between “0” and “3”.	○ OFF
• Cycle drive power.	
• Set A197 [Fault Clear] to “1” or “2”.	
• Cycle digital input if T051-T054 [Digital Inx Sel] is set to option 10 “Clear Fault”.	

Automatically Clearing Faults

Option / Step
Clear a Type 1 fault and restart the drive.
1. Set A163 [Auto Rstrt Tries] to a value other than “0”.
2. Set A164 [Auto Rstrt Delay] to a value other than “0”.
Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.
1. Set A163 [Auto Rstrt Tries] to a value other than “0”.
2. Set A164 [Auto Rstrt Delay] to “0”.

Auto Restart (Reset/Run)

The Auto Restart feature allows the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows remote or “unattended” operation. Only certain faults are allowed to be reset. Certain faults (Type 2) that indicate possible drive component malfunction are not resettable.

Caution should be used when enabling this feature, since the drive will attempt to issue its own start command based on user selected programming.

Fault Descriptions

Table 4.A Fault Types, Descriptions and Actions

No.	Fault	Type[1]	Description	Action
F2	Auxiliary Input	①	Auxiliary input interlock is open.	1. Check remote wiring. 2. Verify communications programming for intentional fault.
F3	Power Loss	②	DC bus voltage remained below 85% of nominal.	1. Monitor the incoming AC line for low voltage or line power interruption. 2. Check input fuses.
F4	UnderVoltage	①	DC bus voltage fell below the minimum value.	Monitor the incoming AC line for low voltage or line power interruption.
F5	OverVoltage	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
F6	Motor Stalled	①	Drive is unable to accelerate motor.	Increase P039 - A147 [Accel Time x] or reduce load so drive output current does not exceed the current set by parameter A179 [Current Limit 1].
F7	Motor Overload	①	Internal electronic overload trip.	1. An excessive motor load exists. Reduce load so drive output current does not exceed the current set by parameter P033 [Motor OL Current]. 2. Verify A170 [Boost Select] setting
F8	Heatsink OvrTmp	①	Heatsink temperature exceeds a predefined value.	1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 45°C (113°F) for IP 30/NEMA 1/UL Type 1 installations or 50°C (122°F) for IP20/Open type installations. 2. Check fan.
F12	HW OverCurrent	②	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper A170 [Boost Select] setting, DC brake volts set too high or other causes of excess current.
F13	Ground Fault	②	A current path to earth ground has been detected at one or more of the drive output terminals.	Check the motor and external wiring to the drive output terminals for a grounded condition.
F15	Load Loss	①	Output current has dropped below the level set in A184 [Load Loss Level].	Check for load loss (i.e., a broken belt).
F29	Analog Input Loss	①	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with T072 [Analog In Loss].	1. Check parameters. 2. Check for broken/loose connections at inputs.

[1] See page 4-1 for a description of fault types.

No.	Fault	Type(1)	Description	Action
F33	Auto Rstrt Tries	②	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of A163 [Auto Rstrt Tries].	Correct the cause of the fault and manually clear.
F38	Phase U to Gnd	②	A phase to ground fault has been detected between the drive and motor in this phase.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace drive if fault cannot be cleared.
F39	Phase V to Gnd			
F40	Phase W to Gnd			
F41	Phase UV Short	②	Excessive current has been detected between these two output terminals.	1. Check the motor and drive output terminal wiring for a shorted condition. 2. Replace drive if fault cannot be cleared.
F42	Phase UW Short			
F43	Phase VW Short			
F48	Params Defaulted		The drive was commanded to write default values to EEPROM.	1. Clear the fault or cycle power to the drive. 2. Program the drive parameters as needed.
F63	SW OverCurrent	①	Programmed A183 [SW Current Trip] has been exceeded.	Check load requirements and A183 [SW Current Trip] setting.
F64	Drive Overload	②	Drive rating of 110% for 1 minute or 150% for 3 seconds has been exceeded.	Reduce load or extend Accel Time.
F70	Power Unit	②	Failure has been detected in the drive power section.	1. Cycle power. 2. Replace drive if fault cannot be cleared.
F71	Net Loss		The communication network has faulted.	1. Cycle power. 2. Check communications cabling. 3. Check network adapter setting. 4. Check external network status.
F81	Comm Loss	②	RS485 (DSI) port stopped communicating.	1. Check RS485 wiring connection. 2. Check if a communications adapter or HIM was disconnected. 3. Increase C106 [Comm Loss Time] to an appropriate time for application. 4. Change C105 [Comm Loss Action] to a value other than “0” (fault), if appropriate for the application.
F94	Function Loss	②	P036 [Start Source] is set to setting 6. The input to terminal 01 has been opened.	Close input to terminal 01 and re-start the drive.
F100	Parameter Checksum	②	The checksum read from the board does not match the checksum calculated.	Set P041 [Reset To Defalts] to option 1 “Reset Defaults”.

No.	**Fault**	**Type**[1]	**Description**	**Action**
F122	I/O Board Fail	②	Failure has been detected in the drive control and I/O section.	1. Cycle power. 2. Replace drive if fault cannot be cleared.

[1] See page 4-1 for a description of fault types.

Common Symptoms and Corrective Actions

Motor does not Start.

Cause(s)	Indication	Corrective Action
No output voltage to the motor.	None	Check the power circuit. • Check the supply voltage. • Check all fuses and disconnects. Check the motor. • Verify that the motor is connected properly. Check the control input signals. • Verify that a Start signal is present. If 2-Wire control is used, verify that either the Run Forward or Run Reverse signal is active, but not both. • Verify that I/O Terminal 01 is active. • Verify that P036 [Start Source] matches your configuration. • Verify that A166 [Reverse Disable] is not prohibiting movement.
Drive is Faulted	Flashing red status light	Clear fault. • Press Stop • Cycle power • Set A197 [Fault Clear] to option 1 “Clear Faults”. • Cycle digital input if T051 - T054 [Digital Inx Sel] is set to option 7 “Clear Fault”.

Drive does not Start from Start or Run Inputs wired to the terminal block.

Cause(s)	Indication	Corrective Action
Drive is Faulted	Flashing red status light	Clear fault. • Press Stop • Cycle power • Set A197 [Fault Clear] to option 1 "Clear Faults". • Cycle digital input if T051 - T054 [Digital Inx Sel] is set to option 7 "Clear Fault".
Incorrect programming. • P036 [Start Source] is set to option 0 "Keypad" or option 5 "RS485 (DSI) Port". • T051 - T054 [Digital Inx Sel] is set to option 5 "Local" and the input is active.	None	Check parameter settings.
Incorrect input wiring. See 1-20 for wiring examples. • 2 wire control requires Run Forward, Run Reverse or Jog input. • 3 wire control requires Start and Stop inputs • Stop input is always required.	None	Wire inputs correctly and/or install jumper.
Incorrect Sink/Source DIP switch setting.	None	Set switch to match wiring scheme.

Drive does not Start from Integral Keypad.

Cause(s)	Indication	Corrective Action
Integral keypad is not enabled.	Green LED above Start key is not illuminated.	• Set parameter P036 [Start Source] to option 0 "Keypad". • Set parameter T051 - T054 [Digital Inx Sel] to option 5 "Local" and activate the input.
I/O Terminal 01 "Stop" input is not present.	None	Wire inputs correctly and/or install jumper.

Drive does not respond to changes in speed command.

Cause(s)	Indication	Corrective Action
No value is coming from the source of the command.	The drive "Run" indicator is lit and output is 0 Hz.	• Check d301 [Control Source] for correct source. • If the source is an analog input, check wiring and use a meter to check for presence of signal. • Check b002 [Commanded Freq] to verify correct command.
Incorrect reference source is being selected via remote device or digital inputs.	None	• Check d301 [Control Source] for correct source. • Check d302 [Contrl In Status] to see if inputs are selecting an alternate source. Verify settings for T051 - T054 [Digital Inx Sel]. • Check P038 [Speed Reference] for the source of the speed reference. Reprogram as necessary. • Review the Speed Reference Control chart on page 1-24.

Motor and/or drive will not accelerate to commanded speed.

Cause(s)	Indication	Corrective Action
Acceleration time is excessive.	None	Reprogram P039 [Accel Time 1] or A147 [Accel Time 2].
Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration.	None	Compare b003 [Output Current] with A179 [Current Limit 1]. Remove excess load or reprogram P039 [Accel Time 1] or A147 [Accel Time 2]. Check for improper A170 [Boost Select] setting.
Speed command source or value is not as expected.	None	Verify b002 [Commanded Freq]. Check d301 [Control Source] for the proper Speed Command.
Programming is preventing the drive output from exceeding limiting values.	None	Check P035 [Maximum Freq] to insure that speed is not limited by programming.

Motor operation is unstable.

Cause(s)	Indication	Corrective Action
Motor data was incorrectly entered.	None	1. Correctly enter motor nameplate data into P031, P032 and P033. 2. Enable A194 [Compensation]. 3. Use A170 [Boost Select] to reduce boost level.

Drive will not reverse motor direction.

Cause(s)	Indication	Corrective Action
Digital input is not selected for reversing control.	None	Check T051 - T054 [Digital Inx Sel] and P036 [Start Source]. Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring. (See page 1-18)
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
Reverse is disabled.	None	Check A166 [Reverse Disable].

Drive does not power up.

Cause(s)	Indication	Corrective Action
No input power to drive.	None	Check the power circuit. • Check the supply voltage. • Check all fuses and disconnects.
Jumper between Power Terminals P2 and P1 not installed and/or DC Bus Inductor not connected.	None	Install jumper or connect DC Bus Inductor.

Supplemental Drive Information

Drive, Fuse & Circuit Breaker Ratings

The tables on the following pages provide drive ratings and recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 degree C and the U.S. N.E.C. Other country, state or local codes may require different ratings.

Fusing

If fuses are chosen as the desired protection method, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

- IEC – BS88 (British Standard) Parts 1 & 2 (1), EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T or J must be used. (2)

Circuit Breakers

Refer to listings in the following tables for recommended circuit breakers (inverse time or instantaneous trip) and 140M Self-Protecting Motor Starters.

---

(1) Typical designations include, but may not be limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

(2) Typical designations include;
Type CC - KTK-R, FNQ-R
Type J - JKS, LPJ
Type T - JJS, JJN

Specifications

Drive Ratings

Catalog Number	Output Ratings			Input Ratings			Branch Circuit Protection		
		Amps							
	kW (HP)	*45°C*	*50°C*	*Voltage Range*	*kVA*	*Amps*	*Fuses*	*140M Motor Protectors*[1]	*Contactors*
200 - 240V AC – 3-Phase Input, 0 - 230V 3-Phase Output									
22C-B012N103	2.2 (3.0)	12	12	180-265	6.5	15.5	20	140M-F8E-C16	100-C23
22C-B017N103	3.7 (5.0)	17.5	17.5	180-265	8.8	21	30	140M-F8E-C25	100-C37
22C-B024N103	5.5 (7.5)	24	24	180-265	10.9	26.1	35	140M-F8E-C32	100-C37
22C-B033N103	7.5 (10)	33	33	180-265	14.4	34.6	45	140M-F8E-C45	100-C45
22C-B049A103	11 (15)	49	49	180-265	21.3	51	70	140-CMN-6300	100-C60
22C-B065A103	15 (20)	65	65	180-265	28.3	68	90	140-CMN-9000	100-C85
22C-B075A103	18.5 (25)	75	75	180-265	32.5	78	100	140-CMN-9000	100-D95
22C-B090A103	22 (30)	90	81	180-265	38.3	92	125	–	100-D110
22C-B120A103	30 (40)	120	120	180-265	51.6	124	175	–	100-D180
22C-B145A103	37 (50)	145	130	180-265	62.4	150	200	–	100-D180
380 - 480V AC – 3-Phase Input, 0 - 460V 3-Phase Output									
22C-D6P0N103	2.2 (3.0)	6	6	340-528	6.3	7.5	10	140M-D8E-C10	100-C09
22C-D010N103	4.0 (5.0)	10.5	10.5	340-528	10.9	13	20	140M-D8E-C16	100-C16
22C-D012N103	5.5 (7.5)	12	12	340-528	11.9	14.2	20	140M-D8E-C16	100-C23
22C-D017N103	7.5 (10)	17	17	340-528	15.3	18.4	25	140M-D8E-C20	100-C23
22C-D022N103	11 (15)	22	22	340-528	19.2	23	30	140M-F8E-C32	100-C30
22C-D030N103	15 (20)	30	27	340-528	25.8	31	40	140M-F8E-C32	100-C37
22C-D038A103	18.5 (25)	38	38	340-528	33.3	40	50	140M-F8E-C45	100-C60
22C-D045A103	22 (30)	45.5	45.5	340-528	39.1	47	60	140-CMN-6300	100-C60
22C-D060A103	30 (40)	60	54	340-528	53.3	64	80	140-CMN-9000	100-C85
22C-D072A103	37 (50)	72	72	340-528	60.7	73	100	140-CMN-9000	100-C85
22C-D088A103	45 (60)	88	88	340-528	74.9	90	125	–	100-D110
22C-D105A103	55 (75)	105	105	340-528	89	107	150	–	100-D140
22C-D142A103	75 (100)	142	128	340-528	124.8	150	200	–	100-D180
22C-D170A103	90 (125)	170	170	340-528	142	170	250	–	100-D250
22C-D208A103	110 (150)	208	208	340-528	167	200	250	–	100-D250

(1) Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001… to determine the frame and breaking capacity required for your application.

Category	**Specification**	
Agency Certification	c UL us	Listed to UL508C and CAN/CSA-22.2 Listed to UL508C for plenums
	✓	Certified to AS/NZS, 1997 Group 1, Class A
	CE	Marked for all applicable European Directives EMC Directive (89/336) EN 61800-3, EN 50081-1, EN 50082-2 Low Voltage Directive (73/23/EEC) EN 50178, EN 60204
	The drive is also designed to meet the appropriate portions of the following specifications: NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. IEC 146 - International Electrical Code.	
Protection	Bus Overvoltage Trip:	200-240V AC Input: 405V DC bus voltage (equivalent to 290V AC incoming line) 380-460V AC Input: 810V DC bus voltage (equivalent to 575V AC incoming line)
	Bus Undervoltage Trip:	200-240V AC Input: 210V DC bus voltage (equivalent to 150V AC incoming line) 380-480V AC Input: 390V DC bus voltage (equivalent to 275V AC incoming line)
	Power Ride-Thru:	100 milliseconds
	Logic Control Ride-Thru:	0.5 seconds minimum, 2 seconds typical
	Electronic Motor Overload Protection:	I^2t protection - 110% for 60 seconds (Provides Class 10 protection)
	Overcurrent:	180% hardware limit, 220% instantaneous fault
	Ground Fault Trip:	Phase-to-ground on drive output
	Short Circuit Trip:	Phase-to-phase on drive output
Environment	Altitude:	1000 m (3300 ft) max. without derating. Above 1000 m (3300 ft) derate 3% for every 305 m (1000 ft).
	Maximum Surrounding Air Temperature without derating: IP20, Open Type: IP30, NEMA Type 1, UL Type 1:	 –10 to 50 degrees C (14 to 122 degrees F) –10 to 45 degrees C (14 to 113 degrees F)
	Cooling Method:	Fan: All drive ratings
	Storage Temperature:	–40 to 70 degrees C (–40 to 158 degrees F)
	Atmosphere:	**Important:** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
	Relative Humidity:	0 to 95% non-condensing
	Shock (operating):	15G peak for 11ms duration (±1.0 ms)
	Vibration (operating):	1G peak, 5 to 2000 Hz
	Seismic Rating	Meets the seismic requirements of the 2003 International Building Code as specified by AC156.

Category	Specification		
Electrical	Voltage Tolerance:		200-240V ±10% 380-480V ±10%
	Frequency Tolerance:		48-63 Hz
	Input Phases:		Three-phase input provides full rating. Single-phase operation provides 50% rated current.
	Displacement Power Factor:		0.98 across entire speed range
	Efficiency:		97.5% at rated amps, nominal line voltage
	Maximum Short Circuit Rating:		100,000 Amps Symmetrical (Frame C Drives) 200,000 Amps Symmetrical (Frame D, E, F Drives)
	Actual Short Circuit Rating:		Determined by AIC Rating of installed fuse/circuit breaker
	Transistor Type:		Isolated Gate Bipolar (IGBT)
	Internal DC Bus Choke: 200-240V AC Input: 380-480V AC Input:		 11-37 kW (15-50 HP) Panel Mount Drives 11-110 kW (15-150 HP) Panel Mount Drives
Control	Method:		Sinusoidal PWM, Volts/Hertz
	Carrier Frequency Frames C and D: Frames E and F:		 2-10 kHz, Drive rating based on 4 kHz 2-8 kHz, Drive rating based on 4 kHz
	Frequency Accuracy Digital Input: Analog Input: Analog Output:		 Within ±0.05% of set output frequency Within 0.5% of maximum output frequency, 10-Bit resolution ±2% of full scale, 10-Bit resolution
	Speed Regulation - Open Loop with Slip Compensation:		±1% of base speed across a 60:1 speed range
	Output Frequency:		0-320 Hz (programmable)
	Stop Modes:		Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S Curve.
	Accel/Decel:		Two independently programmable accel and decel times. Each time may be programmed from 0 - 600 seconds in 0.1 second increments.
	Intermittent Overload:		110% Overload capability for up to 1 minute
	Electronic Motor Overload Protection		Class 10 protection with speed sensitive response.
Control Inputs	Digital:	Quantity:	(3) Semi-programmable (4) Programmable
		Type Source Mode (SRC): Sink Mode (SNK):	 18-24V = ON, 0-6V = OFF 0-6V = ON, 18-24V = OFF
	Analog:	Quantity:	(1) Isolated, –10 to 10V or 4-20mA (1) Non-isolated, 0 to 10V or 4-20mA
		Specification Resolution: 0 to 10V DC Analog: 4-20mA Analog: External Pot:	 10-bit 100k ohm input impedance 250 ohm input impedance 1-10k ohm, 2 Watt minimum

Category	**Specification**		
Control Outputs	Relay:	Quantity:	(2) Programmable Form C
		Specification	
		Resistive Rating:	3.0A at 30V DC, 3.0A at 125V, 3.0A at 240V AC
		Inductive Rating:	0.5A at 30V DC, 0.5A at 125V, 0.5A at 240V AC
	Optional Relay Card:	Quantity:	(6) Optional Programmable Form A (Drive Frames D, E & F Only)
		Specification	
		Resistive Rating:	0.1A at 30V DC Class II circuits, 3.0A at 125V, 3.0A at 240V AC
		Inductive Rating:	0.1A at 30V DC Class II circuits, 3.0A at 125V 3.0A at 240V AC
	Opto:	Quantity:	(1) Programmable
		Specification:	30V DC, 50mA Non-inductive
	Analog:	Quantity:	(2) Non-Isolated, 0-10V or 4-20mA
		Specification	
		Resolution:	10-bit
		0 to 10V DC Analog:	1k ohm minimum
		4-20mA Analog:	525 ohm maximum
Keypad	Display:	Integral 2 line by 16 character LCD with (5) LED Indicators	
	Languages:	English, Français, Español, Italiano, Deutsch, Português, Nederlands	
Communication	Type:	Serial (RS485)	
	Supported Protocols (Standard):	Drive Serial Interface (DSI) Modbus RTU Metasys N2	
	Supported Protocols (Optional):	DeviceNet EtherNet/IP PROFIBUS DP ControlNet LonWorks P1 - Floor Level Network (FLN)	
	Software (Optional):	Windows Based Pocket PC/Windows Mobile 2003	

PowerFlex 400 Watts Loss (Rated Load, Speed & PWM)

Voltage	kW (HP)	Panel Mount Watts	Flange Mount Watts		
		Total	External	Internal	Total
200-240V AC	2.2 (3.0)	146	119	28	146
	3.7 (5.0)	207	174	33	207
	5.5 (7.5)	266	228	39	266
	7.5 (10)	359	315	44	359
	11 (15)	488	–	–	–
	15 (20)	650	–	–	–
	18.5 (25)	734	–	–	–
	22 (30)	778	–	–	–
	30 (40)	1055	–	–	–
	37 (50)	1200	–	–	–
380-480V AC	2.2 (3.0)	105	77	28	105
	4.0 (5.0)	171	143	28	171
	5.5 (7.5)	200	161	39	200
	7.5 (10)	267	229	39	267
	11 (15)	329	285	44	329
	15 (20)	435	380	55	435
	18.5 (25)	606	–	–	–
	22 (30)	738	–	–	–
	30 (40)	664	–	–	–
	37 (50)	1019	–	–	–
	45 (60)	1245	–	–	–
	55 (75)	1487	–	–	–
	75 (100)	2043	–	–	–
	90 (125)	2617	–	–	–
	110 (150)	3601	–	–	–

Input Power Connections

Figure A.1 Frame C, D, and E Connections

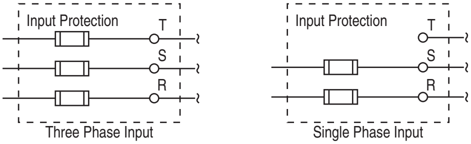
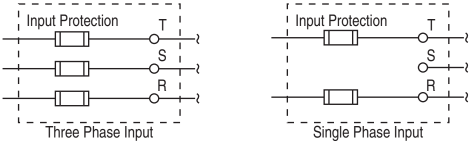


Figure A.2 Frame F Connections



Note: UL Approval pending for Single-Phase operation.

Notes:

Appendix B

Accessories and Dimensions

Product Selection

Table B.1 Catalog Number Description

22C	**-**	**B**	**024**	**N**	**1**	**0**	**3**
Drive		Voltage Rating	Rating	Enclosure	HIM	Emission Class	Comm Slot

Table B.2 PowerFlex 400 Drives

Drive Ratings						
			Output Current (Amps)			
Input Voltage	**kW**	**HP**	**45°C**	**50°C**	**Catalog Number**	**Frame Size**
240V 50/60 Hz 3-Phase	2.2	3.0	12	12	22C-B012N103	C
	3.7	5.0	17.5	17.5	22C-B017N103	C
	5.5	7.5	24	24	22C-B024N103	C
	7.5	10	33	33	22C-B033N103	C
	11	15	49	49	22C-B049A103	D
	15	20	65	65	22C-B065A103	D
	18.5	25	75	75	22C-B075A103	D
	22	30	90	81	22C-B090A103	D
	30	40	120	120	22C-B120A103	E
	37	50	145	130	22C-B145A103	E
480V 50/60 Hz 3-Phase	2.2	3.0	6	6	22C-D6P0N103	C
	4.0	5.0	10.5	10.5	22C-D010N103	C
	5.5	7.5	12	12	22C-D012N103	C
	7.5	10	17	17	22C-D017N103	C
	11	15	22	22	22C-D022N103	C
	15	20	30	27	22C-D030N103	C
	18.5	25	38	38	22C-D038A103	D
	22	30	45.5	45.5	22C-D045A103	D
	30	40	60	54	22C-D060A103	D
	37	50	72	72	22C-D072A103	E
	45	60	88	88	22C-D088A103	E
	55	75	105	105	22C-D105A103	E
	75	100	142	128	22C-D142A103	E
	90	125	170	170	22C-D170A103	F
	110	150	208	208	22C-D208A103	F

Table B.3 PowerFlex 400 Flange Mount Drives

Drive Ratings						
			Output Current			
Input Voltage	kW	HP	45°C	50°C	Catalog Number	Frame Size
240V 50/60 Hz 3-Phase	2.2	3	12A	12A	22C-B012F103	C
	3.7	5	17.5A	17.5A	22C-B017F103	C
	5.5	7.5	24A	24A	22C-B024F103	C
	7.5	10	33A	33A	22C-B033F103	C
480V 50/60 Hz 3-Phase	2.2	3	6.0A	6.0A	22C-D6P0F103	C
	4.0	5	10A	10A	22C-D010F103	C
	5.5	7.5	12A	12A	22C-D012F103	C
	7.5	10	17A	17A	22C-D017F103	C
	11	15	22A	22A	22C-D022F103 (1)	C
	15	20	30A	27A	22C-D030F103 (1)	C

(1) A DC bus inductor is required. See Table B.7 for ordering information.

Table B.4 Bulletin 1321-3R Series Line Reactors – 200-240V, 60 Hz, Three-Phase

						Catalog Number	
kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance mh	Watts Loss	IP00 (Open Style)	IP11 (MENA Type 1)
3% Impedance							
2.2	3.0	12	18	1.25	26	1321-3R12-A	1321-3RA12-A
3.7	5.0	18	27	0.8	36	1321-3R18-A	1321-3RA18-A
5.5	7.5	25	37.5	0.5	48	1321-3R25-A	1321-3RA25-A
7.5	10	35	52.5	0.4	49	1321-3R35-A	1321-3RA35-A
11	15	45	67.5	0.3	54	1321-3R45-A	1321-3RA45-A
15	20	55	82.5	0.25	64	1321-3R55-A	1321-3RA55-A
18.5	25	80	120	0.2	82	1321-3R80-A	1321-3RA80-A
22	30	80	120	0.2	82	1321-3R80-A	1321-3RA80-A
30	40	100	150	0.15	94	1321-3R100-A	1321-3RA100-A
37	50	130	195	0.1	108	1321-3R130-A	1321-3RA130-A
5% Impedance							
2.2	3.0	12	18	2.5	31	1321-3R12-B	1321-3RA12-B
3.7	5.0	18	27	1.5	43	1321-3R18-B	1321-3RA18-B
5.5	7.5	25	37.5	1.2	52	1321-3R25-B	1321-3RA25-B
7.5	10	35	52.5	0.8	54	1321-3R35-B	1321-3RA35-B
11	15	45	67.5	0.7	62	1321-3R45-B	1321-3RA45-B
15	20	55	82.5	0.5	67	1321-3R55-B	1321-3RA55-B
18.5	25	80	120	0.4	86	1321-3R80-B	1321-3RA80-B
22	30	80	120	0.4	86	1321-3R80-B	1321-3RA80-B
30	40	100	150	0.3	84	1321-3R100-B	1321-3RA100-B
37	50	130	195	0.2	180	1321-3R130-B	1321-3RA130-B

Table B.5 Bulletin 1321-3R Series Line Reactors – 380-480V, 60 Hz, Three-Phase

kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance	Watts Loss	Catalog Number IP00 (Open Style)	Catalog Number IP11 (MENA Type 1)
3% Impedance							
2.2	3.0	8	12	5	25.3	1321-3R8-C	1321-3RA8-C
4.0	5.0	12	18	2.5	31	1321-3R12-B	1321-3RA12-B
5.5	7.5	12	18	2.5	31	1321-3R12-B	1321-3RA12-B
7.5	10	18	27	1.5	43	1321-3R18-B	1321-3RA18-B
11	15	25	37.5	1.2	52	1321-3R25-B	1321-3RA25-B
15	20	35	52.5	0.8	54	1321-3R35-B	1321-3RA35-B
18.5	25	35	52.5	0.8	54	1321-3R35-B	1321-3RA35-B
22	30	45	67.5	0.7	62	1321-3R45-B	1321-3RA45-B
30	40	55	82.5	0.5	67	1321-3R55-B	1321-3RA55-B
37	50	80	120	0.4	86	1321-3R80-B	1321-3RA80-B
45	60	80	120	0.4	86	1321-3R80-B	1321-3RA80-B
55	75	100	150	0.3	84	1321-3R100-B	1321-3RA100-B
75	100	130	195	0.2	180	1321-3R130-B	1321-3RA130-B
90	125	160	240	0.15	149	1321-3R160-B	1321-3RA160-B
110	150	200	300	0.11	168	1321-3R200-B	1321-3RA200-B
5% Impedance							
2.2	3.0	8	12	7.5	28	1321-3R8-D	1321-3RA8-D
4.0	5.0	12	18	4.2	41	1321-3R12-C	1321-3RA12-C
5.5	7.5	12	18	4.2	41	1321-3R12-C	1321-3RA12-C
7.5	10	18	27	2.5	43	1321-3R18-C	1321-3RA18-C
11	15	25	37.5	2.0	61	1321-3R25-C	1321-3RA25-C
15	20	35	52.5	1.2	54	1321-3R35-C	1321-3RA35-C
18.5	25	35	52.5	1.2	54	1321-3R35-C	1321-3RA35-C
22	30	45	67.5	1.2	65	1321-3R45-C	1321-3RA45-C
30	40	55	82.5	0.85	71	1321-3R55-C	1321-3RA550-C
37	50	80	120	0.7	96	1321-3R80-C	1321-3RA80-C
45	60	80	120	0.7	96	1321-3R80-C	1321-3RA80-C
55	75	100	150	0.45	108	1321-3R100-C	1321-3RA100-C
75	100	130	195	0.3	128	1321-3R130-C	1321-3RA130-C
90	125	160	240	0.23	138	1321-3R160-C	1321-3RA160-C
110	150	200	300	0.185	146	1321-3R200-C	1321-3RA200-C

Table B.6 Bulletin 1321 - DC Series Bus Inductors - 200-240V, 60 Hz, Three-Phase

kW	HP	DC Amps	Inductance mh	Watts Loss	Catalog Number IP00 (Open Style)
2.2	3	12	0.92	5	1321-DC12-1
3.7	5	18	0.63	5	1321-DC18-1
5.5	7.5	32	0.85	11	1321-DC32-1
7.5	10	40	0.75	15	1321-DC40-2

Table B.7 Bulletin 1321 - DC Series Bus Inductors - 380-480V, 60 Hz, Three-Phase

kW	HP	DC Amps	Inductance mh	Watts Loss	Catalog Number IP00 (Open Style)
2.2	3	9	3.68	7	1321-DC9-2
4.0	5	12	2.1	7	1321-DC12-2
5.5	7.5	18	3.75	17	1321-DC18-4
7.5	10	25	1.75	13	1321-DC25-4
11	15	32	2.68	21	1321-DC32-2 (1)
15	20	40	2.0	29	1321-DC40-4 (1)

(1) Required on 11 and 15 kW (15 and 20 HP) Frame C Flange Mount drive ratings.

Table B.8 EMC Line Filters

Drive Ratings			
Input Voltage	**kW**	**HP**	**Catalog Number**
240V 50/60 Hz 3-Phase	2.2	3.0	22-RF034-CS
	4.0	5.0	22-RF034-CS
	5.5	7.5	22-RF034-CS
	7.5	10	22-RF034-CS
	11	15	22-RFD070
	15	20	22-RFD100
	18.5	25	22-RFD100
	22	30	22-RFD150
	30	40	22-RFD150
	37	50	22-RFD180
480V 50/60 Hz 3-Phase	2.2	3.0	22-RF018-CS
	4.0	5.0	22-RF018-CS
	5.5	7.5	22-RF018-CS
	7.5	10	22-RF018-CS
	11	15	22-RF026-CS
	15	20	22-RFD036
	18.5	25	22-RFD050
	22	30	22-RFD050
	30	40	22-RFD070
	37	50	22-RFD100
	45	60	22-RFD100
	55	75	22-RFD150
	75	100	22-RFD180
	90	125	Consult Factory
	110	150	Consult Factory

Table B.9 Communication Option Kits and Accessories

Item	Description	Catalog Number
DeviceNet Communication Adapter	Embedded communication option for use with the PowerFlex family of drives. Requires a Communication Adapter Cover when used with Frame C PowerFlex 400 drives (Ordered Separately).	22-COMM-D
EtherNet/IP Communication Adapter	Embedded communication option for use with the PowerFlex family of drives. Requires a Communication Adapter Cover when used with Frame C PowerFlex 400 drives (Ordered Separately).	22-COMM-E
Profibus DP Communication Adapter	Embedded communication option for use with the PowerFlex family of drives. Requires a Communication Adapter Cover when used with Frame C PowerFlex 400 drives (Ordered Separately).	22-COMM-P
Communication Adapter Cover	Cover that houses the communication adapter. Frame C Drive	 22C-CCC
Serial Converter Module (RS485 to RS232)	Provides serial communication via DF1 protocol for use with DriveExplorer and DriveExecutive software. Includes: DSI to RS232 serial converter (one) 1203-SFC serial cable (one) 22-RJ45CBL-C20 cable (one) DriveExplorer Lite CD (one)	22-SCM-232
DSI Cable	2.0 meter RJ45 to RJ45 cable, male to male connectors.	22-RJ45CBL-C20
Serial Cable	2.0 meter serial cable with a locking low profile connector to connect to the serial converter and a 9-pin sub-miniature D female connector to connect to a computer.	1203-SFC
Null Cable Converter	For use when connecting the serial converter to DriveExplorer on a handheld PC.	1203-SNM
Splitter Cable	RJ45 one to two port splitter cable	AK-U0-RJ45-SC1
Terminating Resistors	RJ45 120 Ohm resistors (2 pieces)	AK-U0-RJ45-TR1
Terminal Block	RJ45 Two position terminal block (5 pieces)	AK-U0-RJ45-TB2P
DriveExplorer Software (CD-ROM) Version 3.01 or later	Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online. Compatibility: Windows 95, 98, ME, NT 4.0 (Service Pack 3 or later), 2000, XP and CE(1)	9306-4EXP01ENE
DriveExecutive software (CD-ROM) Version 1.01 or later	Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online and offline. Compatibility: Windows 98, ME, NT 4.0 (Service Pack 3 or later), 2000 and XP	9303-4DTE01ENE
Serial Flash Firmware Kit	Use a PC to update drive firmware.	AK-U9-FLSH1

(1) See www.ab.com/drives/driveexplorer.htm for supported devices.

Table B.10 Human Interface Module (HIM) Option Kits and Accessories

Item	Description	Catalog Number
LCD Display, Remote Panel Mount	LCD Display Digital Speed Control CopyCat Capable IP66 (NEMA Type 4X/12) indoor use only Includes 2.0 meter cable	22-HIM-C2S
LCD Display, Remote Handheld	LCD Display Digital Speed Control Full Numeric Keypad CopyCat Capable IP30 (NEMA Type 1) Includes 1.0 meter cable Panel Mount with optional Bezel Kit	22-HIM-A3
Bezel Kit	Panel mount for LCD Display, Remote Handheld unit, IP30 (NEMA Type 1)	22-HIM-B1
DSI HIM Cable (DSI HIM to RJ45 cable)	1.0 Meter (3.3 Feet) 2.9 Meter (9.51 Feet)	22-HIM-H10 22-HIM-H30

Table B.11 Frame C IP30/NEMA 1/UL Type 1 Kit

Item	Description	Drive Frame	Catalog Number
IP30/NEMA 1/UL Type 1 Kit	Field installed kit. Converts drive to IP30/ NEMA 1/UL Type 1 enclosure. Includes conduit box with mounting screws and plastic top panel.	C	22-JBAC
IP30/NEMA 1/UL Type 1 Kit for Communication Option	Field installed kit. Converts drive to IP30/ NEMA 1/UL Type 1 enclosure. Includes communication option conduit box with mounting screws and plastic top panel.	C	22-JBCC

Table B.12 Field Installed Option

Item	Description	Catalog Number
Auxiliary Relay Board	Field installed kit. Expands drive output capabilities.	AK-U9-RLB1

Product Dimensions

Table B.13 PowerFlex 400 Frames and Weights

Frame	kW (HP)	Drive Weight kg (lbs.)	Packaged Weight kg (lbs.)
240V AC – 3-Phase			
C	2.2 (3.0)	2.89 (6.4)	3.41 (7.5)
C	4.0 (5.0)	2.97 (6.5)	3.49 (7.7)
C	5.5 (7.5)	3.72 (8.2)	4.27 (9.4)
C	7.5 (10)	3.78 (8.3)	4.33 (9.5)
D	11 (15)	12.1 (26.7)	13.4 (29.5)
D	15 (20)	12.7 (28.0)	14 (30.9)
D	18.5 (25)	12.7 (28.0)	14 (30.9)
D	22 (30)	12.7 (28.0)	14 (30.9)
E	30 (40)	38 (83.8)	48.2 (106.3)
E	37 (50)	38 (83.8)	48.2 (106.3)
480V AC – 3-Phase			
C	2.2 (3.0)	2.87 (6.3)	3.39 (7.5)
C	4.0 (5.0)	3.03 (6.7)	3.55 (7.8)
C	5.5 (7.5)	3.65 (8.0)	4.2 (9.3)
C	7.5 (10)	3.75 (8.3)	4.3 (9.5)
C	11 (15)	6.41 (14.1)	7.41 (16.3)
C	15 (20)	6.47 (14.3)	7.49 (16.5)
D	18.5 (25)	12.7 (28.0)	14 (30.9)
D	22 (30)	12.7 (28.0)	14 (30.9)
D	30 (40)	14.3 (31.5)	15.6 (34.4)
E	37 (50)	36 (79.4)	46.2 (101.9)
E	45 (60)	36 (79.4)	46.2 (101.9)
E	55 (75)	41 (90.4)	51.2 (112.9)
E	75 (100)	41 (90.4)	51.2 (112.9)
F	90 (125)	78 (172.0)	88 (194.0)
F	110 (150)	78 (172.0)	88 (194.0)
240V AC – 3-Phase, Plate Drive			
C	2.2 (3.0)	2.66 (5.9)	3.26 (7.2)
C	4.0 (5.0)	2.74 (6.0)	3.34 (7.4)
C	5.5 (7.5)	3.15 (6.9)	3.75 (8.3)
C	7.5 (10)	3.21 (7.1)	3.81 (8.4)
480V AC – 3-Phase, Plate Drive			
C	2.2 (3.0)	2.63 (5.8)	3.23 (7.1)
C	4.0 (5.0)	2.77 (6.1)	3.37 (7.4)
C	5.5 (7.5)	3.04 (6.7)	3.64 (8.0)
C	7.5 (10)	3.13 (6.9)	3.73 (8.2)
C	11 (15)	3.19 (7.0)	3.79 (8.4)
C	15 (20)	3.25 (7.2)	3.85 (8.5)

Figure B.1 PowerFlex 400 Frame C Drive - *Dimensions are in millimeters and (inches)*

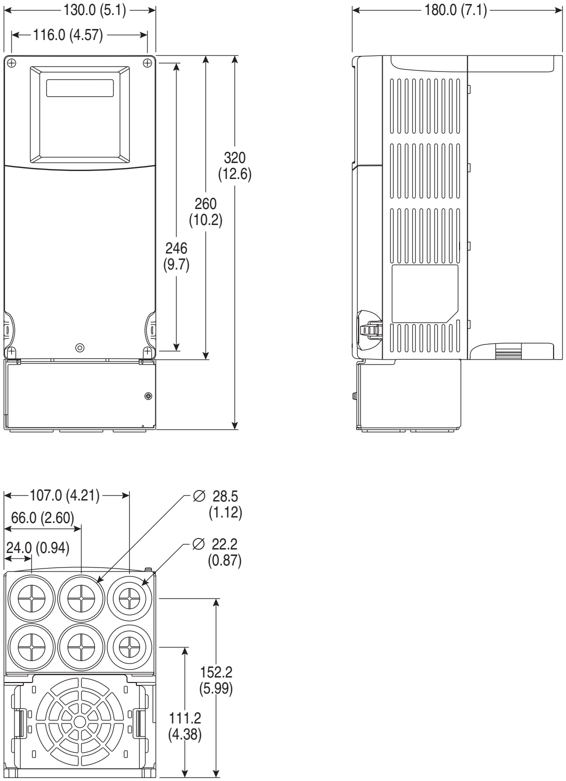


Figure B.2 PowerFlex 400 Frame D Drive - *Dimensions are in millimeters and (inches)*

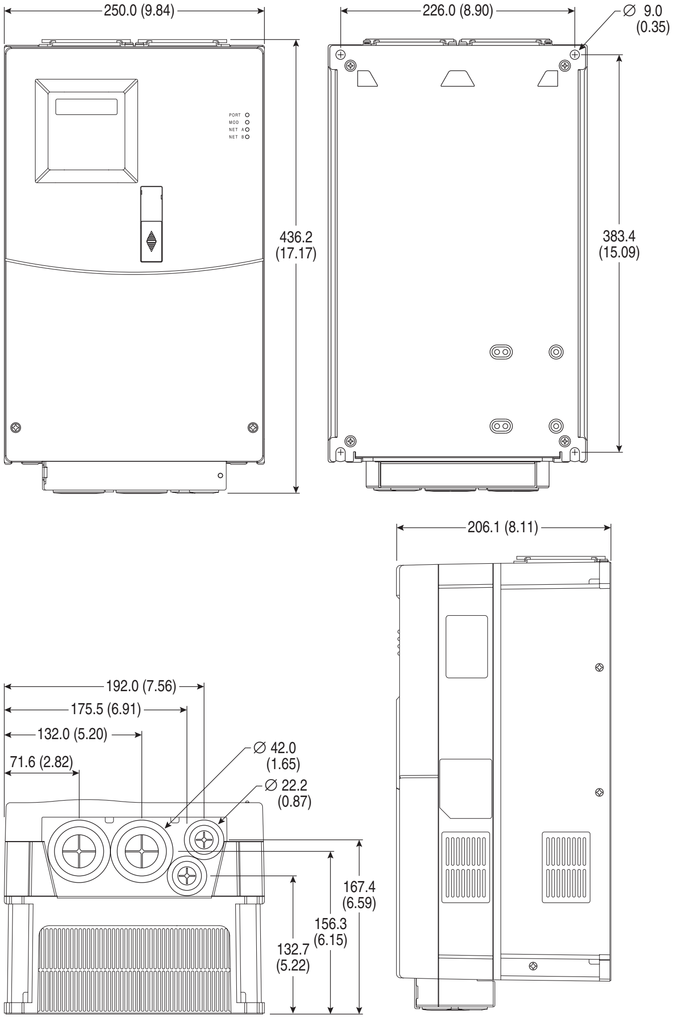


Figure B.3 PowerFlex 400 Frame E Drive - *Dimensions are in millimeters and (inches)*

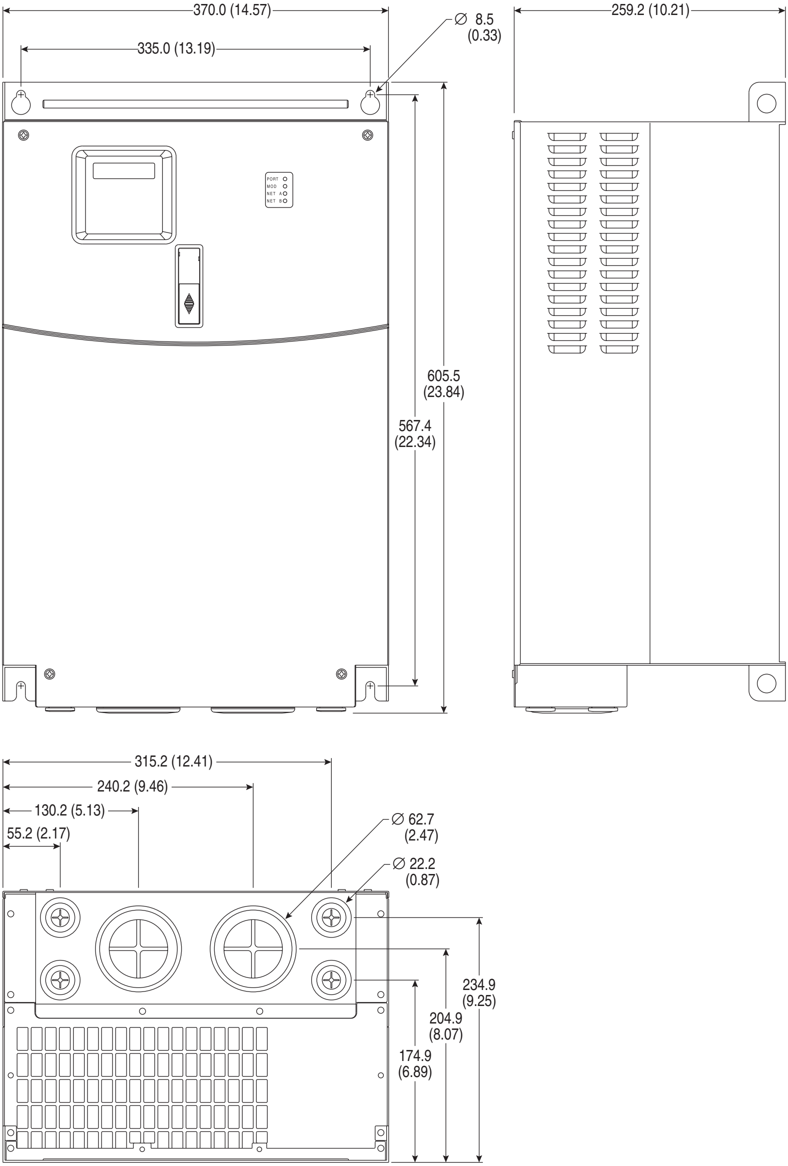


Figure B.4 PowerFlex 400 Frame F Drive - *Dimensions are in millimeters and (inches)*

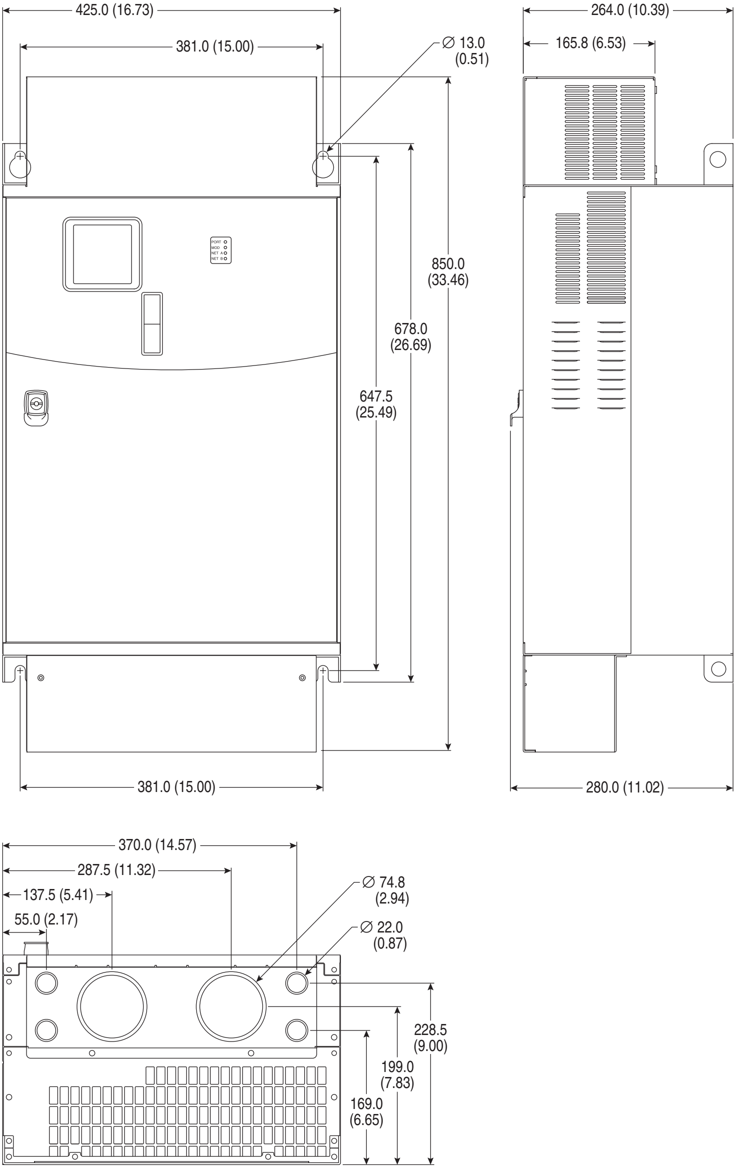
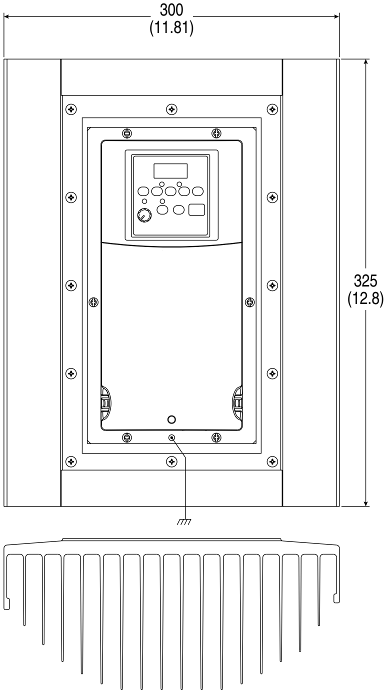
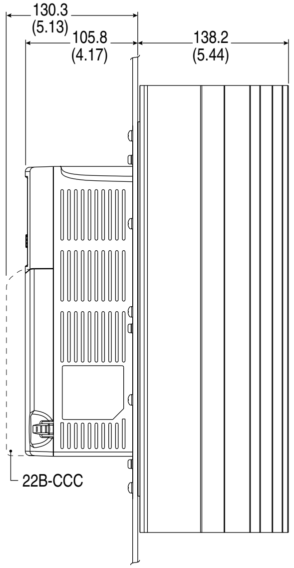


Figure B.5 PowerFlex 400 Frame C Flange Mount Drive - *Dimensions are in millimeters and (inches)*





Cutout Dimensions

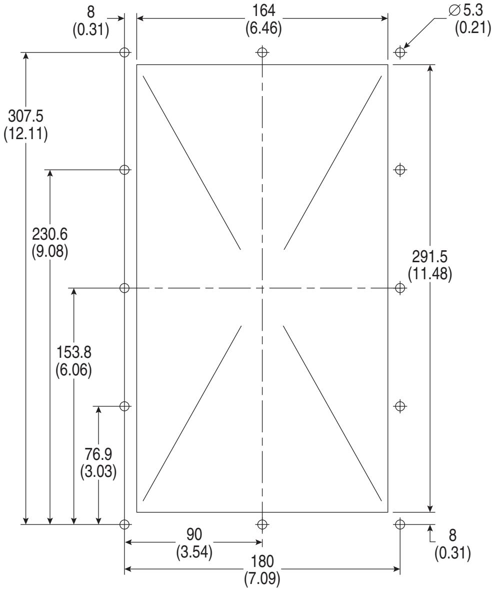
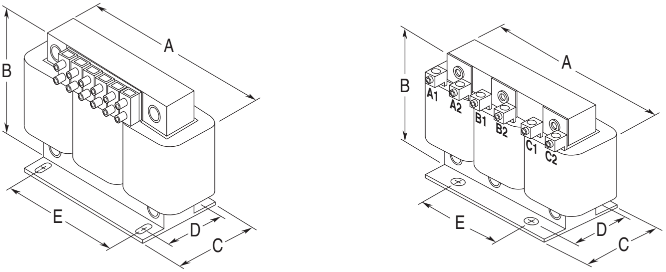


Figure B.6 Bulletin 1321-3R Series Line Reactors – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).

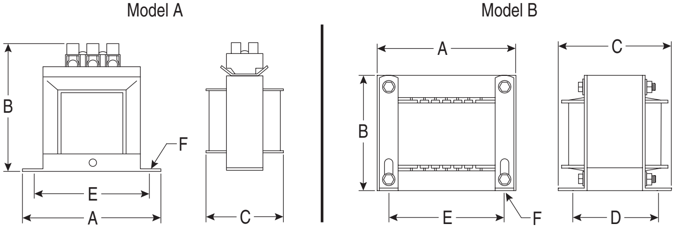


IP00 (Open) –
45 Amps (fundamental) and Below

IP00 (Open) –
55 Amps (fundamental) and Above

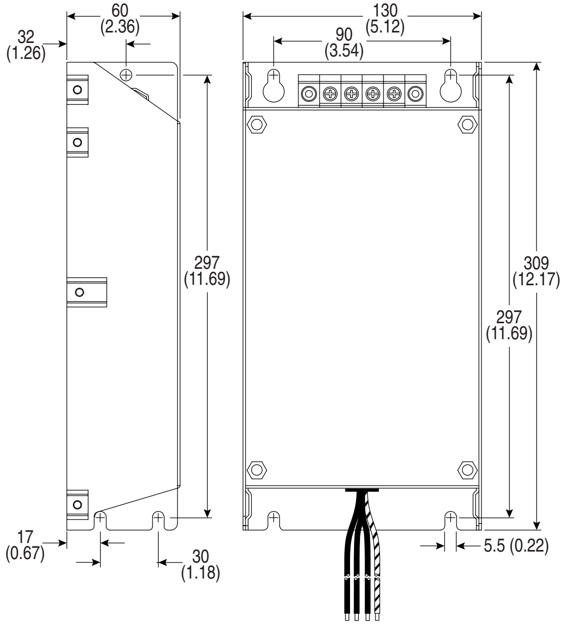
Catalog Number	A	B	C	D	E	Weight
1321-3R8-C	152 (6.00)	122 (4.80)	86 (3.40)	67 (2.62)	51 (2.00)	5.0 (11)
1321-3R8-D	152 (6.00)	122 (4.80)	86 (3.40)	63 (2.48)	51 (2.00)	5.9 (13)
1321-3R12-A	152 (6.00)	127 (5.00)	84 (3.30)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R12-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.5 (10)
1321-3R12-C	152 (6.00)	127 (5.00)	91 (3.60)	69 (2.73)	51 (2.00)	8.2 (18)
1321-3R18-B	152 (6.00)	135 (5.30)	89 (3.50)	63 (2.48)	51 (2.00)	5.5 (12)
1321-3R18-C	183 (7.20)	146 (5.76)	92 (3.63)	66 (2.60)	76 (3.00)	7.3 (16)
1321-3R25-A	183 (7.20)	146 (5.76)	85 (3.35)	60 (2.35)	76 (3.00)	4.9 (11)
1321-3R25-B	183 (7.20)	146 (5.76)	85 (3.35)	60 (2.35)	76 (3.00)	6.3 (14)
1321-3R25-C	183 (7.20)	146 (5.76)	105 (4.10)	79 (3.10)	76 (3.00)	8.1 (18)
1321-3R35-A	193 (7.60)	146 (5.76)	91 (3.60)	66 (2.60)	76 (3.00)	6.3 (14)
1321-3R35-B	183 (7.20)	147 (5.80)	95 (3.75)	79 (3.10)	76 (3.00)	7.3 (16)
1321-3R35-C	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	13.6 (30)
1321-3R45-A	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	10.4 (23)
1321-3R45-B	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	12.7 (28)
1321-3R45-C	229 (9.00)	184 (7.25)	135 (5.30)	93 (3.66)	76 (3.00)	17.7 (39)
1321-3R55-A	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	10.9 (24)
1321-3R55-B	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	12.3 (27)
1321-3R55-C	229 (9.00)	184 (7.25)	142 (5.60)	99 (3.90)	76 (3.00)	18.6 (41)
1321-3R80-A	274 (10.80)	216 (8.50)	139 (5.47)	88 (3.47)	92 (3.63)	19.5 (43)
1321-3R80-B	274 (10.80)	216 (8.50)	139 (5.47)	88 (3.47)	92 (3.63)	23.1 (51)
1321-3R80-C	274 (10.80)	210 (8.26)	156 (6.16)	106 (4.16)	92 (3.63)	25.0 (55)
1321-3R100-A	274 (10.80)	217 (8.55)	139 (5.48)	84 (3.30)	92 (3.63)	21.3 (47)
1321-3R100-B	274 (10.80)	210 (8.25)	144 (5.66)	93 (3.66)	92 (3.63)	23.1 (51)
1321-3R100-C	274 (10.80)	210 (8.25)	156 (6.16)	106 (4.16)	92 (3.63)	33.6 (74)
1321-3R130-A	229 (9.00)	179 (7.04)	118 (4.66)	80 (3.16)	76 (3.00)	13.2 (29)
1321-3R130-B	274 (10.80)	213 (8.40)	144 (5.66)	93 (3.66)	92 (3.63)	25.9 (57)
1321-3R130-C	279 (11.00)	216 (8.50)	156 (6.16)	106 (4.16)	92 (3.63)	29.0 (64)
1321-3R160-A	274 (10.80)	216 (8.50)	172 (6.80)	80 (3.16)	92 (3.63)	19.0 (42)
1321-3R160-B	279 (11.00)	216 (8.50)	178 (7.00)	88 (3.47)	92 (3.63)	23.0 (51)
1321-3R160-C	287 (11.30)	216 (8.50)	229 (9.00)	118 (4.66)	92 (3.63)	33.0 (72)
1321-3R200-B	274 (10.80)	216 (8.50)	210 (8.30)	112 (4.41)	92 (3.63)	31.0 (67)
1321-3R200-C	274 (10.80)	216 (8.50)	254 (10.00)	150 (5.91)	92 (3.63)	46.0 (100)

Figure B.7 Bulletin 1321-DC Series Bus Inductors – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).

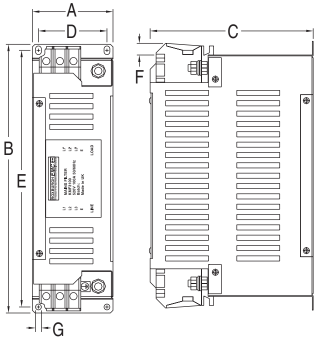


Catalog Number	Model	A	B	C	D	E	F	Weight *kg (lbs.)*
1321-DC9-2	A	95 (3.75)	83 (3.25)	51 (2.00)	–	80 (3.13)	4.7 (0.19)	
1321-DC12-1	A	95 (3.75)	83 (3.25)	44 (1.75)	–	80 (3.13)	4.7 0.19)	
1321-DC12-2	B	97 (3.81)	114 (4.50)	72 (2.82)	51 (2.00)	80 (3.13)	5x8 (.20x.33)	5.9 (13.0)
1321-DC18-1	A	95 (3.75)	83 (3.25)	51 (2.00)	–	80 (3.13)	4.7 (0.19)	
1321-DC18-4	B	118 (4.63)	133 (5.25)	102 (4.00)	64 (2.50)	95 (3.75)	5x8 (.20x.33)	3.6 (8.0)
1321-DC25-4	B	97 (3.81)	114 (4.50)	76 (3.00)	64 (2.50)	80 (3.13)	5x8 (.20x.33)	5.9 (13.0)
1321-DC32-1	B	97 (3.81)	114 (4.50)	84 (3.32)	64 (2.50)	80 (3.13)	5x8 (.20x.33)	2.3 (5.0)
1321-DC32-2	B	118 (4.63)	133 (5.25)	108 (4.25)	76 (3.00)	95 (3.75)	5x8 (.20x.33)	4.5 (10.0)
1321-DC40-2	B	97 (3.81)	114 (4.50)	95 (3.75)	76 (3.00)	80 (3.13)	5x8 (.20x.33)	3.2 (7.0)
1321-DC40-4	B	165 (6.50)	166 (6.55)	152 (6.00)	86 (3.38)	135 (5.31)	7x13 (.28x.52)	9.5 (21.0)

Figure B.8 EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF018-CS, 22-RF018-CL, 22-RF026-CS, 22-RF026-CL, 22-RF026-CL, 22-RF034-CS



Catalog Numbers: 22-RFD036, 22-RFD050, 22-RFD070, 22-RFD100, 22-RFD150, 22-RFD180



Catalog Number	A	B	C	D	E	F	G
22-RFD036	74 (2.91)	272 (10.71)	161 (6.34)	60 (2.36)	258 (10.16)	7.5 (0.30)	7 (0.28)
22-RFD050	93 (3.66)	312 (12.28)	190 (7.48)	79 (3.11)	298 (11.73)	13.5 (0.53)	7 (0.28)
22-RFD070	93 (3.66)	312 (12.28)	190 (7.48)	79 (3.11)	298 (11.73)	13.5 (0.53)	7 (0.28)
22-RFD100	93 (3.66)	312 (12.28)	190 (7.48)	79 (3.11)	298 (11.73)	13.5 (0.53)	7 (0.28)
22-RFD150	126 (4.96)	312 (12.28)	224 (8.82)	112 (4.41)	298 (11.73)	19.5 (0.77)	7 (0.28)
22-RFD180	126 (4.96)	312 (12.28)	224 (8.82)	112 (4.41)	298 (11.73)	27 (1.06)	7 (0.28)

Catalog Numbers: 22-RFD330

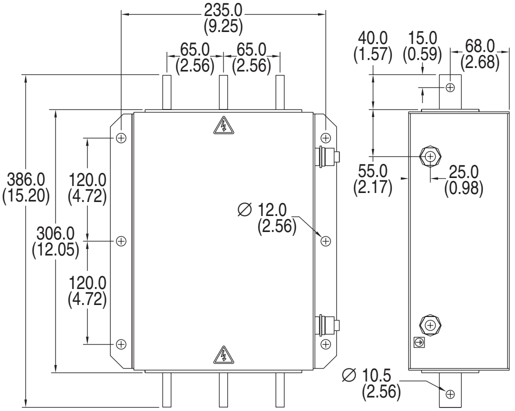


Figure B.9 Remote (Panel Mount) Small HIM – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-C2S

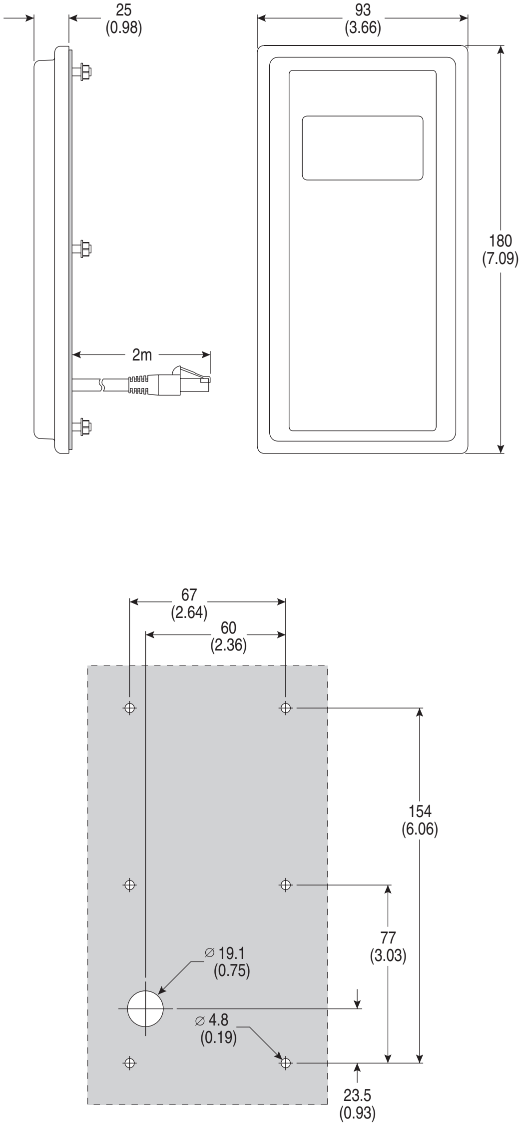
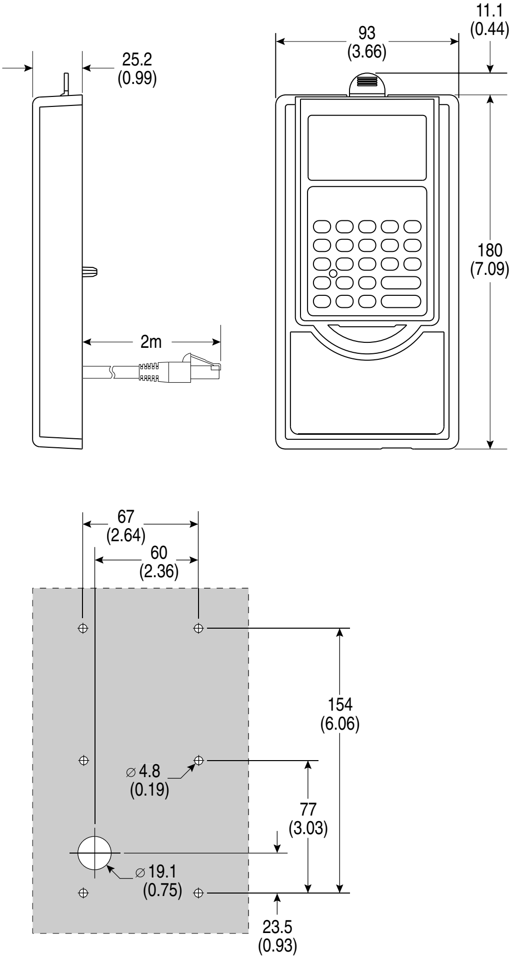


Figure B.10 NEMA Type 1 Bezel – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-B1



RJ45 DSI Splitter Cable

The PowerFlex 400 drive provides a RJ45 port to allow the connection of a single peripheral device. The RJ45 DSI Splitter Cable can be used to connect a second DSI peripheral device to the drive.

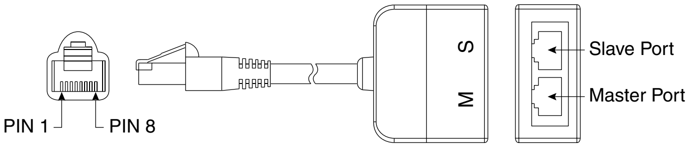
Connectivity Guidelines

ATTENTION: Risk of injury or equipment damage exists. The peripherals may not perform as intended if these Connectivity Guidelines are not followed. Precautions should be taken to follow these Connectivity Guidelines.

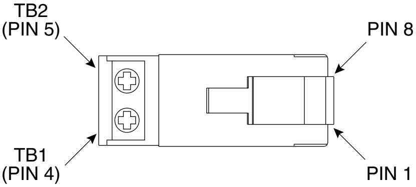
- Two peripherals maximum can be attached to a drive.
- If a single peripheral is used, it must be connected to the Master port (M) on the splitter and configured for "Auto" (default) or "Master." Parameter 9 [Device Type] on the DSI keypads and Parameter 1 [Adapter Cfg] on the Serial Converter are used to select the type (Auto / Master / Slave).
- **Do not use the RJ45 Splitter Cable with a drive that has an internal network communication adapter installed.** Since only one additional peripheral can be added, the second peripheral can be connected directly to the RJ45 port on the drive. The internal Comm is always the Master, therefore the external peripheral must be configured as "Auto" (for temporary connections) or "Slave" (for permanent connections).
- If two peripherals will be powered up at the same time, one must be configured as the "Master" and connected to the Master port (M) and the other must be connected as the "Slave" and connected to the Slave port (S).

DSI Cable Accessories

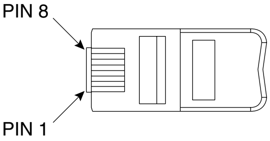
RJ45 Splitter Cable – Catalog Number: AK-U0-RJ45-SC1



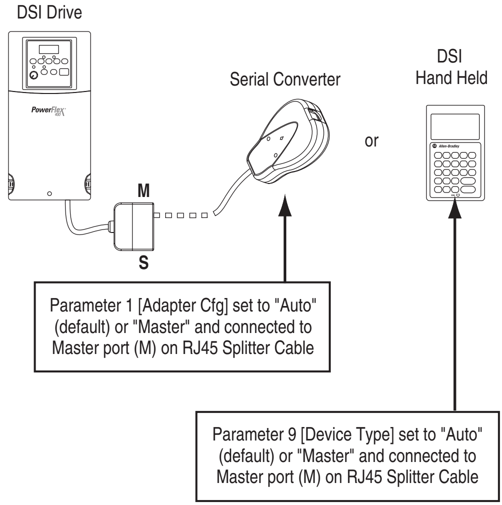
RJ45 Two-Position Terminal Block Adapter –
Catalog Number: AK-U0-RJ45-TB2P



RJ45 Adapter with Integrated Termination Resistor –
Catalog Number: AK-U0-RJ45-TR1



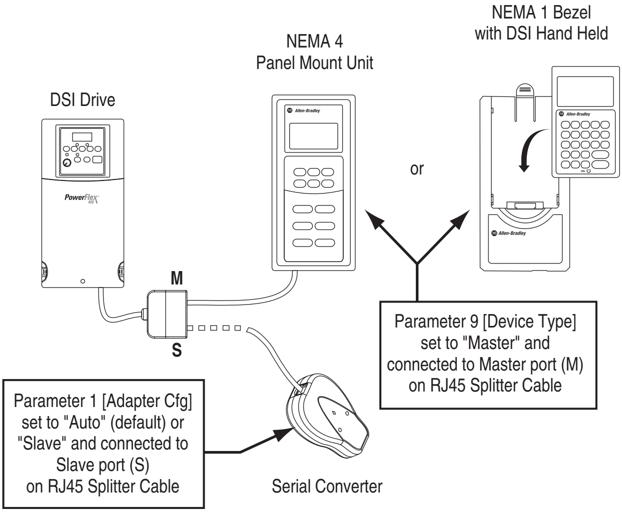
Connecting One Temporary Peripheral



Parameter 1 [Adapter Cfg] set to "Auto" (default) or "Master" and connected to Master port (M) on RJ45 Splitter Cable

Parameter 9 [Device Type] set to "Auto" (default) or "Master" and connected to Master port (M) on RJ45 Splitter Cable

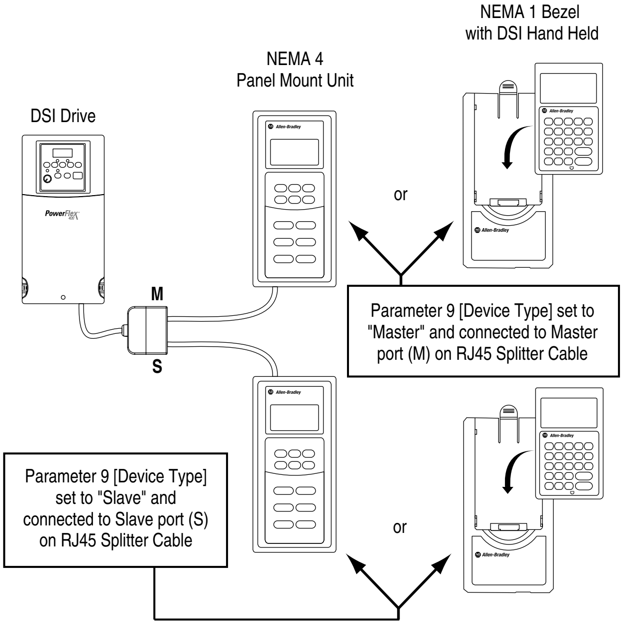
Connecting One Temporary Peripheral and One Permanent Peripheral



Parameter 9 [Device Type] set to "Master" and connected to Master port (M) on RJ45 Splitter Cable

Parameter 1 [Adapter Cfg] set to "Auto" (default) or "Slave" and connected to Slave port (S) on RJ45 Splitter Cable

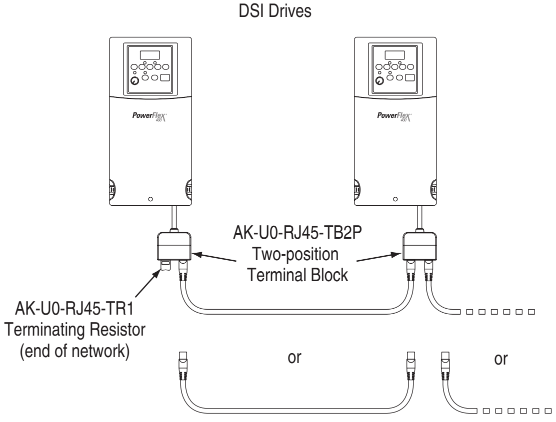
Connecting Two Permanent Peripherals



Parameter 9 [Device Type] set to "Master" and connected to Master port (M) on RJ45 Splitter Cable

Parameter 9 [Device Type] set to "Slave" and connected to Slave port (S) on RJ45 Splitter Cable

Connecting an RS-485 Network



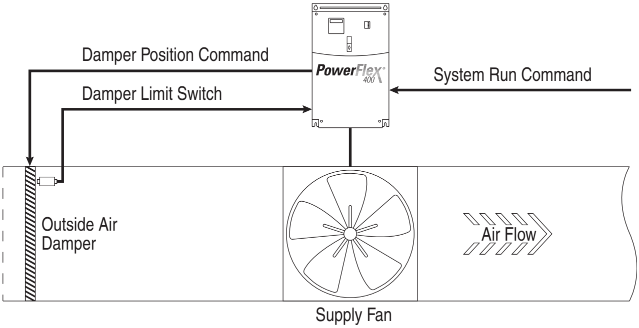
Customer supplied RJ45 male-to-RJ45 male cables with wires connected at pins 4 and 5 only.

Both the Master (M) and Slave (S) ports on the RJ45 Splitter Cable operate as standard RS-485 ports in this configuration.

Application Notes

Damper Control Setup

The PowerFlex 400 allows damper control logic to be imbedded within the drive reducing cost associated with external control hardware and software. A system Run command can be wired directly into one of the drive inputs. Relay outputs can be used to energize the damper to either open or close. A damper limit switch can be wired back to the drive providing indication that the damper is in the proper position and that it is safe for the drive to run at commanded speed.



Example

- The System Run Command can come from a terminal block, integral keypad, or communication port. Configure parameter P036 [Start Source] per application requirements.
- Set one of the available digital inputs, parameter T051-T054 [Digital Inx Sel] to option 36 “Damper Input”. The damper end switch or limit switch should be wired into this input.
- Set one of the available relay outputs, parameter T055/T060 [Relay Outx Sel] to option 2 “Motor Running”. This output should be used to energize the damper to either open or close.

PID Setup

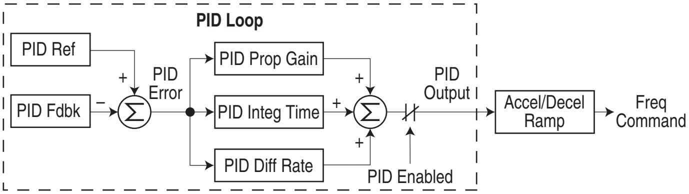
PID Control Loop

The PowerFlex 400 has a built-in PID (proportional, integral, differential) control loop. The PID loop is used to maintain a process feedback (such as pressure, flow or tension) at a desired set point. The PID loop works by subtracting the PID feedback from a reference and generating an error value. The PID loop reacts to the error, based on the PID Gains, and outputs a frequency to try to reduce the error value to 0. To enable the PID loop, parameter A152 [PID Ref Sel] must be set to an option other than 0 “PID Disabled”.

Exclusive Control and Trim Control are two basic configurations where the PID loop may be used.

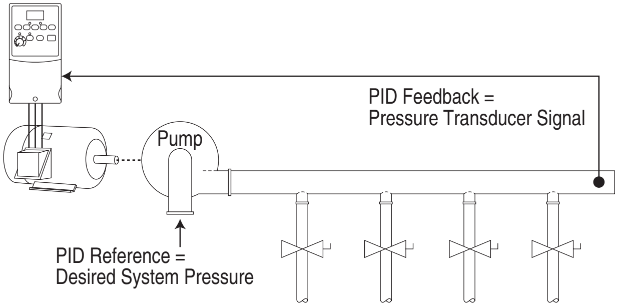
Exclusive Control

In Exclusive Control, the Speed Reference becomes 0, and the PID Output becomes the entire Freq Command. Exclusive Control is used when A152 [PID Ref Sel] is set to option 1, 2, 3 or 4. This configuration does not require a master reference, only a desired set point, such as a flow rate for a pump.



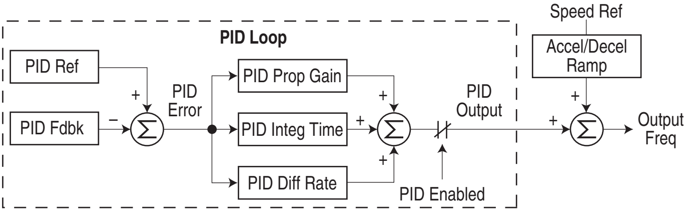
Example

- In a pumping application, the PID Reference equals the Desired System Pressure set point.
- The Pressure Transducer signal provides PID Feedback to the drive. Fluctuations in actual system pressure, due to changes in flow, result in a PID Error value.
- The drive output frequency increases or decreases to vary motor shaft speed to correct for the PID Error value.
- The Desired System Pressure set point is maintained as valves in the system are opened and closed causing changes in flow.
- When the PID Control Loop is disabled, the Commanded Speed is the Ramped Speed Reference.



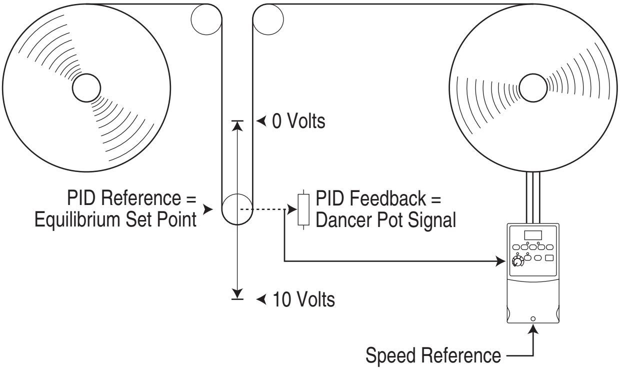
Trim Control

In Trim Control, the PID Output is added to the Speed Reference. In Trim mode, the output of the PID loop bypasses the accel/decel ramp as shown. Trim Control is used when A152 [PID Ref Sel] is set to option 5, 6, 7 or 8.



Example

- In a winder application, the PID Reference equals the Equilibrium set point.
- The Dancer Pot signal provides PID Feedback to the drive. Fluctuations in tension result in a PID Error value.
- The Master Speed Reference sets the wind/unwind speed.
- As tension increases or decreases during winding, the Speed Reference is trimmed to compensate. Tension is maintained near the Equilibrium set point.



PID Reference and Feedback

Parameter A152 [PID Ref Sel] is used to enable the PID mode (A152 = 0 “PID Disabled”) and to select the source of the PID Reference. If A152 [PID Ref Sel] is not set to 0 “PID Disabled”, PID can still be disabled by select programmable digital input options (parameters T051-T054) such as “Local” or “PID Disable”.

Table D.A A152 [PID Ref Sel] Options

Option	Description
0 “PID Disabled”	Disables the PID loop (default setting)
1 “PID Setpoint“	Selects Exclusive Control. A157 [PID Setpoint] will be used to set the value of the PID Reference
2 “Analog In 1”	Selects Exclusive Control. Selects the Analog In 1 Input.
3 “Analog In 2”	Selects Exclusive Control. Selects the Analog In 2 Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
4 “Comm Port”	Selects Exclusive Control. The reference word from a communication network (see Appendix E for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.
5 “Setpnt, Trim”	Selects Trim Control. A157 [PID Setpoint] will be used to set the value of the PID Reference.
6 “0-10V, Trim”	Selects Trim Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
7 “4-20mA, Trim”	Selects Trim Control. Selects the 4-20mA Input.
8 “Comm, Trim”	Selects Trim Control. The reference word from a communication network (see Appendix E for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.

A153 [PID Feedback Sel] is used to select the source of the PID feedback.

Table D.B A153 [PID Feedback Sel] Options

Option	Description
0 “Analog In 1”	Selects the Analog In 1 Input (default setting).
1 “Analog In 2“	Selects the Analog In 2 Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
2 “Comm Port”	The reference word from a communication network (see Appendix E for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Feedback. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% Feedback. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% Feedback.

Analog PID Reference Signals

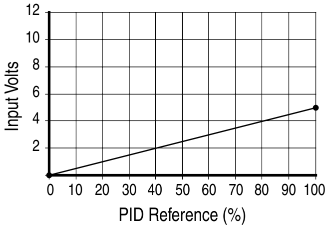
Parameters T070 [Analog In 1 Lo], T071 [Analog In 1 Hi], T074 [Analog In 2 Lo], and T075 [Analog In 2 Hi] are used to scale or invert an analog PID Reference.

Examples

Scale Function

For a 0-5 volt signal, the following parameter settings are used so that a 0 volt signal = 0% PID Reference and a 5 volt signal = 100% PID Reference.

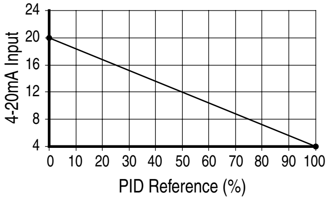
- T069 [Analog In 1 Sel] or T073 [Analog In 2 Sel] = 2 “Voltage Mode - Unipolar”.
- T070 [Analog In 1 Lo] or T074 [Analog In 2 Lo] = 0.0%
- T071 [Analog In 1 Hi] or T075 [Analog In 2 Hi] = 50.0%
- A152 [PID Ref Sel] = 0 “0-10V Input”



Invert Function

For a 4-20mA signal, the following parameter settings are used so that a 20mA signal = 0% PID Reference and a 4mA signal = 100% PID Reference.

- T069 [Analog In 1 Sel] or T073 [Analog In 2 Sel] = 1 “Current Mode 4-20 mA”
- T070 [Analog In 1 Lo] or T074 [Analog In 2 Lo] = 100.0%
- T071 [Analog In 1 Hi] or T075 [Analog In 2 Hi] = 0.0%
- A152 [PID Ref Sel] = 2 “Analog In 1” or 3 “Analog In 2”



PID Deadband

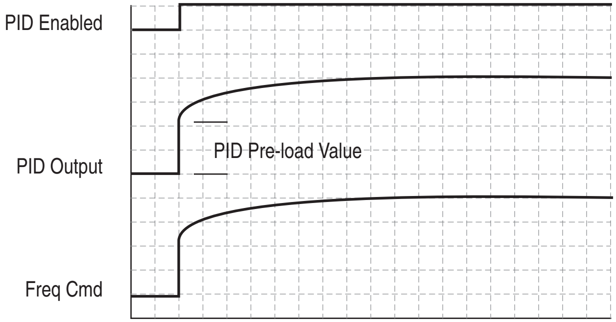
Parameter A158 [PID Deadband] is used to set a range, in percent, of the PID Reference that the drive will ignore.

Example

- [PID Deadband] is set to 5.0
- The PID Reference is 25.0%
- The PID Regulator will not act on a PID Error that falls between 20.0 and 30.0%

PID Preload

The value set in A159 [PID Preload], in Hertz, will be pre-loaded into the integral component of the PID at any start or enable. This will cause the drive's frequency command to initially jump to that preload frequency, and the PID loop starts regulating from there.



PID Pre-load Value > 0

PID Limits

A150 [PID Trim Hi] and A151 [PID Trim Lo] are used to limit the PID output and are only used in trim mode. [PID Trim Hi] sets the maximum frequency for the PID output in trim mode. [PID Trim Lo] sets the reverse frequency limit for the PID output in trim mode. Note that when the PID reaches the Hi or Lo limit, the PID regulator stops integrating so that windup does not occur.

PID Gains

The proportional, integral, and differential gains make up the PID regulator.

- A154 [PID Prop Gain]
  The proportional gain (unitless) affects how the regulator reacts to the magnitude of the error. The proportional component of the PID regulator outputs a speed command proportional to the PID error. For example, a proportional gain of 1 would output 100% of max frequency when the PID error is 100% of the analog input range. A larger value for [PID Prop Gain] makes the proportional component more responsive, and a smaller value makes it less responsive. Setting [PID Prop Gain] to 0.00 disables the proportional component of the PID loop.
- A155 [PID Integ Time]
  The integral gain (units of seconds) affects how the regulator reacts to error over time and is used to get rid of steady state error. For example, with an integral gain of 2 seconds, the output of the integral gain component would integrate up to 100% of max frequency when the PID error is 100% for 2 seconds. A larger value for [PID Integ Time] makes the integral component less responsive, and a smaller value makes it more responsive. Setting [PID Integ Time] to 0 disables the integral component of the PID loop.
- A156 [PID Diff Rate]
  The Differential gain (units of 1/seconds) affects the rate of change of the PID output. The differential gain is multiplied by the difference between the previous error and current error. Thus, with a large error the D has a large effect and with a small error the D has less of an effect. This parameter is scaled so that when it is set to 1.00, the process response is 0.1% of [Maximum Freq] when the process error is changing at 1% / second. A larger value for [PID Diff Rate] makes the differential term have more of an effect and a small value makes it have less of an effect. In many applications, the D gain is not needed. Setting [PID Diff Rate] to 0.00 (factory default) disables the differential component of the PID loop.

Guidelines for Adjusting the PID Gains

1. Adjust the proportional gain. During this step it may be desirable to disable the integral gain and differential gain by setting them to 0. After a step change in the PID Feedback:
   - If the response is too slow increase A154 [PID Prop Gain].
   - If the response is too quick and/or unstable (see Figure D.1), decrease A154 [PID Prop Gain].
   - Typically, A154 [PID Prop Gain] is set to some value below the point where the PID begins to go unstable.
2. Adjust the integral gain (leave the proportional gain set as in Step 1). After a step change in the PID Feedback:
   - If the response is too slow (see Figure D.2), or the PID Feedback does not become equal to the PID Reference, decrease A155 [PID Integ Time].
   - If there is a lot of oscillation in the PID Feedback before settling out (see Figure D.3), increase A155 [PID Integ Time].
3. At this point, the differential gain may not be needed. However, if after determining the values for A154 [PID Prop Gain] and A155 [PID Integ Time]:
   - Response is still slow after a step change, increase A156 [PID Diff Rate].
   - Response is still unstable, decrease A156 [PID Diff Rate].

The following figures show some typical responses of the PID loop at different points during adjustment of the PID Gains.

Figure D.1 Unstable

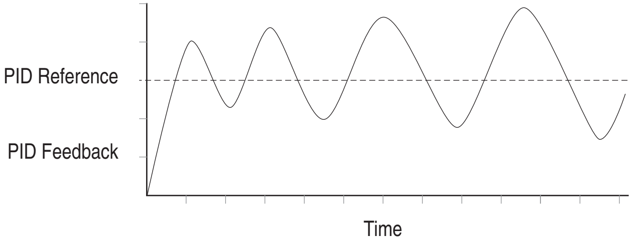


Figure D.2 Slow Response – Over Damped

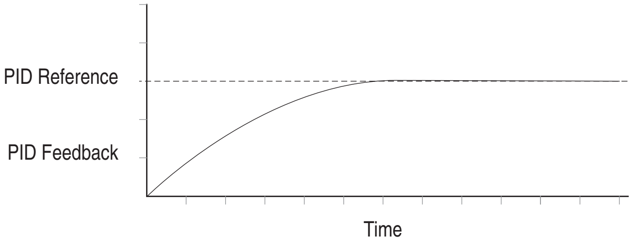


Figure D.3 Oscillation – Under Damped

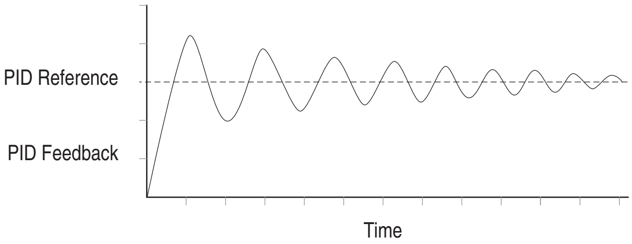
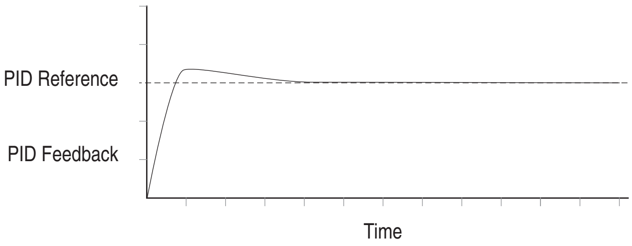


Figure D.4 Good Response – Critically Damped

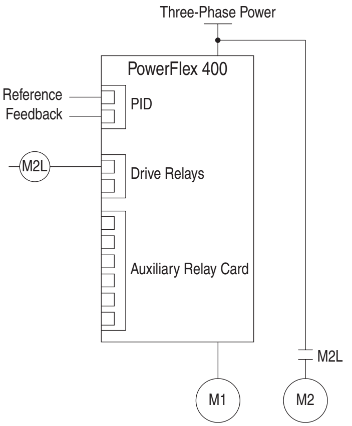


Auxiliary Motor Control Setup

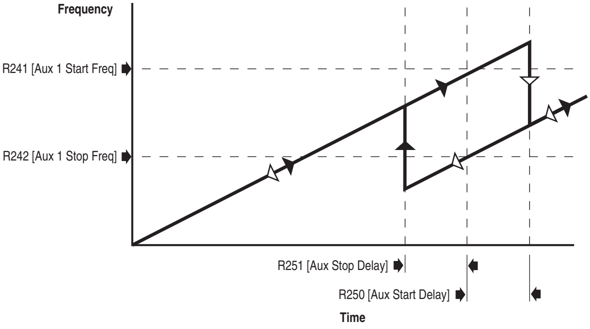
The PowerFlex 400 has a built in Auxiliary Motor Control feature. This feature allows operation of up to three (3) line-started motors in addition to the motor controlled directly by the PowerFlex 400 drive. System output can vary from 0% (auxiliary motors off and drive-controlled motor at zero speed) to 400% (3 auxiliary motors and drive-controlled motor at full speed). To enable the Auxiliary Motor Control, parameter R239 [Aux Motor Mode] must be set to an option 1 "Enabled." When enabled, the internal PID controller in the PowerFlex 400 uses a reference and feedback signal to adjust the speed of the drive controlled motor such that the feedback signal follows the reference signal. When demand exceeds the first motors capacity, the PowerFlex 400 Auxiliary Motor Control automatically starts an auxiliary motor. The speed of the drive controlled motor is reduced to account for the auxiliary motors additional output to the system. If demand continues to increase, the PowerFlex Auxiliary Motor Control starts additional motors using the same process. When demand decreases, an auxiliary motor is stopped and the PowerFlex Auxiliary Motor Control increases the speed of the drive controlled motor to account for lost system output. A Motor Interlock input identifies motors that are out of service and causes them to skipped over to the next available motor.

An AutoSwap function also can be used which allows equal wear to be placed on each motor by periodically swapping the drive controlled and auxiliary motors. Each motor in the system will over time be connected to the PowerFlex 400 drive and also directly to the AC line. During an AutoSwap, the motor directly connected to the PowerFlex 400 drive is stopped and the contactor is opened. The contactor of the next motor that will be controlled by the PowerFlex 400 drive is opened if running across the AC line. A contactor is closed connecting this motor directly to the PowerFlex 400 drive and is started. An additional motor is line started if required.

Example 1
One External Motor without AutoSwap

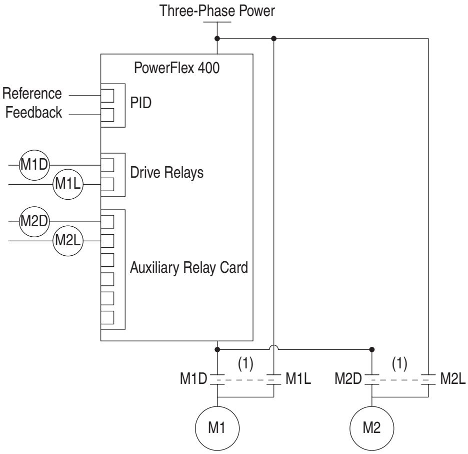


- Auxiliary Motor Control is enabled via Parameter R239 [Aux Motor Mode].
- Number of auxiliary motors is set via Parameter R240 [Aux Motor Qty].
- Relays are configured for Auxiliary Motor Control via parameters T055, T060, R222, and R225.
- The frequency of Motor #1 that Motor #2 turns on at is set via Parameter R241 [Aux 1 Start Freq].
- The time that Motor #1 is above the value set by R241 [Aux 1 Start Freq] before turning on Motor #2 is set via Parameter R250 [Aux Start Delay].
- The frequency of Motor #1 that Motor #2 turns off at is set via Parameter R242 [Aux 1 Stop Freq].
- The time that Motor #1 is below the value set by R242 [Aux 1 Stop Freq] before turning off Motor #2 is set via Parameter R251 [Aux Stop Delay].
- PID setup is done via Parameters A150 through A159. See Appendix D for additional information.



Important: If using auxiliary motor control, ensure that wiring and parameter configuration are correct before wiring contactor outputs. All relays on the Auxiliary Relay Card will energize on power-up by default. Failure to verify proper wiring and parameter configuration can result in improper motor operation or drive damage.

Example 2
One External Motor with AutoSwap



(1) Mechanically interlocked contactors are recommended to ensure that the drive contactor and the line contactor do not close at the same time. If the drive and line contactor close at the same time, drive damage may result.

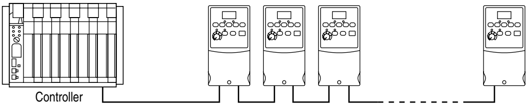
- Auxiliary Motor Control is enabled via Parameter R239 [Aux Motor Mode].
- Number of auxiliary motors is set via Parameter R240 [Aux Motor Qty].
- Relays are configured for Auxiliary Motor Control via parameters T055, T060, R222, R225, R228, R231, R234, and R237.
- The frequency of Motor #1 that Motor #2 turns on at is set via Parameter R241 [Aux 1 Start Freq].
- The time that Motor #1 is above the value set by R241 [Aux 1 Start Freq] before turning on Motor #2 is set via Parameter R250 [Aux Start Delay].
- The frequency of Motor #1 that Motor #2 turns off at is set via Parameter R242 [Aux 1 Stop Freq].
- The time that Motor #1 is below the value set by R242 [Aux 1 Stop Freq] before turning off Motor #2 is set via Parameter R251 [Aux Stop Delay].
- The running time between the PowerFlex 400 switching control from Motor #1 to Motor #2 is set via R253 [Aux AutoSwap Time].
- PID setup is done via Parameters A150 through A159. See Appendix D for additional information.
- The maximum PID output level that an AutoSwap can occur is set via Parameter R254 [Aux AutoSwap Lvl]. AutoSwap will be delayed until the PID output drops below this parameter setting.

Important: If using auxiliary motor control, ensure that wiring and parameter configuration are correct before wiring contactor outputs. All relays on the Auxiliary Relay Card will energize on power-up by default. Failure to verify proper wiring and parameter configuration can result in improper motor operation or drive damage.

Notes:

Modbus RTU Protocol

PowerFlex 400 drives support the RS485 (DSI) protocol to allow efficient operation with Rockwell Automation peripherals. In addition, some Modbus functions are supported to allow simple networking. PowerFlex 400 drives can be multi-dropped on an RS485 network using Modbus protocol in RTU mode.

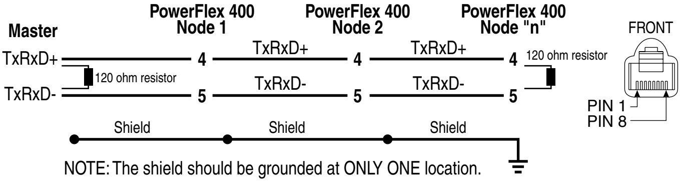


For information regarding DeviceNet or other communication protocols, refer to the appropriate user manual.

Network Wiring

Network wiring consists of a shielded 2-conductor cable that is daisy-chained from node to node.

Figure E.1 Network Wiring Diagram



Only pins 4 and 5 on the RJ45 plug should be wired. The other pins on the PowerFlex 400 RJ45 socket contain power, etc. for other Rockwell Automation peripheral devices and must not be connected.

Wiring terminations on the master controller will vary depending on the master controller used and “TxRxD+” and “TxRxD-” are shown for illustration purposes only. Refer to the master controller’s user manual for network terminations. Note that there is no standard for the “+” and “-” wires, and consequently Modbus device manufacturers interpret them differently. If you have problems with initially establishing communications, try swapping the two network wires at the master controller.

Standard RS485 wiring practices apply. Termination resistors need to be applied at each end of the network cable. RS485 repeaters may need to be used for long cable runs, or if greater than 32 nodes are needed on the network.

Parameter Configuration

The following PowerFlex 400 parameters are used to configure the drive to operate on a network.

Parameter	Details	Reference
P036 [Start Source]	Set to 5 "RS485 (DSI) Port" if Start is controlled from the network.	Page 3-8
P038 [Speed Reference]	Set to 5 "RS485 (DSI) Port" if the Speed Reference is controlled from the network.	Page 3-10
C102 [Comm Format]	Sets the transmission mode, data bits, parity and stop bits for the RS485 (DSI) Port. All nodes on the network must be set to the same setting.	Page 3-27
C103 [Comm Data Rate]	Sets the data rate for the RS485 (DSI) Port. All nodes on the network must be set to the same data rate.	Page 3-27
C104 [Comm Node Addr]	Sets the node address for the drive on the network. Each device on the network requires a unique node address.	Page 3-28
C105 [Comm Loss Action]	Selects the drive's response to communication problems.	Page 3-28
C106 [Comm Loss Time]	Sets the time that the drive will remain in communication loss before the drive implements C105 [Comm Loss Action].	Page 3-28
C107 [Comm Write Mode]	Determines whether parameter changes made over communication port are saved or stored in RAM only. If they are stored in RAM, the values will be lost at power-down.	Page 3-27

Supported Modbus Function Codes

The peripheral interface (DSI) used on PowerFlex 400 drives supports some of the Modbus function codes.

Modbus Function Code	Command
03	Read Holding Registers
06	Preset (Write) Single Register

Important: Modbus devices can be 0-based (registers are numbered starting at 0) or 1-based (registers are numbered starting at 1). Depending on the Modbus Master used, the register addresses listed on the following pages may need to be offset by +1. For example, Logic Command may be register address 8192 for some master devices (e.g. ProSoft 3150-MCM SLC Modbus scanner) and 8193 for others (e.g. PanelViews).

Writing (06) Logic Command Data

The PowerFlex 400 drive can be controlled via the network by sending Function Code 06 writes to register address 8192 (Logic Command). P036 [Start Source] must be set to 5 "RS485 (DSI) Port" in order to accept the commands.

Logic Command

Address (Decimal)	Bit(s)	Description
8192	0	1 = Stop, 0 = Not Stop
	1	1 = Start, 0 = Not Start
	2	1 = Jog, 0 = No Jog
	3	1 = Clear Faults, 0 = Not Clear Faults
	5,4	00 = No Command
		01 = Forward Command
		10 = Reverse Command
		11 = No Command
	6	1 = Local Control(1), 0 = Comm Control
	7	1 = MOP Increment, 0 = Not Increment
	9,8	00 = No Command
		01 = Accel Rate 1 Enable
		10 = Accel Rate 2 Enable
		11 = Hold Accel Rate Selected
	11,10	00 = No Command
		01 = Decel Rate 1 Enable
		10 = Decel Rate 2 Enable
		11 = Hold Decel Rate Selected
	14,13,12	000 = No Command
		001 = Freq. Source = P038 [Speed Reference]
		010 = Freq. Source = A142 [Internal Freq]
		011 = Freq. Source = Comms (Addr 8193)
		100 = A143 [Preset Freq 0]
		101 = A144 [Preset Freq 1]
		110 = A145 [Preset Freq 2]
		111 = A146 [Preset Freq 3]
	15	1 = MOP Decrement, 0 = Not Decrement

(1) Local Control causes the drive to use C108 [Start Source 2] and C109 [Speed Ref 2] for start and speed reference control.

Writing (06) Reference

The Speed Reference to a PowerFlex 400 drive can be controlled via the network by sending Function Code 06 writes to register address 8193 (Reference). P038 [Speed Reference] must be set to 5 "RS485 (DSI) Port" in order to accept the Speed Reference.

Reference

Address (Decimal)	Description
8193	A decimal value entered as xxx.xx where the decimal point is fixed. For example, a decimal "1000" equals 10.00 Hz and "543" equals 5.43 Hz.

Reading (03) Logic Status Data

The PowerFlex 400 Logic Status data can be read via the network by sending Function Code 03 reads to register address 8448 (Logic Status).

Error Codes

Address (Decimal)	Bit(s)	Description
8448	0	1 = Ready, 0 = Not Ready
	1	1 = Active (Running), 0 = Not Active
	2	1 = Cmd Forward, 0 = Cmd Reverse
	3	1 = Rotating Forward, 0 = Rotating Reverse
	4	1 = Accelerating, 0 = Not Accelerating
	5	1 = Decelerating, 0 = Not Decelerating
	6	1 = Alarm, 0 = No Alarm
	7	1 = Faulted, 0 = Not Faulted
	8	1 = At Reference, 0 = Not At Reference
	9	1 = Reference Controlled by Comm
	10	1 = Operation Cmd Controlled by Comm
	11	1 = Parameters have been locked
	12	Digital Input 1 Status
	13	Digital Input 2 Status
	14	Digital Input 3 Status
	15	Digital Input 4 Status

Reading (03) Feedback

The Feedback (Output Frequency) from the PowerFlex 400 drive can be read via the network by sending Function Code 03 reads to register address 8451 (Feedback).

Feedback(1)

Address (Decimal)	Description
8451	A xxx.xx decimal value where the decimal point is fixed. For example, a decimal “1234” equals 12.34 Hz and “300” equals 3.00 Hz.

(1) Returns the same data as Reading (03) Parameter b001 [Output Freq].

Reading (03) Drive Error Codes

The PowerFlex 400 Error Code data can be read via the network by sending Function Code 03 reads to register address 8449 (Drive Error Codes).

Logic Status		
Address (Decimal)	**Value (Decimal)**	**Description**
8449	0	No Fault
	2	Auxiliary Input
	3	Power Loss
	4	Undervoltage
	5	Overvoltage
	6	Motor Stalled
	7	Motor Overload
	8	Heatsink Overtemperature
	12	HW Overcurrent (300%)
	13	Ground Fault
	15	Load Loss
	29	Analog Input Loss
	33	Auto Restart Tries
	38	Phase U to Ground Short
	39	Phase V to Ground Short
	40	Phase W to Ground Short
	41	Phase UV Short
	42	Phase UW Short
	43	Phase VW Short
	48	Params Defaulted
	63	Software Overcurrent
	64	Drive Overload
	70	Power Unit Fail
	71	Net Loss
	81	Communication Loss
	94	Function Loss
	100	Parameter Checksum Error
	122	I/O Board Fail

Reading (03) and Writing (06) Drive Parameters

To access drive parameters, the Modbus register address equals the parameter number. For example, a decimal “1” is used to address Parameter b001 [Output Freq] and decimal “39” is used to address Parameter P039 [Accel Time 1].

Additional Information

Refer to **http://www.ab.com/drives/** for additional information.

Notes:

Metasys N2

Appendix F provides information about controlling a PowerFlex 400 drive, setting its Reference, and accessing its parameters through configurable objects when the Metasys N2 network protocol is selected.

Understanding Metasys N2

Metasys nodes are built up by the use of several virtual objects. The Metasys N2 master performs read and write commands to these virtual objects, and the internal Metasys protocol firmware transfers/translates the data between these virtual objects and the drive.

When a read or write command occurs to a certain dedicated virtual object, data in the virtual objects is refreshed from or transferred to the drive.

The Metasys N2 master performs read and write commands to the virtual objects one at a time. The data types that are used in the virtual objects are binary input (BI), binary output (BO), analog input (AI), analog output (AO), and internal integer (ADI).

The Metasys N2 master also performs cyclic polling of all the virtual objects.

Metasys N2 Virtual Objects

A Metasys N2 node may contain up to 256 virtual objects in each of its seven different data types, called regions (Table F.1).

Table F.1 Description of the Regions of a Virtual Object

Region	Type	Short	Description
Region 1	Analog Input	AI	32-bit, IEEE-standard floats
Region 2	Binary Input	BI	1-bit
Region 3	Analog Output	AO	32-bit, IEEE-standard floats
Region 4	Binary Output	BO	1-bit
Region 5	Internal Float	ADF	32-bit, IEEE-standard floats (Analog Data Float)
Region 6	Internal Integer	ADI	16-bit (Analog Data Integer)
Region 7	Internal Byte	DB	8-bit (Analog Data Byte)

Metasys N2 Data Types

Table F.2 Internal Structure of Metasys N2 Analog Input (AI)

Attribute	Type	Description
1	Byte	Object Configuration
2	Byte	Object Status
3	Float	Analog Input Value
8	Float	Low Alarm Limit
9	Float	Low Warning Limit
10	Float	High Warning Limit
11	Float	High Alarm Limit
12	Float	Differential

Table F.3 Internal Structure of Metasys N2 Binary Input (BI)

Attribute	Type	Description
1	Byte	Object Configuration
2	Byte	Object Status

Table F.4 Internal Structure of Metasys N2 Analog Output (AO)

Attribute	Type	Description
1	Byte	Object Configuration
2	Byte	Object Status
3	Float	Current Value

Table F.5 Internal Structure of Metasys N2 Binary Output (BO)

Attribute	Type	Description
1	Byte	Object Configuration
2	Byte	Object Status
3	Integer	Minimum On-Time
4	Integer	Minimum Off-Time
5	Integer	Maximum Cycle/Hour

Table F.6 Internal Structure of Metasys N2 Internal Integer (ADI)

Attribute	Type	Description
1	Byte	Object Status
2	Integer	Current Value. Signed 16-bit.

Network Points

Table F.7 Binary Inputs

Network Point					
Type (NPT)	**Address (NPA)**	**Name**	**Description**	**ON (“1”)**	**OFF (“0”)**
BI	1	Ready	Logic Status bit 00	Ready	Not Ready
BI	2	Active	Logic Status bit 01	Active	Not Active
BI	3	Cmd Dir	Logic Status bit 02	Forward	Reverse
BI	4	Act Dir	Logic Status bit 03	Forward	Reverse
BI	5	Accel	Logic Status bit 04	Accelerating	Not Accelerating
BI	6	Decel	Logic Status bit 05	Decelerating	Not Decelerating
BI	7	Alarm	Logic Status bit 06	Alarm	No Alarm
BI	8	Fault	Logic Status bit 07	Fault	No Fault
BI	9	At Speed	Logic Status bit 08	At Reference	Not at Reference
BI	10	Main Freq	Logic Status bit 09	Comm Controlled	Not Comm Controlled
BI	11	Oper Cmd	Logic Status bit 10	Comm Controlled	Not Comm Controlled
BI	12	Param Lock	Logic Status bit 11	Locked	Not Locked
BI	13	Digital In 1	Logic Status bit 12 (Drive Terminal #2)	On	Off
BI	14	Digital In 2	Logic Status bit 13 (Drive Terminal #3)	On	Off
BI	15	Digital In 3	Logic Status bit 14 (Drive Terminal #4)	On	Off
BI	16	Digital In 4	Logic Status bit 15 (Drive Terminal #5)	On	Off
BI	17	Digital In 5	Drive Terminal #6	On	Off
BI	18	Digital In 6	Drive Terminal #7	On	Off
BI	19	Digital In 7	Drive Terminal #8	On	Off

Table F.8 Analog Inputs

Network Point					
Type (NPT)	**Address (NPA)**	**Name**	**Description**	**Units**	**Min/Max**
AI	1	Feedback	Feedback	%	0/100
AI	2	Speed	d323 [Output RPM]	RPM	0/24000
AI	3	Current	b003 [Output Current]	A	0.00/Rated × 2
AI	4	DC Bus Volts	b005 [DC Bus Voltage]	V	0/820
AI	5	Last Fault	b307 [Fault 1 Code]	1	1/100
AI	6	2nd Fault	b308 [Fault 2 Code]	1	1/100
AI	7	Analog In 1	Drive Analog Input #1 (Drive Terminal #13)	%	–
AI	8	Analog In 2	Drive Analog Input #2 (Drive Terminal #17)	%	–
AI	9	Read Value	Read value of Param. selected by AO 10	Varies by the parameter selected.	
AI	10	User In 1	User-defined Input 1 (Param. selected via ADI 1)		
AI	11	User In 2	User-defined Input 2 (Param. selected via ADI 2)		
AI	12	User In 3	User-defined Input 3 (Param. selected via ADI 3)		
AI	13	User In 4	User-defined Input 4 (Param. selected via ADI 4)		

Table F.9 Binary Outputs

Network Point				**Values**	
Type (NPT)	**Address (NPA)**	**Name**	**Description**	**ON (“1”)**	**OFF (“0”)**
BO	1	Run Enable	Logic Command bit 00	Enable	Stop (Coast)
BO	2	Start/Stop	Logic Command bit 00 & 01	Start	Stop (Normal)
BO	3	Jog	Logic Command bit 02	Jog	Not Jog
BO	4	Clear Faults	Logic Command bit 03	Clear Flts	Not Clear Flts
BO	5	Fwd/Rev	Logic Command bit 04 & 05	Forward	Reverse
BO	6	Not Used	Logic Command bit 06	–	–
BO	7	MOP Inc	Logic Command bit 07	Increment	Not Increment
BO	8	Accel 1	Logic Command bit 08	Accel Rate 1	Not Accel 1
BO	9	Accel 2	Logic Command bit 09	Accel Rate 2	Not Accel 2
BO	10	Decel 1	Logic Command bit 10	Decel Rate 1	Not Decel 1
BO	11	Decel 2	Logic Command bit 11	Decel Rate 2	Not Decel 2
BO	12	Ref Sel 1	Logic Command bit 12	BO	
BO	13	Ref Sel 2	Logic Command bit 13	14 13 12	
BO	14	Ref Sel 3	Logic Command bit 14	0 0 0 = No Command	
				0 0 1 = P038 [Speed Reference]	
				0 1 0 = A142 [Internal Freq]	
				0 1 1 = Comm - Address 8193 (1)	
				1 0 0 = A143 [Preset Freq 0]	
				1 0 1 = A144 [Preset Freq 1]	
				1 1 0 = A145 [Preset Freq 2]	
				1 1 1 = A146 [Preset Freq 3]	
BO	15	MOP Dec	Logic Command bit 15	Decrement	Not Decrement
BO	16	Pnl Lock	Lock-out Drive Front Panel	Lock	Unlock
BO	17	Digital Out 1	Relay #1 on Drive (Drive Terminal R1, R2, R3)	On	Off
BO	18	Digital Out 2	Relay #2 on Drive (Drive Terminal R4, R5, R6)	On	Off
BO	19	Opto Out	Terminal #19	On	Off

(1) See Writing (06) Reference on page E-3.

Table F.10 Analog Outputs

Network Point					
Type (NPT)	**Address (NPA)**	**Name**	**Description**	**Units**	**Min/Max**
AO	1	Reference	Reference	%	0/100
AO	2	Accel 1	P039 [Accel Time 1]	Secs	0.0/600.0
AO	3	Decel 1	P040 [Decel Time 1]	Secs	0.0/600.0
AO	4	Mtr OL Current	P033 [Motor OL Current]	A	0.0/Rated × 2
AO	5	PID Setpoint	A157 [PID Setpoint]	%	0/100
AO	6	Analog Out 1	Drive Analog Output #1 (T084)	%	–
AO	7	Analog Out 2	Drive Analog output #2 (T087)	%	–
AO	8	Write Param #	Param. number to write in AO 9	–	0 to Max Param.
AO	9	Write Value	Write value of param. selected by AO 8	Based on AO 8 selected param.	
AO	10	Read Param #	Param. number to read in AI 9	–	0 to Max Param.
AO	11	User Out 1	User-defined Output 1 (Param. selected via ADI 5)	Varies by the parameter selected.	
AO	12	User Out 2	User-defined Output 2 (Param. selected via ADI 6)		
AO	13	User Out 3	User-defined Output 3 (Param. selected via ADI 7)		
AO	14	User Out 4	User-defined Output 4 (Param. selected via ADI 8)		

Table F.11 Internal Integer

Network Point					
Type (NPT)	Address (NPA)	Name	Description	Min/Max	Default
ADI	1	Param# IN1	User IN 1 (AI 10) Data Source (Param#)	0/Max Drive Params.	b001 [Output Freq] (Hz)
ADI	2	Param# IN2	User IN 2 (AI 11) Data Source (Param#)	0/Max Drive Params.	b011 [Elapsed MWh]
ADI	3	Param# IN3	User IN 3 (AI 12) Data Source (Param#)	0/Max Drive Params.	b012 [Elapsed Run Time]
ADI	4	Param# IN4	User IN 4 (AI 13) Data Source (Param#)	0/Max Drive Params.	b014 [Drive Temperature]
ADI	5	Param# OUT1	User OUT 1 (AO 11) Data Source (Param#)	0/Max Drive Params.	A154 [PID Gain]
ADI	6	Param# OUT2	User OUT 2 (AO 12) Data Source (Param#)	0/Max Drive Params.	A155 [PID Integral Time]
ADI	7	Param# OUT3	User OUT 3 (AO 13) Data Source (Param#)	0/Max Drive Params.	A156 [PID Diff Rate]
ADI	8	Param# OUT4	User OUT 4 (AO 14) Data Source (Param#)	0/Max Drive Params.	A158 [PID Deadband]

Using Percent (%) for the Reference

The Reference (AO 1) for Metasys N2 is set as a percentage from 0% to +100%.

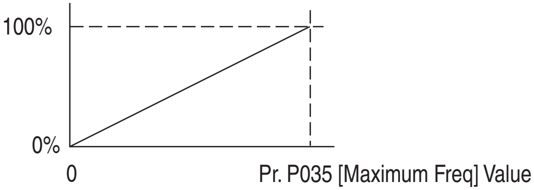


Table F.12 Example Speed Reference and Feedback for a PowerFlex 400 (P035 = 60 Hz)

Reference (AO 1)		Feedback (AI 1)	
Percent	Speed	Speed	Percent
100%	60 Hz	60 Hz	100%
50%	30 Hz	30 Hz	50%
25%	15 Hz	15 Hz	25%
0%	0 Hz	0 Hz	0%

Using Metasys Configurable Objects to Access Parameters

Configurable objects are inputs and outputs that let you read and write parameter values. These objects handle only 16-bit parameter values.

Reading Parameter Values

The configurable points may show any parameter in the drive by configuring the Param# for INx point. The drive reads the value of the parameter configured in the Param# for INx point and shows the result in the User INx point. The Param# for INx's default to commonly accessed parameters and can be changed if desired. A "0" disables the fetching of data and a "0" is returned in the respective User INx. See Figure F.1 and Table F.13.

Figure F.1 Configurable Input Point Operation Objects Inputs

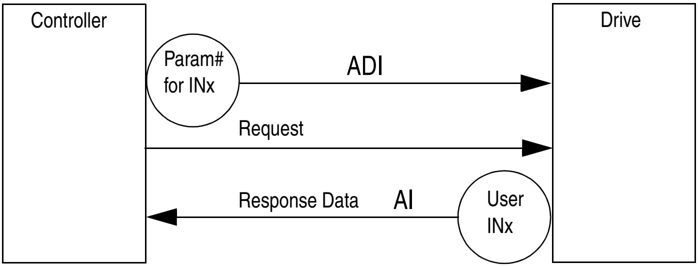


Table F.13 Configurable Objects: Inputs

Network Point				
Type (NPT)	**Address (NPA)**	**Name**	**Description**	**Default**
AI	10	User IN1	User-defined Input 1	0
AI	11	User IN2	User-defined Input 2	0
AI	12	User IN3	User-defined Input 3	0
AI	13	User IN4	User-defined Input 4	0
ADI	1	Param# for IN1	User IN1 (AI 10) Data Source (Param#)	b001 [Output Freq] (Hz)
ADI	2	Param# for IN2	User IN2 (AI 11) Data Source (Param#)	b011 [Elapsed MWh]
ADI	3	Param# for IN3	User IN3 (AI 12) Data Source (Param#)	b012 [Elapsed Run Time]
ADI	4	Param# for IN4	User IN4 (AI 13) Data Source (Param#)	b014 [Drive Temp]

Writing Parameter Values

ATTENTION: Risk of equipment damage exists. If configurable outputs are programmed to write parameter data to Non-Volatile Storage (NVS) frequently, the NVS will quickly exceed its life cycle and cause the drive to malfunction. Do not create a program that frequently uses configurable outputs to write parameter data to NVS.

These outputs are written each time the User OUTx point is written from the network.

The Param# for OUTx's default to commonly accessed parameters and can be changed if desired. A value of "0" in the Param# for OUTx field disables the writing of data for that specific point.

Figure F.2 Configurable Objects: Outputs

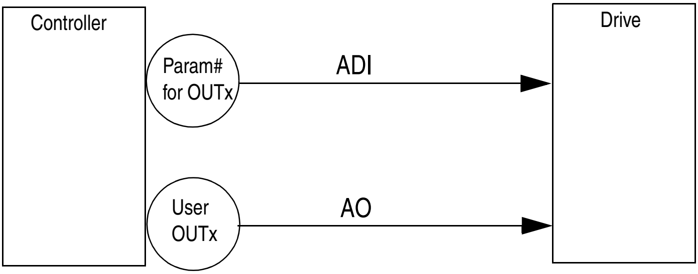


Table F.14 Configurable Objects: Outputs

Network Point				
Type (NPT)	Address (NPA)	Description	Range	Default
AO	6	User OUT1	Varies by the parameter selected by Param# for OUTx.	0
AO	7	User OUT2		0
AO	8	User OUT3		0
AO	9	User OUT4		0
ADI	5	User OUT1 (A06) Destination (Param#)	0 (not in use), 1 to maximum # of drive parameters	A154 [PID Prop Gain]
ADI	6	User OUT2 (A07) Destination (Param#)	0 (not in use), 1 to maximum # of drive parameters	A155 [PID Integ Time]
ADI	7	User OUT3 (A08) Destination (Param#)	0 (not in use), 1 to maximum # of drive parameters	A156 [PID Diff Rate]
ADI	8	User OUT4 (A09) Destination (Param#)	0 (not in use), 1 to maximum # of drive parameters	A158 [PID Deadband]

Notes:

P1 – Floor Level Network (FLN)

Appendix G provides information about controlling a PowerFlex 400 drive, setting its Reference, and accessing its parameters through configurable points when the P1-FLN protocol is selected. The P1-FLN protocol is a serial communication protocol used by the Siemens APOGEE® system.

Understanding P1-FLN

The P1-FLN master performs read and write commands to certain points, and the internal P1-FLN protocol firmware transfers/translates the data between these points and the drive.

When a read or write command occurs to a certain point, data in the point is refreshed from or transferred to the drive.

The P1-FLN master also performs cyclic polling of all the virtual objects.

P1-FLN Points

A P1-FLN node may contain up to 99 points.

Network Points

Table G.1 Point Database for Application 2735

Point Number	Point Type	Subpoint Name	Factory Default (SI Units)	Engineering Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
01	LAO	CTLR ADDRESS	99	–	1	0	–	–
02	LAO	APPLICATION	2735	–	1	0	–	–
{03}	LAI	FREQ OUTPUT	0	HZ	0.01	0	–	–
{04}	LAI	PCT OUTPUT	0	PCT	0.1	0	–	–
{05}	LAI	SPEED	0	RPM	1	0	–	–
{06}	LAI	CURRENT	0	AMPS	0.1	0	–	–
{07}	LAI	TORQUE	0	AMPS	0.1	0	–	–
{08}	LAI	POWER	0	HP (KW)	0.1333 (0.1)	0 (0)	–	–
{09}	LAI	DRIVE TEMP	0	DEG F (DEG C)	1.8 (1)	32 (0)	–	–
{11}	LAI	DRIVE MWH	0	MWH	0.1	0	–	–
{12}	LAI	RUN TIME	0	HRS	10	0	–	–
{13}	LAI	DC BUS VOLT	0	VOLTS	1	0	–	–
20	LAO	OVRD TIME	1	HRS	1	0	–	–
{21}	LDI	FWD.REV MON	FWD	–	1	0	REV	FWD
{22}	LDO	CMD FWD.REV	FWD	–	1	0	REV	FWD
{23}	LDI	RUN.STOP MON	STOP	–	1	0	RUN	STOP
{24}	LDO	CMD RUN.STOP	STOP	–	1	0	RUN	STOP
{25}	LDI	READY	READY	–	1	0	READY	NOTRDY
{26}	LDO	RUN ENABLE	STOP	–	1	0	ENABLE	STOP
{29}	LDO	DAY NGT	DAY	–	1	0	NIGHT	DAY
30	LAO	CURRENT LIMT	***1**	AMPS	0.1	0	–	–
31	LAO	ACCEL TIME	20	SEC	0.02	0	–	–
32	LAO	DECEL TIME	20	SEC	0.02	0	–	–
33	LDO	KEYPAD LOCK	UNLOCK	–	1	0	LOCK	UNLOCK
{36}	LAO	READ PARAM	0	–	1	0	–	–
{37}	LAI	READ VALUE	0	–	1	0	–	–
{38}	LAO	WRITE PARAM	0	–	1	0	–	–
{39}	LAO	WRITE VALUE	0	–	1	0	–	–
{40}	LDO	DIGITAL OUT1	OFF	–	1	0	ON	OFF
{41}	LDO	DIGITAL OUT2	OFF	–	1	0	ON	OFF
{42}	LDO	DIGITAL OUT3	OFF	–	1	0	ON	OFF
{43}	LDO	OPT RELAY 1	OFF	–	1	0	ON	OFF
{44}	LDO	OPT RELAY 2	OFF	–	1	0	ON	OFF
{45}	LDO	OPT RELAY 3	OFF	–	1	0	ON	OFF
{46}	LDO	OPT RELAY 4	OFF	–	1	0	ON	OFF
{47}	LDO	OPT RELAY 5	OFF	–	1	0	ON	OFF
{48}	LDO	OPT RELAY 6	OFF	–	1	0	ON	OFF
{49}	LDI	DIGITAL IN 1	OFF	–	1	0	ON	OFF
{50}	LDI	DIGITAL IN 2	OFF	–	1	0	ON	OFF
{51}	LDI	DIGITAL IN 3	OFF	–	1	0	ON	OFF
{52}	LDI	DIGITAL IN 4	OFF	–	1	0	ON	OFF
{53}	LDI	DIGITAL IN 5	OFF	–	1	0	ON	OFF
{54}	LDI	DIGITAL IN 6	OFF	–	1	0	ON	OFF
{55}	LDI	DIGITAL IN 7	OFF	–	1	0	ON	OFF
{60}	LAI	INPUT REF 1	0	***3**	0.1	0	–	–
{61}	LAI	INPUT REF 2	0	***3**	0.1	0	–	–
{62}	LAO	ANALOG OUT 1	0	PCT	0.1	0	–	–
{63}	LAO	ANALOG OUT 2	0	PCT	0.1	0	–	–
{64}	LAI	LAST FAULT	0	–	1	0	–	–

Table G.1 Point Database for Application 2735

Point Number	Point Type	Subpoint Name	Factory Default (SI Units)	Engineering Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
65	LAO	PID GAIN	1	PTC	0.01	0	–	–
66	LAO	PID INT TIME	2	SEC	0.1	0	–	–
67	LAO	PID DIF RATE	0	PERSEC ***2**	0.01	0	–	–
68	LAO	PID SETPOINT	0	PTC	0.1	0	–	–
{70}	LDI	CMD DIR MON	FWD	–	1	0	REV	FWD
{71}	LDI	ACCELERATING	OFF	–	1	0	ON	OFF
{72}	LDI	DECELERATING	OFF	–	1	0	ON	OFF
{73}	LDI	ALARM	NORMAL	–	1	0	ALARM	NORMAL
{74}	LDI	AT SPEED	OFF	–	1	0	ON	OFF
{75}	LDI	MAIN FREQ	OFF	–	1	0	ON	OFF
{76}	LDI	OPER CMD	OFF	–	1	0	ON	OFF
{77}	LDI	PARAM LOCK	UNLOCK	–	1	0	LOCK	UNLOCK
{78}	LDO	JOG	OFF	–	1	0	ON	OFF
{79}	LDO	LOCAL CNTRL ***4**	OFF	–	1	0	ON	OFF
{80}	LDO	MOP INC	OFF	–	1	0	ON	OFF
{81}	LDO	ACCEL RATE 1	OFF	–	1	0	ON	OFF
{82}	LDO	ACCEL RATE 2	OFF	–	1	0	ON	OFF
{83}	LDO	DECEL RATE 1	OFF	–	1	0	ON	OFF
{84}	LDO	DECEL RATE 2	OFF	–	1	0	ON	OFF
{85}	LDO	REF SELECT 1	OFF	–	1	0	ON	OFF
{86}	LDO	REF SELECT 2	OFF	–	1	0	ON	OFF
{87}	LDO	REF SELECT 3	OFF	–	1	0	ON	OFF
{88}	LDO	MOP DEC	OFF	–	1	0	ON	OFF
{92}	LAO	REFERENCE	0	PCT	0.01	0	–	–
{93}	LDI	OK.FAULT	OK	–	1	0	FAULT	OK
{94}	LDO	RESET FAULT	NORMAL	–	1	0	RESET	NORMAL
{99}	LAO	ERROR STATUS	0	–	1	0	–	–

a. Points not listed are not used in this application.
b. A single value in a column means that the value is the same in English units and in SI units.
c. Point numbers that appear in brackets { } may be unbundled at the field panel.
*1 Depends on drive model
*2 1 / Secs
*3 Depending on configuration, units can be volts or milliamperes.
*4 Local Control causes the drive to use C108 [Start Source 2] and C109 [Speed Ref 2] for start and speed reference control.

Table G.2 Point Database for Application 2735

Point Number	Subpoint Name	Parameter
01	CTLR ADDRESS	C104
02	APPLICATION	–
03	FREQ OUTPUT	b001
04	PCT OUTPUT	d322
05	SPEED	d323
06	CURRENT	b003
07	TORQUE	b013
08	POWER	b010
09	DRIVE TEMP	b014
11	DRIVE MWH	b011
12	RUN TIME	b012
13	DC BUS VOLT	b005
20	OVRD TIME	–
21	FWD.REV MON	–
22	CMD FWD.REV	–
23	RUN.STOP MON	b066, bit 1 (Running)
24	CMD RUN.STOP	–
25	READY	d302, bit 2 (I/O Terminal 01)
26	RUN ENABLE	–
29	DAY NGT	–
30	CURRENT LIMIT	P033
31	ACCEL TIME 1	P039
32	DECEL TIME 1	P040
33	KEYPAD LOCK	A198
36	READ PARAM #	–
37	READ VALUE	–
38	WRITE PARAM #	–
39	WRITE VALUE	–
40	DIGITAL OUT 1	T055, T056
41	DIGITAL OUT 2	T060, T061
42	DIGITAL OUT 3	T065, T066
43	OPT RELAY 1	R221, R222 ***1**
44	OPT RELAY 2	R224, R225 ***1**
45	OPT RELAY 3	R227, R228 ***1**
46	OPT RELAY 4	R230, R231 ***1**
47	OPT RELAY 5	R233, R234 ***1**
48	OPT RELAY 6	R236, R237 ***1**
49	DIGITAL IN 1	d302, bit 0 (I/O Terminal 02)
50	DIGITAL IN 2	d302, bit 1 (I/O Terminal 03)
51	DIGITAL IN 3	d302, bit 2 (I/O Terminal 01)
52	DIGITAL IN 4	d302, bit 3 (I/O Terminal 05)
53	DIGITAL IN 5	d302, bit 4 (I/O Terminal 06)
54	DIGITAL IN 6	d302, bit 5 (I/O Terminal 07)
55	DIGITAL IN 7	d302, bit 6 (I/O Terminal 08)
60	INPUT REF 1	d305
61	INPUT REF 2	d306
62	ANALOG OUT 1	T082
63	ANALOG OUT 2	T085
64	LAST FAULT	b007
65	PID GAIN	A154
66	PID INT TIME	A155
67	PID DIFF RATE	A156
68	PID SETPOINT	A157

Table G.2 Point Database for Application 2735

Point Number	Subpoint Name	Parameter
70	CMD DIR MON	b006, bit 2 (Forward)
71	ACCELERATING	b006, bit 3 (Accelerating)
72	DECELERATING	b006, bit 4 (Decelerating)
73	ALARM	–
74	AT SPEED	–
75	MAIN FREQ	d301 (Digit 0)
76	OPER CMD	d301 (Digit 1)
77	PARAM LOCK	–
78	JOG	–
79	LOCAL CNTRL	–
80	MOP INC	–
81	ACCEL RATE 1	–
82	ACCEL RATE 2	–
83	DECEL RATE 1	–
84	DECEL RATE 2	–
85	REF SELECT 1	–
86	REF SELECT 2	–
87	REF SELECT 3	–
88	MOP DEC	–
92	REFERENCE	b022
93	OK.FAULT	–
94	RESET FAULT	–
99	ERROR STATUS	–

*1 These parameters affect the operation of an optional auxiliary relay board.

Using Percent (%) for the Reference

The Reference (Point 92) for P1 is set as a percentage from 0% to +100%.

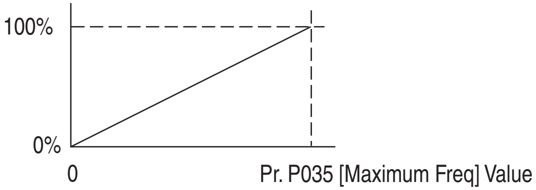


Table G.3 Example Speed Reference and Feedback for a PowerFlex 400 (P035 = 60 Hz)

Reference (Point 92)		PCT Output (Point 4)	
Percent	**Speed**	**Speed**	**Percent**
100%	60 Hz	60 Hz	100%
50%	30 Hz	30 Hz	50%
25%	15 Hz	15 Hz	25%
0%	0 Hz	0 Hz	0%

Using P1 Configurable Points to Access Parameters

Configurable points are inputs and outputs that let you read and write parameter values. These objects handle only 15-bit parameter values (0 – 32767).

Important: If a parameter has a decimal point, the value must be properly scaled by the user. For example, Accel Time has two decimal places. To use the value 60.00, the scaled value 6000 must be communicated to the drive. The scaled value 6000 will be returned.

Reading Parameter Values

The configurable points may show any parameter in the drive by configuring the Param# in the Read Param point. The drive reads the value of the parameter configured in the Param# for the Read Param point and shows the result in the Read Value point. The Param# for the Read Param point default to commonly accessed parameters and can be changed if desired. A "0" disables the fetching of data and a "0" is returned in the Read Value point. See Figure G.1 and Table G.4.

Figure G.1 Configurable Input Point Operation

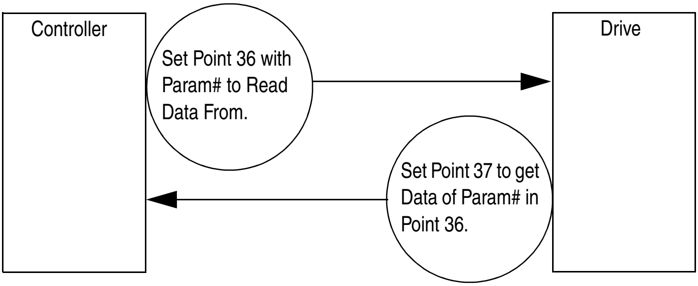


Table G.4 Configurable Points: Inputs

Point	Name	Description	Default
36	Read Param	Param# to read value	0
37	Read Value	Value of parameter specified by Point 36	0

Writing Parameter Values

These outputs are written each time the Write Value point is written from the network.

The Param# for Write Param point's default to commonly accessed parameters and can be changed if desired. A value of "0" in the Param# for Write Param point field disables the writing of data.

Figure G.2 Configurable Output Point Operation

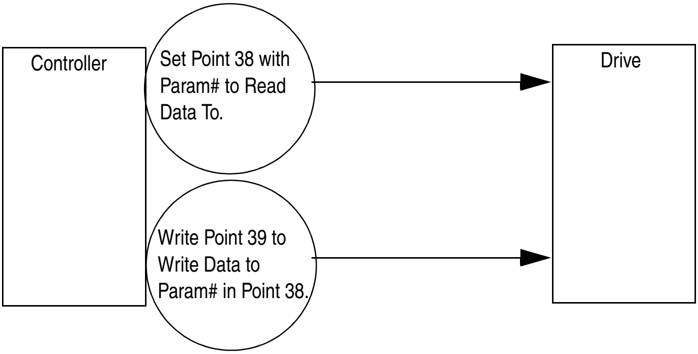


Table G.5 Configurable Points: Outputs

Point	Name	Description	Default
38	Write Param	Param# to write value	0
39	Write Value	New value of parameter specified by Point 38	0

Index

5011625904-T304

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 22C-UM001E-EN-P – November 2005

Supercedes 22C-UM001D-EN-P – August 2005

100-C16D10
100-C23D10

ITEM # 31 & 31A

Contactors

Product Selection

3-Pole AC-Operated Contactors

- AC Operating Mechanism
- 3 Main Contacts

Cat. No. 100-C23⊗10

Cat. No. 100-C37⊗00

Cat. No. 100-C43⊗00

Cat. No. 100-C85⊗00

Ie [A]		Ratings for Switching AC Motors — AC-2, AC-3, AC-4										Aux. Contacts		Cat. No.
		kW (50 Hz)				Hp (60 Hz)								
						1∅		3∅						
AC-3	AC-1	230V	380V 415V 400V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	
9	32	3	4	4	4	1/3	1	2	2	5	7-1/2	1	0	100-C09⊗10
												0	1	100-C09⊗01
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	1	0	100-C12⊗10
												0	1	100-C12⊗01
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	1	0	100-C16⊗10
												0	1	100-C16⊗01
23	32	7.5	11	11	11	2	3	5	7-1/2	15	15	1	0	100-C23⊗10
												0	1	100-C23⊗01
30	50	10	15	15	15	2	5	7-1/2	10	20	25	0	0	100-C30⊗00
												1	0	100-C30⊗10
												0	1	100-C30⊗01
37	50	11	18.5	18.5	18.5	3	5	10	10	25	30	0	0	100-C37⊗00
												1	0	100-C37⊗10
												0	1	100-C37⊗01
43	85	13	22	22	22	3	7-1/2	10	15	30	30	0	0	100-C43⊗00
												1	0	100-C43⊗10
												0	1	100-C43⊗01
60	100	18.5	30	30	30	5	10	15	20	40	50	0	0	100-C60⊗00
												1	0	100-C60⊗10
												0	1	100-C60⊗01
72	100	22	37	37	37	5	15	20	25	50	60	0	0	100-C72⊗00
												1	0	100-C72⊗10
												0	1	100-C72⊗01
85	100	25	45	45	45	7-1/2	15	25	30	60	60	0	0	100-C85⊗00
												1	0	100-C85⊗10
												0	1	100-C85⊗01

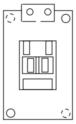
⊗ Voltage Suffix Code and Terminal Position

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: 120V, 60 Hz: **Cat. No. 100-C09⊗10** becomes **Cat. No.100-C09D10**.

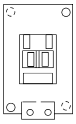
V / Hz	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
50Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	—	—	—	—	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

Coil Terminal Position

- All contactors are delivered with the coil terminals located on the **line side**.
- For **load side** coil terminations, insert a **U** prior to the coil voltage code. Example: **Cat. No. 100-C09UD10**.



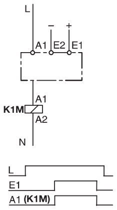
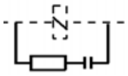
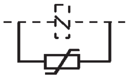
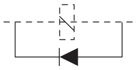
Cat. No. 100-C09⊗10 Line Side



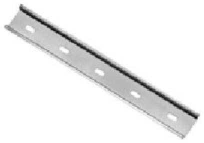
Cat. No. 100-C09U⊗10 Load Side

100-JE ITEM # 32

Control Modules (For 100-C09…C85 contactors), Continued

	Description		Voltage Range	Connection Diagrams	For Use With	Cat. No.
	**DC Interface** (electronic) Interface between the DC control signal (PLC) and the AC operating mechanism of the contactor. Requires no additional surge suppression on the relay coils		Input: 12V DC Output: 110…240V AC		100-C with AC coils 110…240V AC	100-JE12
			Input: 18…30V DC Output: 110…240V AC			100-JE
			Input: 48V DC Output: 110…240V AC			100-JE48
	**Surge Suppressors** For limitation of coil switching transients. Plug-in, coil mounted Suitable for all 100-C contactor sizes, 9…85 A RC, Varistor and Diode Versions	**RC Module** AC Operating Mechanism	24…48V AC, 50/60 Hz		100-C with AC coils	100-FSC48
			110…280V AC, 50/60 Hz			100-FSC280
			380…480V AC, 50/60 Hz			100-FSC480
		Varistor Module AC/DC Operating Mechanism	12…55V AC/ 12…77V DC		100-C all	100-FSV55
			56…136V AC/ 78…180V DC		100-C all	100-FSV136
			137…277V AC/ 181…350V DC		100-C all	100-FSV277
			278…575V AC		100-C all	100-FSV575
		Diode Module DC Operating Mechanism	12…250V DC		100-C with DC coils	100-FSD250

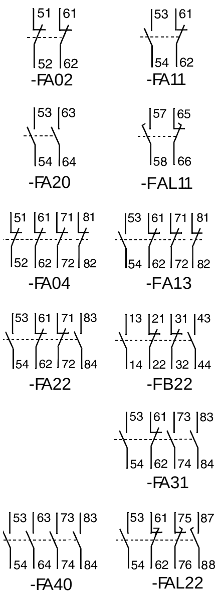
Assembly Components (For 100-C09…C85 contactors)

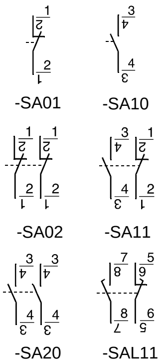
	Description	For Use With	Pkg. Quantity*	Cat. No.
 *Cat. No. 100-S0*	**Dovetail Connectors** For use in contactor and starter assemblies. Single Connector — 0 mm Spacing	100-C all	10	100-S0
	Dovetail Connectors For use in contactor and starter assemblies. Dual Connector — 9 mm Spacing			100-S9
 *Cat. No. 100-SCCA*	**Protective Covers** Provides protection against unintended manual operation For contactors and front mounted auxiliary contacts, pneumatic timers and latches	100-C all	1	100-SCCA
 *Cat. No. 100-SCFA*		100-FA, -FB, -FC, -FP, -FL;	10	100-SCFA
 *Cat. No. 105-PW23*	**Reversing Power Wiring Kits** For reversing connection with a solid-state or thermal overload relay	100-C09…C23	1	105-PW23
		100-C30…C37		105-PW37
		100-C43		105-PW43
		100-C60…85		105-PW85
	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	100-C09…85	10	199-DR1

* Must be ordered in multiples of package quantities.

100-SA20 ITEM # 48

Auxiliary Contacts

	Description	N.O.	N.C.	Connection Diagrams	For Use With	Cat. No.
 	**Auxiliary Contact Blocks for Front Mounting ❶❸** • 2- and 4-pole • Quick and easy mounting without tools • Mutual positive guidance to the main contactor poles (except for L types) • Models with equal function with several terminal numbering choices L = Late break/Early make	0	2		700-CF	100-FA02
		1	1		700-CF	100-FA11
		2	0		700-CF	100-FA20
		1L	1L		700-CF	100-FAL11
		0	4		700-CF	100-FA04
		1	3		700-CF	100-FA13
		2	2		700-CF	100-FA22
		3	1		700-CF	100-FA31
		4	0		700-CF	100-FA40
		1+1L	1+1L		700-CF	100-FAL22

	Description	N.O.	N.C.	Connection Diagrams	For Use With	Cat. No.
 	**Auxiliary Contact Blocks for Side Mounting without Sequence Terminal Designations ❷❸** • 1- and 2-pole • Two-way numbering for right or left mounting on the contactor • Quick and easy mounting without tools • Mutual positive guidance and to the main relay poles (except for L types) L = Late break/Early make	0	1		700-CF	100-SA01
		1	0		700-CF	100-SA10
		0	2		700-CF	100-SA02
		1	1		700-CF	100-SA11
		2	0		700-CF	100-SA20
		L1	L1		700-CF	100-SAL11

❶ Control Relay and Auxiliary Contact
❷ Up to 8 auxiliary contacts may be mounted (a maximum of 4 N.C. contacts on the front of the contactor and a maximum of 2 N.O. contacts on each side).
❸ Maximum No. of Contacts: Refer to the following tables

700CF (AC and DC coils), vertical mounting, 60°C

Cat. No. 700-	Max. N.O. Side Aux.	Max. N.C. Side Aux.	Max. N.O. Front + Side Aux.	Max. N.C. Front + Side Aux.	Max. N.O. + N.C. Front + Side Aux.
CF400	2	4	6	6	6
CF310	2	4	6	6	6
CF220	2	4	6	6	6
CF040 ❹	2	2	4	4	4

700CF (AC and DC coils), vertical mounting, 40°C

Cat. No. 700-	Max. N.O. Side Aux.	Max. N.C. Side Aux.	Max. N.O. Front + Side Aux.	Max. N.C. Front + Side Aux.	Max. N.O. + N.C. Front + Side Aux.
CF400	2	4	6	7	7
CF310	2	4	6	7	7
CF220	2	4	6	7	7
CF040 ❹	2	3	4	5	5

❹ AC coils only.

140M-C2E-C16
140M-C2E-C20

ITEM # 27 & 27A

Product Selection

Motor Protection Circuit Breakers

- Short Circuit Protection — Standard Magnetic Trip (Fixed at 13 x I_e)
- Overload Protection — Trip Class 10

Cat. No. 140M-C

Cat. No. 140M-D

Cat. No. 140M-F

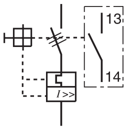
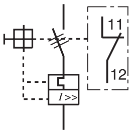
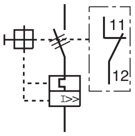
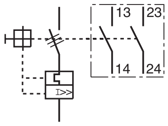
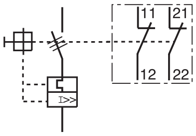
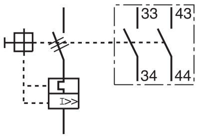
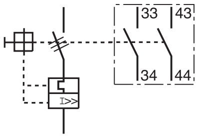
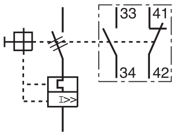
Cat. No. 140-CMN

Rated Operational Current (I_e)	Motor Current Adjustment Range	Magnetic Trip Current	Ultimate Interrupting Current [kA] (I_{cu})		3-phase Hp Ratings [Hp]∗				Max. kW, 3-Phase				Cat. No.
[A]	[A]	[A]	400V	480V	200V	230V	460V	575V	230V	400/415V	500V	690V	
C-Frame													
0.16 A	0.10…0.16	2.1	100	65	—	—	—	—	—	0.02	—	—	140M-C2E-A16
0.25 A	0.16…0.25	3.3	100	65	—	—	—	—	—	0.06	—	—	140M-C2E-A25
0.40 A	0.25…0.40	5.2	100	65	—	—	—	—	—	0.09	—	—	140M-C2E-A40
0.63 A	0.40…0.63	8.2	100	65	—	—	—	—	0.06…0.09	0.12…0.18	0.18	0.25	140M-C2E-A63
1.0 A	0.63…1.0	13	100	65	—	—	—	0.5	0.12	0.25	0.25…0.37	0.37…0.55	140M-C2E-B10
1.6 A	1.0…1.6	21	100	65	—	—	0.5…0.75	0.75	0.18…0.25	0.37…0.55	0.55…0.75	0.75…1.1	140M-C2E-B16
2.5 A	1.6…2.5	33	100	65	0.5	0.5	0.75…1	1…1.5	0.37	0.75	1.1	1.8	140M-C2E-B25
4.0 A	2.5…4.0	52	100	65	0.75	0.75	1.5…2	2…3	0.55…0.75	1.1…1.5	1.5…2.2	2.2…3.0	140M-C2E-B40
6.3 A	4.0…6.3	82	100	65	1	1…1.5	3	5	1.1…1.5	2.2	2.5…3.0	4.0	140M-C2E-B63
10 A	6.3…10	130	100	65	1.5…2	2…3	5	7.5	2.2	3.0…4.0	4.0…6.3	5.5…7.5	140M-C2E-C10
16 A	10…16	208	50	30	3	—	7.5…10	10	3.0…4.0	5.5…7.5	7.5…10	11…13	140M-C2E-C16 ⬅
20 A	14.5…20	260	15	30	5	5	—	15	4.0…5.5	7.5…10	11	15…17	140M-C2E-C20 ⬅
25 A	18…25	325	15	25	—	7.5	15	20	—	11	15	18.5…22	140M-C2E-C25
D-Frame													
2.5 A	1.6…2.5	33	100	65	0.5	0.5	0.75…1	1…1.5	0.37	0.75	1.1	1.8	140M-D8E-B25
4.0 A	2.5…4.0	52	100	65	0.75	0.75	1.5…2	2-3	0.55…0.75	1.1…1.5	1.5…2.2	2.2…3.0	140M-D8E-B40
6.3 A	4.0…6.3	82	100	65	1	1…1.5	3	5	1.1…1.5	2.2	2.5…3.0	4.0	140M-D8E-B63
10 A	6.3…10	130	100	65	1.5…2	2…3	5	7.5	2.2	3.0…4.0	4.0…6.3	5.5…7.5	140M-D8E-C10
16 A	10…16	208	100	65	3	—	7.5…10	10	3.0…4.0	5.5…7.5	7.5…10	11…13	140M-D8E-C16
20 A	14.5…20	260	50	65	5	5	—	15	4.0…5.5	7.5…10	11	15…17	140M-D8E-C20
25 A	18…25	325	50	65	—	7.5	15	20	—	11	15	18.5…22	140M-D8E-C25
F-Frame													
10 A	6.3…10	130	65	65	1.5…2	2…3	5	7.5	2.2	3.0…4.0	4.0…6.3	5.5…7.5	140M-F8E-C10
16 A	10…16	208	65	65	3	—	7.5…10	10	3.0…4.0	5.5…7.5	7.5…10	11…13	140M-F8E-C16
20 A	14.5…20	260	65	65	5	5	—	15	4.0…5.5	7.5…10	11	15…17	140M-F8E-C20
25 A	18…25	325	65	65	—	7.5	15	20	5.5…6.3	11	15	18.5…22	140M-F8E-C25
32 A	23…32	416	65	65	7.5	10	20	25…30	7.5	15	15…20	22…25	140M-F8E-C32
45 A	32…45	585	—	—	10	15	25…30	30…40	11…13	18.5…22	22…30	30…40	140M-F8E-C45
CMN-Frame													
25 A	16…25	350	65	65	5	7.5	15	15…20	5.5…7.5	7.5…13	11…15	15…22	140-CMN-2500
40 A	25…40	560	65	65	10	10	20…30	25…30	10…11	15…22	18.5…25	25…30	140-CMN-4000
63 A	40…63	882	65	42	15…20	15…20	30…40	40…60	13…20	25…32	30…40	37…55	140-CMN-6300
90 A	63…90	1260	50	35	25…30	25…30	50…60	75	22…25	37…45	45…55	63…75	140-CMN-9000

∗ Horsepower/kW ratings shown in the table above are for reference. **The final selection of the MPCB depends on the actual motor full load current and service factor.**

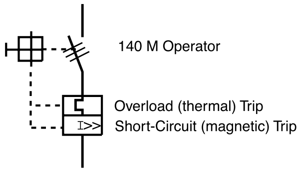
140M-C-AFA10 ITEM # 28

Accessories

Description							Connection Diagram†	For Use With	Cat. No.
		Operator Position*			Term. No.	Description			
		OFF	ON	Tripped					
		←	↑	↘					
	**Front-Mounted Auxiliary Contact** 1-pole or 2-pole No additional space required - Only (1) per MPCB	O	X	O	13-14	N.O. Aux		140M-C, D, F	140M-C-AFA10
		X	O	X	11-12	N.C. Aux		140M-C, D, F	140M-C-AFA01
		O	X	O	13-14	N.O. Aux		140M-C, D, F	140M-C-AFA11
		X	O	X	21-22	N.C. Aux			
		O	X	O	13-14	N.O. Aux		140M-C, D, F	140M-C-AFA20
		O	X	O	23-24	N.O. Aux			
		X	O	X	11-12	N.C. Aux		140M-C, D, F	140M-C-AFA02
		X	O	X	21-22	N.C. Aux			
	**Right Side-Mounted Auxiliary Contact** 2-pole Adds 9 mm to the width of the device - (2) per MPCB	O	X	O	33-34	N.O. Aux		140M-C, D, F	140M-C-ASA20
		O	X	O	43-44	N.O. Aux			
		X	O	X	31-32	N.C. Aux		140M-C, D, F	140M-C-ASA02
		X	O	X	41-42	N.C. Aux			
		O	X	O	33-34	N.O. Aux		140M-C, D, F	140M-C-ASA11
		X	O	X	41-42	N.C. Aux			

* X = Contact Closed
O = Contact Open

†



‡ Accessories for 140M-H, page 2-57. Accessories for 140M-J, page 2-62.

140M-C-KN ITEM # 29

Motor Circuit Protectors/Motor Protection Circuit Breakers

Accessories, Continued

	Description		For Use With	Cat. No.
	**Anti-Tamper Shield** Provides protection against inadvertent adjustment of the current setting	10 pcs/pkg	140M-C, D, F	140M-C-CA
	**Lockable Twist Knob** For 1 padlock 4…8 mm (5/16 in.) dia. shackle Can be locked in OFF position	Black	140M-C, D, F	140M-C-KN
		Red/Yellow	140M-C/-D	140M-C-KRY
		Red/Yellow	140M-F	140M-F-KRY
	**Padlockable Operating Knob** Accepts 8 mm (5/16 in.) padlock — up to three padlocks Permits padlocking in the off position	Black	140-CMN	140-KN
		Red/Yellow		140-KRY
	**Door Coupling Handle** For 3 padlocks 4…8 mm (5/16 in.) in diameter IP66 Protection/Type 1, 12 Interlock override capability Can be modified for locking in ON position Ships with coupling — order extension shaft and legend plate separately Mounting depth (adapter-door): 140-C: 105.5 mm ± 5 mm (4.5 in. ± 3/16 in.) 140-D: 114.5 mm ± 5 mm (4.5 in. ± 3/16 in.) 140-F: 137.1 mm ± 5 mm (5.4 in. ± 3/16 in.)	Black	140M-C, D, F	140M-C-DN66
			140-CMN	140-CDN66
		Red/Yellow	140M-C, D, F	140M-C-DRY66
			140-CMN	140-CDRY66
	**Extension Shaft** Cut to required length for mounting depth (adapter-door): 140M-C: 117…338 mm (4.6 in.…13.3 in.) 140M-D: 126…347 mm (5.0 in.…13.7in.) 140M-F: 149…369 mm (5.4 in.…14.5 in.) 140-CMN: 180…403 mm (7.1 in.…15.9 in.)		140M-C-DN66, 140M-C-DRY66, 140-CDN66, 140-CDRY66	140M-C-DS
	**Legend Plate** Marking: “Haupschalter” and “Main Switch”		140-CDN66	140M-C-DFCN
	Marking: “Not-Aus” and “Emergency Off”		140-CDRY66	140M-C-DFCRY
	**Locking Tag** Padlock attachment to the lockable handles Up to three padlocks 4…8 mm (5/16 in.) shackle		140M-C-KN 140M-C-KRY 140M-F-KRY	140M-C-M3
	**IP65 Non-Metallic Enclosure** Knockouts for PG16 and PG21 fittings Suitable for flexible cable with internal ground wire or conduit when externally grounded around the outside of the enclosure	Black Handle	140M-C	198E-AYTG2
		Red/Yellow Handle	140M-C	198E-AYTJ2
	**Terminal Cover** For covering of unused Commoning Link terminals IP2X finger protection		140M-C, 140M-D	140M-C-WS
			140M-F	140M-F-WS
	**Screw Adapter** For screw arrangement of a Motor Protection Circuit Breaker	10 pcs/pkg	140M-C, D, F	140M-C-N45
	**Disconnector Module** Provides visible isolation from line side connections to the Bulletin 140M-C, -D circuit breakers. Can be removed or put in a “park” position. Padlockable with up to 2 padlocks 3...6mm (1/4”) in diameter.		140M-C, -D	140M-C-TRE

140M-C-PEC23 ITEM # 30

Motor Circuit Protectors/Motor Protection Circuit Breakers

Accessories, Continued

Description			For Use With	Cat. No.
	**ECO Connecting Modules — 25 A** Eco-starters mount on **SINGLE** DIN Rail (140M on DIN Rail) **ELECTRICAL AND MECHANICAL** interconnection of 140M MPCB and 100-M (with AC or DC coils) or 100-C (with AC coils) contactors		140M-C to 100-M	140M-C-PEM12
			140M-C to 100-C09…C23	140M-C-PEC23
			140M-D to 100-C09…C23	140M-D-PEC23
	Connecting Modules — 25 A and 45 A • Contactor and MPCB **MUST BE** mounted separately on (2) DIN Rails **ELECTRICAL** interconnection between 140M MPCB and 100-C contactors (with AC coils)		140M-C to 100-C09…C23	140M-C-PNC23
			140M-D to 100-C09…C23	140M-D-PNC23
			140M-D to 100-C30…C37	140M-D-PNC37
			140M-F to 100-C30…C37	140M-F-PNC37
			140M-F to 100-C43	140M-F-PNC43
	Coil Modules — 25 A and 45 A • For use with Bulletin 103T/107T 3-component starters		140M-C, -D to 100-C09…C23	140M-C-PSC23
			140M-D, -F to 100-C30…C43	140M-F-PSC23
	**Spacing Adapter** Required for Self-Protected combination motor controller (Type E) applications of 140M-C, -D, and -F MPCBs		140M-C, -D	140M-C-TE
			140M-F	140M-F-TE
	**Compact Busbar Feeder Block** Supply of compact busbars Increases terminal capacity	IEC terminal spacings	140M-C, -D	140M-C-WB
		UL terminal spacings		140M-C-WBE
			140M-F	140M-F-WBE
	**Compact Busbar Feeder Terminal** For supply of commoning links Top feed — overlaps commoning link		140M-C, -D	140M-C-WTE
			140M-F	140M-F-WTE
	**Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current** 45 mm spacing For use with front-mounted auxiliary contact	2 connections	140M-C, -D	140M-C-W452
		3 connections		140M-C-W453
		4 connections		140M-C-W454
		5 connections		140M-C-W455
	Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current 54 mm spacing For use with side-mounted auxiliary contact	2 connections	140M-C, -D	140M-C-W542
		3 connections		140M-C-W543
		4 connections		140M-C-W544
		5 connections		140M-C-W545
	Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current 63 mm spacing For use with side-mounted undervoltage trip and shunt trip	2 connections	140M-C, -D	140M-C-W632
		3 connections		140M-C-W633
		4 connections		140M-C-W634
		5 connections		140M-C-W635
	**Jumper for 140M-D to 140M-C** Accommodates difference in depth from 140M-D to 140M-C Can be used with all other commoning links 54 mm spacing	2 connections	140M-D to 140M-C	140M-C-WD542
	**Three-Phase Compact Busbar for 45 A Motor Protection Circuit Breakers — 115 A Max Continuous Current** 54 mm spacing For use with front-mounted auxiliary contact	2 connections	140M-F	140M-F-W542
		3 connections		140M-F-W543
		4 connections		140M-F-W544
	Three-Phase Compact Busbar for 45 A Motor Protection Circuit Breakers — 115 A Max Continuous Current 63 mm spacing For use with side-mounted auxiliary contact	2 connections	140M-F	140M-F-W632
		3 connections		140M-F-W633
		4 connections		140M-F-W634
	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10 pcs/kg	140M-D 140M-F	199-DR1
	**DIN (#3) Symmetrical Rail** 35 mm x 15 mm x 1 m long Top Hat Rail (DIN #3 Symmetrical Rail)	5 pcs/kg	140M-C 140M-D 140M-F 140-CMN	1492-DR9

440E-L13141
440E-A13083

ITEM # 76 & 78

Emergency Stop Devices

Cable (Rope) Pull Switches

Lifeline Rope Tensioner System (LRTS)

Description

The LRTS is a unique cable (rope) tensioning system which enables quicker installation of cable actuated systems. Other methods are traditionally time consuming and sometimes awkward to fit. Features of the system include:

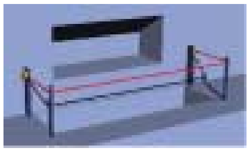
1. Cable adjustment up to 300mm (11.8in) (150mm (5.9in) either side of tensioner)
2. Quick thread and grip of cable with cable grip
3. Cable tidy incorporated into the cable grips
4. Simple tensioning via the setting bolt with allen key.

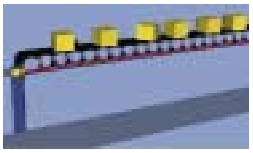
Due to the appeal of quick installation and universal use, the LRTS can also be used for applications other than cable actuated emergency stop systems.

Features

- Unique cable grip system
- Can be installed and commissioned in approximately 3 minutes
- Ease of installation, no specialist tools required
- Up to 300mm (11.8in) of cable adjustment
- Cable tidy incorporated into cable grips

Typical Applications





Specifications

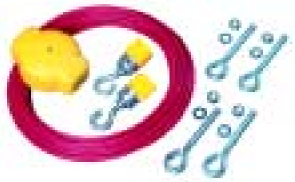
Material	
Tensioner	Glass filled nylon
Cable gripper	Acetal, aluminium alloy, stainless steel
Cable gripper gears	Stainless steel
Cable	Cable to BS 302:1987, wire Ø4.0
P. Bolt	Stainless steel
Colour	
Tensioner	Yellow
Cable gripper	Yellow/natural
Cable	Red
P. Bolt	Natural
Weight	
Tensioner	140g (0.31lb)
Cable gripper	80g (0.17lb)
Operating Temperature	-25°C to +80°C (13°F to 176°F)
Cable Diameter	4mm (0.15in)
Max. Cable Adjustment	300mm (11.8in)
Tensioner Holding Force	500N (112.5lb) max.
Gripper Holding Force	280N (63.0lb) max.
Protection	IP 30
Tensioner Adjustment	5mm A/F Allen key

Four Steps to Install

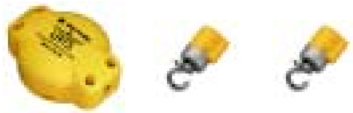
Cable (Rope) Pull Switches

Lifeline Rope Tensioner System (LRTS)

Product Selection

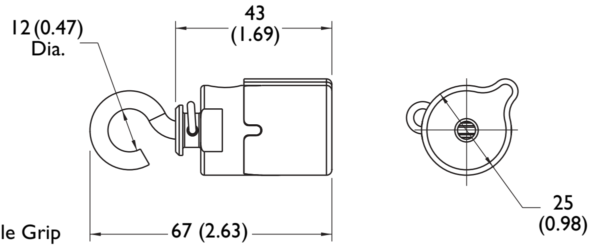
Description		Catalogue Number
	Installation kit—5m	**440E-A13079**
	Installation kit—10m	**440E-A13080**
	Installation kit—15m	**440E-A13081**
	Installation kit—20m	**440E-A13082**
	Installation kit—30m	**440E-A13083**
	Installation kit—50m	**440E-A13084**
	Installation kit—75m	**440E-A13085**

Accessories

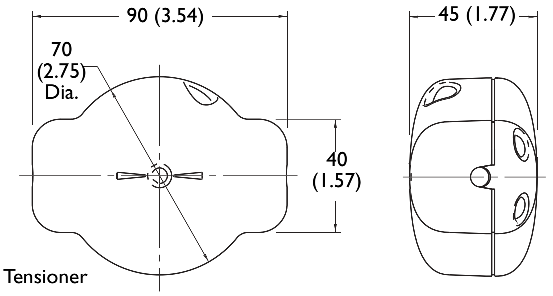
Description		Catalogue Number
	Tensioner and Allen wrench only	**440E-A17105**
	Gripper 2 pack	**440E-A17107**
	Gripper 20 pack	**440E-A17106**
	Tensioner, 2 Grippers and Allen wrench	**440E-A17112**
	2 Tensioners, 2 Grippers and Allen wrench	**440E-A17140**
Red Cable	15m	**440E-A17026**
	30m	**440E-A17027**
	100m	**440E-A17028**
	125m	**440E-A17129**
	300m	**440E-A17095**
	500m	**440E-A17032**

Approximate Dimensions—mm (inches)

Dimensions are not intended to be used for installation purposes.



Cable Grip



Tensioner

Cable (Rope) Pull Switches

Lifeline 4

Description

The Lifeline 4 cable/push button operated system can be installed along or around awkward machinery such as conveyors and provide a constant emergency stop access.

The Lifeline 4 is the only device of its kind to incorporate the following features in one unit making it the most versatile cable switch on the market.

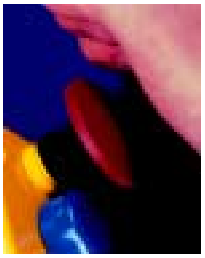
1. The positive mode mechanism ensures that the contacts are immediately latched open on actuation and can only be reset by the intentional action of turning the blue reset knob. The design also protects against nuisance tripping and the effects of thermal expansion.
2. A mushroom head emergency stop button is included on the unit to provide E-Stop access even at the extreme ends of the span.
3. The cable status indicator makes the system easy to set up and maintain for spans up to 125 meters.
4. Four sets of contacts are provided: 2 N.C. + 2 N.O., 3 N.C. + 1 N.O., or 4 N.C. contacts.
5. Sealed to IP 66 with rugged construction using die cast alloy and stainless steel to withstand harsh conditions.

Features

- Switches up to 125 meter span
- Universal mounting and operation
- Lid mounted emergency stop button, designed to conform to EN418
- Switch lockout on cable pulled and cable slack
- Cable status indicator on switch lid

Lid mounted E-Stop button

A mushroom head emergency stop button is included on the unit to provide total E-Stop access even at the extreme ends of the span.



Cable status indicator on lid

The cable status indicator makes the system easy to setup and maintain for spans up to 125 meters.

Specifications

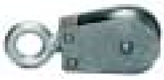
Standards	EN60947-5-5, ISO13850, ISOTR 12100, IEC 60947-5-1, EN 418
Approvals	CE marked for all applicable directive, cULus and BG
Safety Contact	2 N.C. or 3 N.C. or 4 N.C. direct opening action
Designation/Utilization Cat.	
A600/AC-15 (Ue)	600V 500V 240V 120V
(Ie)	1.2A 1.4A 3A 6A
N600/DC-13 (Ue)	600V 500V 250V 125V
(Ie)	0.4A 0.55A 1.1A 2.2A
Thermal Current (Ith)	10A
Minimum Current	5V 5mA
Safety Contact Gap	>2 x 2mm (0.078in)
Rtd. Insulation Voltage	(Ui) 500V
Rtd. Impulse withstand Voltage	(Uimp) 2500V
Pollution Degree	3
Max. Actuation Frequency	1 Cycle per sec
Case Material	Heavy duty die cast alloy
Eye Nut Material	Stainless Steel
Emergency Stop & Indicator Material	Acetal
Protection	IP66
Conduit Entry	3 x M20, 3 x 1/2in NPT, quick-disconnect style
Operating Temperature	-25°C to 80°C (-13°F to 176°F)
Operation Force	<125N (300mm deflection; 28.1lb deflection)
Max Cable Span Between Switches	75m (246ft) standard model 75m to 125m extended length model
Fixing	4 x M5
Mounting	Any position
Mechanical Life	1,000,000
Weight	630g (1.38lb)
Colour	Yellow body, Red E-Stop button, Blue reset button

Important: It is recommended that the LRTS (Lifeline Rope Tensioning System) should be used with the Lifeline 4 cable rope switch.

Product Selection

Cable Span	Safety Contacts	Auxiliary Contacts	Catalogue Number		
			1/2in NPT Conduit	M20 Conduit	Quick Disconnect
Up to 75m	2 N.C.	2 N.O.	**440E-L13133**	**440E-L13137**	**440E-L13140**
	3 N.C.	1 N.O.	**440E-L13043**	**440E-L13042**	**440E-L13141**
	4 N.C.	—	**440E-L13135**	**440E-L13139**	**440E-L13142**
75 to 125m	2 N.C.	2 N.O.	**440E-L13155**	**440E-L13153**	**440E-L13163**
	3 N.C.	1 N.O.	**440E-L13152**	**440E-L13150**	**440E-L13164**
	4 N.C.	—	**440E-L13149**	**440E-L13147**	**440E-L13165**
	Recommended Standard Cable Connector/Cordset (2m (6.5ft) (see page 15-13).				**889M-F12X9AE-2**

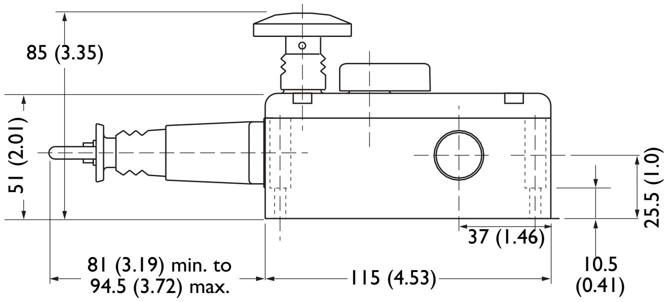
Accessories

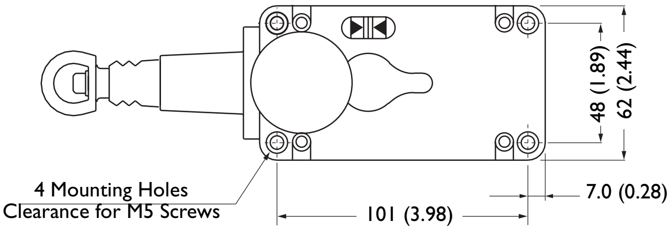
Description		Catalogue Number
	P. Bolt complete M8 x 1.25 Thread Size 58mm (2.28in) Threaded Length 12mm (0.47in) Dia. Eye 95mm (3.74in) Overall Length	**440E-A17003**
	Tensioner spring 19mm (0.75in) Diameter 210mm (8.27in) Overall Length 50N Force	**440E-A13078**
	Replacement cover	**440E-A13054**
	Replacement cover no E-Stop	**440E-A17115**
	Inside corner pulley	**440A-A17101**
	Outside corner pulley	**440A-A17102**
	Mounting Bracket	**440E-A17130**

Approximate Dimensions—mm (inches)

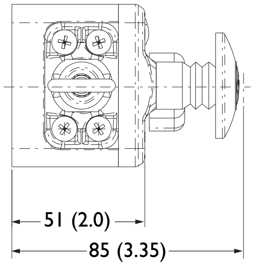
Dimensions are not intended to be used for installation purposes.

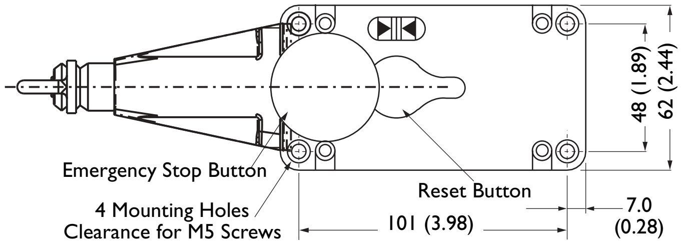
Standard Model

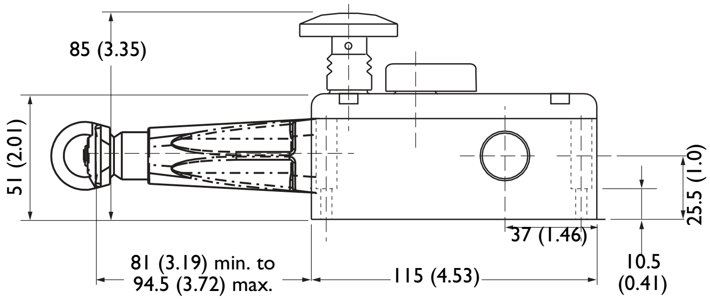




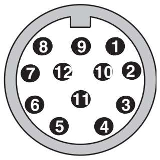
Extended Length Models (75 to 125m cable span)







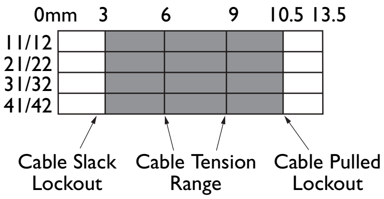
Typical Wiring Diagrams

Connector Pinout		4 N.C.		3 N.C. + 1 N.O.		2 N.C. + 2 N.O.	
		Terminal	Contact	Terminal	Contact	Terminal	Contact
	1	11	N.C.	11	N.C.	11	N.C.
	3	12		12		12	
	4	21	N.C.	21	N.C.	21	N.C.
	6	22		22		22	
	7	31	N.C.	31	N.C.	33	N.O.
	8	32		32		34	
	9	41	N.C.	43	N.O.	43	N.O.
	10	42		44		44	
	12	Ground					

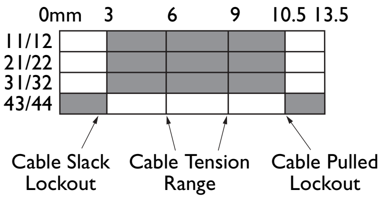
Contact Action

☐ Contact Open ▨ Contact Closed

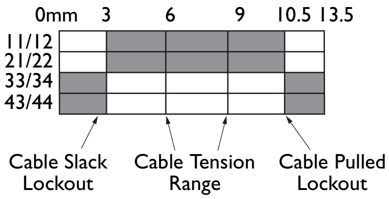
4 N.C. style



3 N.C. + 1 N.O. style

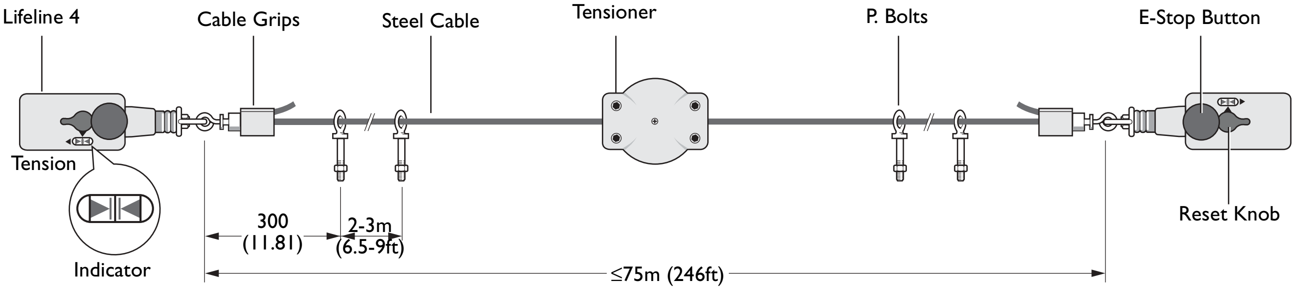


2 N.C. + 2 N.O. style

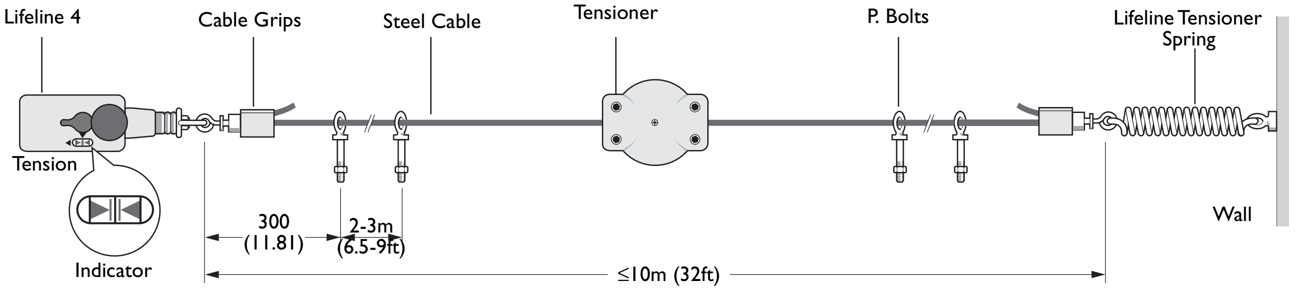


Application Detail—mm (inches)

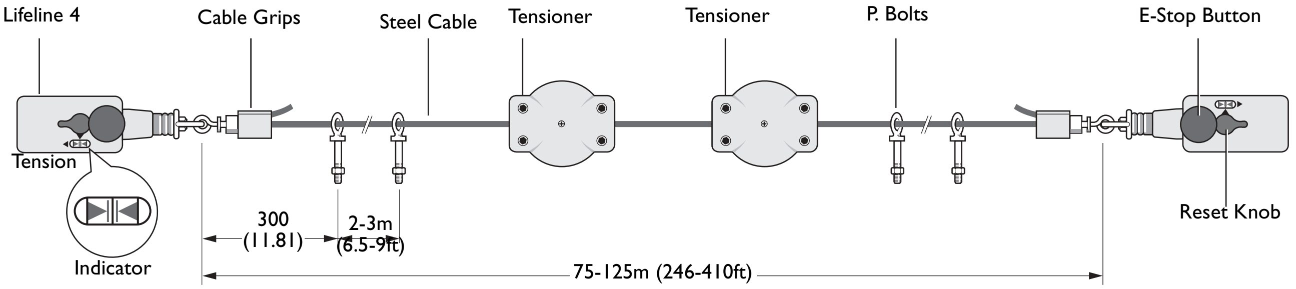
Mounting Specifications



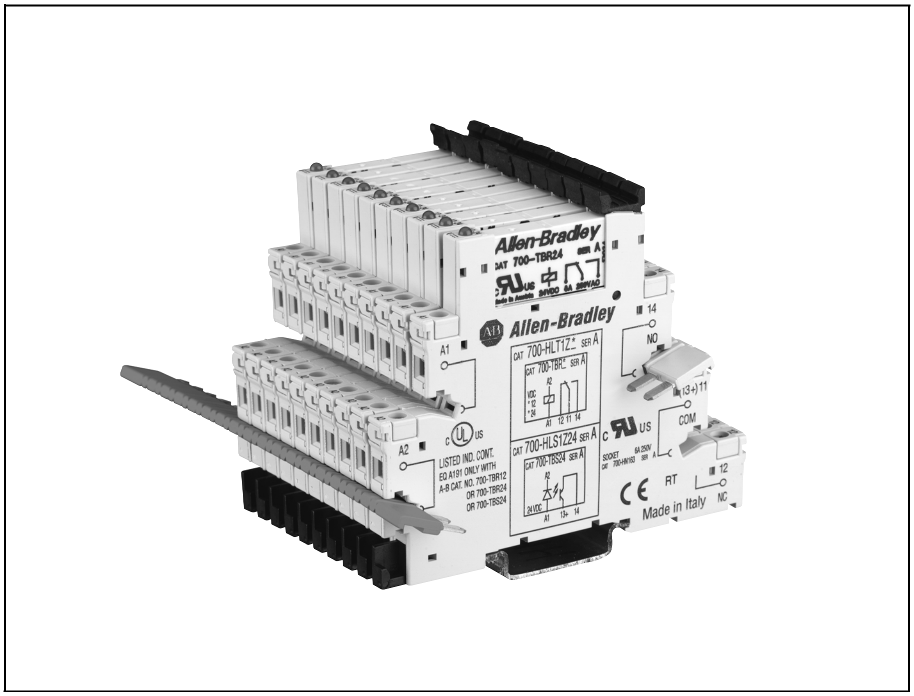
Mounting Specifications with Spring Tensioner



Mounting Specifications for Extended Length Models



700-HLT1Z24 | ITEM # 49



Bulletin 700-HL

- **Relay and Socket Assembled Interface**
- **SPDT – 6 A Output**
- **1 N.O. SSR Output**
- **Externally Replaceable Relay**
- **Built-in Retainer Clip**
- **Standard LED**
- **Ideal for PLC and Drives Applications**

TABLE OF CONTENTS

Description

The Bulletin 700-HL General Purpose Interface Relays feature a fully assembled relay (electro-mechanical or solid-state) and socket. The SPDT version is capable of 6 A per pole. The 1 N.O. solid-state relay has a 2 A rating. The SPDT relay feature AgSnO contacts. All 700-HL assembled devices are UL listed. Coils are available in a variety of AC and DC voltages.

Your order must include:

- Cat. No. of the assembled relay.
- If required, Cat. No. of any accessories.

Conformity to Standards:

EN60947-4-1
EN60947-5-1
IEC 947
CSA 22.2
UL 508
NEMA IEE MAC Compliant
ICS-2 Compliant

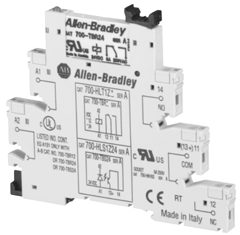
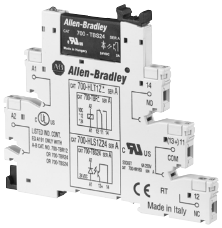
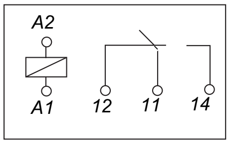
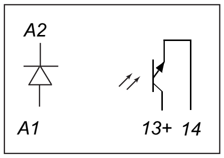
Approvals:

cURus Recognized, File E3125
Guide NLDX 2
cULus Listed, with Allen-Bradley socket
CE Marked (per EU Low Voltage
Directive 73/23 EEC 93/68 EEC)
ABS (American Bureau of Shipping)

Bulletin 700-HL

Interposing/Isolation Relays

Product Selection

Standard built-in Features: • LED • Reverse Polarity Protection for DC Inputs • Surge Protection	 *Cat. No. 700-HLT1Z24*			 *Cat. No. 700-HLS1Z24*		
Specifications				 ❶		
Output Type	SPDT (1 C/O); I_{th} = 6A			1 N.O. solid-state; I_{th} = 2 A		
Recommended Tightening Torque	0.5 Nm max. (4.4 lb.–in.)			0.5 Nm max (4.4 lb.–in.)		
Wire Range	0.14 mm^2…2.5 mm^2 (#26…#14 AWG)			0.14 mm^2…2.5 mm^2 (#26…#14 AWG)		
Approvals	cULus, cURus, ABS, CE			cULus, cURus, ABS, CE		
Assembled Devices	Cat. No.	Pkg Qty.	Factory-stocked Item	Cat. No.	Pkg Qty.	Factory-stocked Item
Input Voltages:						
12V DC	700-HLT1Z12 ❷	10	✔	—	–	
24V DC	➡ 700-HLT1Z24 ❷	10	✔	700-HLS1Z24 ❷	10	✔
48V DC	700-HLT12Z48 ❷	10		700-HLS1Z48 ❷	10	
12V AC/DC	700-HLT1U12	10		—	—	
24V AC/DC	700-HLT1U24	10	✔	—	10	
48V AC/DC	700-HLT1U48	10		—	10	
110/125V AC/DC	700-HLT1U1	10	✔	700-HLS1U1 ❷	10	✔
220-240V AC/DC	700-HLT1U2	10	✔	700-HLS1U2 ❷	10	
Built-in LCSC (leakage current suppression circuit) 120V AC and 125V DC	700-HLT1L1 ❷ (Available in November 2001)	10		700-HLS1L1 ❷ (Available in November 2001)	10	
Built-in LCSC (leakage current suppression circuit) 240V AC	700-HLT1L2 ❷ (Available in November 2001)	10		700-HLS1L2 ❷ (Available in November 2001)	10	

❶ Reverse polarity on the output terminals of the solid-state relay will result in the output being "ON" regardless of the state of the input voltage.

❷ Electromechanical relay to solid-state relay interchangeability possible.

Interposing/Isolation Relays

Specifications ❶

Cat. No. 700-HLT… (Relay Output)			
Electrical Ratings			
Rated Thermal Current (I_{th})	1-Pole — 6 A		
Rated Insulation Voltage (U_i)	250V IEC, 300V UL/CSA		
Contacts	Inductive	1-Pole	
	24V AC, 1-phase	30 A ►][◄	5 A ◄][►
	120V AC, 1-phase	30 A	3 A
	240V AC, 1-phase	15 A	1.5 A
	Make, Break, & Continuous V DC	24V DC	1.0 A
		120V DC	0.2 A
		240V DC	0.1 A
Min. Permissible Contact Ratings	12V, 6 mA (72 mW)		
Permissible Coil Voltage Variation	85…110% of Nominal Voltage at 50 Hz		
	85…110% of Nominal Voltage at 60 Hz		
	80…110% of Nominal Voltage at DC		
Power Consumption ±10%	AC	0.3 VA	
	DC	0.2 W	
Design Specification/Test Requirements			
Dielectric Withstand Voltage	Pole to Pole (VRMS)	1500 VA	
	Contact to Coil (VRMS)	4000 VA	
Mechanical			
Degree of Protection	IP20		
Mechanical Life Operations	1 x 10^7		
Switching Frequency Operations (no-load)	10 cycles/sec		
Coil Voltages	See Product Selection		
Operating Time at Nominal Voltage at 20°C (ms)	Pickup	7 ms	
	Dropout	3 ms	
Maximum Operating Rate (full load = 6 A)	6 cycles/min.		
Environmental			
Temperature	Operating	–40…+55°C	
	Storage	-40…100°C	
Altitude	2000 m (6560 ft)		
Construction			
Insulating Material	Molded High Dielectric Material		
Enclosure	Relay IP67		
Contact Material	Silver Cad. Ox., AgSnO		
Terminal Markings on Socket	In accordance with EN50 0005		
Certifications	cULus, cURus, ABS, CE		

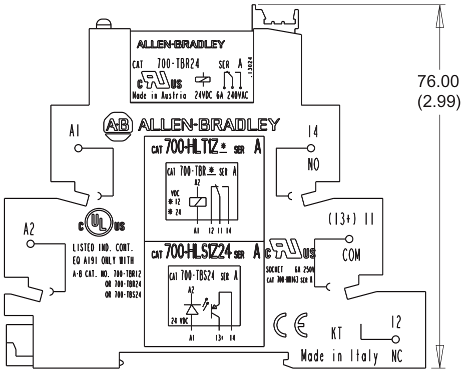
❶ Performance Data – See page Important-2, publication A113.

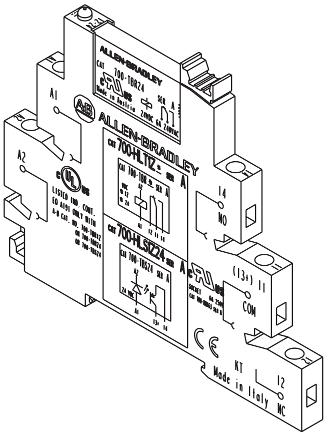
Bulletin 700-HL

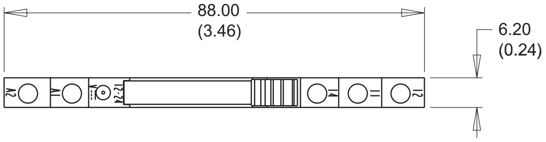
Interposing/Isolation Relays

Approximate Dimensions

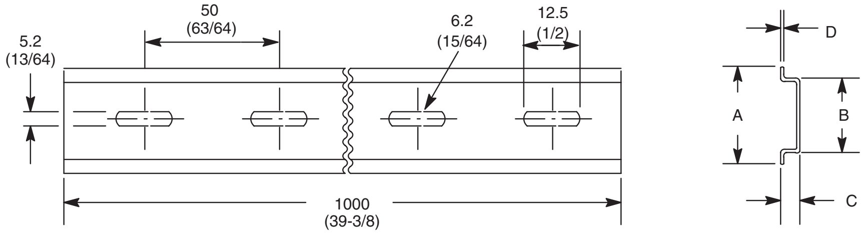
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.







Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.



Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes

Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lbs.) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lbs.) (5/pkg)

700S-CF620DC ITEM # 47

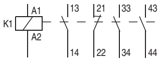
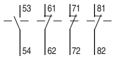
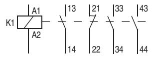
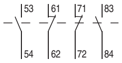
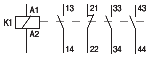
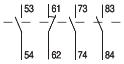
Bulletin 700S-CF

- IEC Industrial Safety Relay
- Positively Guided/Mechanically Linked Contacts as Per IEC 947-5-1 Annex L
- Third Party Certification By SUVA
- Red Cover and Mechanically Linked Contact Symbol on Front Face

Table Of Contents

Type CF Safety Control Relays — 8-Pole AC Voltage

~

AC-1			AC-11 and AC-15							Connection Diagrams		Contacts		Catalog Number ❶
I_e [A]			I_e [A]							Main Contacts	Auxiliary Contacts			
	40°C	60°C	24/48V	120V	240V	400V	500V	600V	690V			N.O.	N.C.	
Main Contacts	25	20	16	14	10	5	2.5	1.8	1			4	4	700S-CF440⊗C
												5	3	700S-CF530⊗C
Adder Deck Contacts	10	6	6	6	3	2	2	1.2	0.7			6	2	700S-CF620⊗C

❶ All Cat. Nos. are factory-stocked.

⊗ AC Voltage Suffix Code

Voltage	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230
50 Hz	R	K	V	W	X	Y	KP	–	D	P	S	KG	–	–	–	F
60 Hz	Q	J	–	V	–	X	–	KP	–	D	–	–	KG	H	L	–
50/60 Hz	–	KJ	–	–	–	KY	KP	–	KD	[illegible]	–	KG	–	–	–	–

Voltage	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
50 Hz	–	VA	T	–	–	–	N	–	G	B	–	M	C	–
60 Hz	–	–	A	T	I	E	–	–	–	N	B	–	–	C
50/60 Hz	KF	–	KA	–	–	–	–	KN	–	KB	–	–	–	–

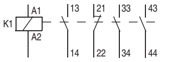
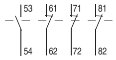
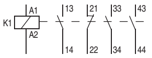
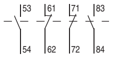
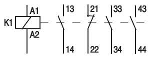
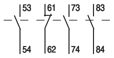
❶ All Cat. Nos. are factory-stocked.
❷ See page 198 for coil voltage selection information.

Industrial Relays

Product Selection, Continued

Ordering Details

Type CF Control Relays — 8-Pole DC Voltage

DC-1		DC-11 and DC-15							Connection Diagrams		Contacts		Catalog Number ❶ ❷
I_e [A]		I_e [A]							Main Contacts	Auxiliary Contacts			
40°C	60°C	24/48V	120V	240V	400V	500V	600V	690V			N.O.	N.C.	
25	20	16	14	10	5	2.5	1.8	1			4	4	**700S-CF440Z⊗C**
											5	3	**700S-CF530Z⊗C**
											6	2	**700S-CF620Z⊗C**

❶ All Cat. Nos. are factory-stocked.
❷ See page 198 for coil voltage selection information.

⊗ DC Voltage Suffix Code ❸

Voltage	9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Standard	**R**	**Q**	**J**	**W**	**Y**	**Z**	**B**	**G**	**E**	**D**	**P**	**S**	**A**	**F**	**T**
With diode suppressor å	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—

❸ When ordering **DJ** coil with built-in surge suppression, remove **Z** from the Cat. No. Example: Cat. No. 700S-CF440Z⊗C becomes Catalog Number 700S-CF440DJC

Accessories

Safety Control Relays with	mm.	(inches)
Auxiliary contact block for side mounting 1- or 2-pole	a + 9	(a + 23/64)
Electronic Timing Module on coil terminal side	b + 24	(b + 15/16)
Mechanical Interlock on side of contactor	a + 9	(a + 23/64)
Interface Module on coil terminal side	b + 9	(b + 23/64)
Surge Suppressor on coil terminal side	b + 3	(b + 1/8)
Labeling with label sheet marking tag sheet with clear cover marking tag adapter for System Bul. 1492W	+ 0 + 0 + 5.5	(+ 0) (+ 0) (+ 7/32)

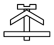
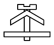
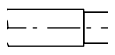
General

		Main Relay Cat. No. 700S-CF ❸	Front Adder Deck Contacts	Side-mounted Contacts
Contact Ratings — NEMA		A600, P600	A600, Q600	
Min. Contact Rating	Standard	20V, 10 mA		
	Gold	12V, 8 mA		
Contact Ratings — IEC AC-15 (solenoids, contactors) at rated voltage IEC 947, EN 60947	24V	16 A	6 A	6 A
	48V	16 A	6 A	6 A
	120V	14 A	6 A	6 A
	240V	10 A	5 A	3 A
	400V	5 A	3 A	2 A
	480V/500V	2.5 A	1.6 A	2 A
	600V	1.8 A	1.2 A	1.2 A
	690V	1 A	1.0 A	0.7 A
AC-12 (Control of resistive loads) IEC 60947	**40°C** I_{th}	25 A	10 A	
	230 V	10 kW	6 A	
	400 V	17 kW		
	690 V	30 kW		
	60°C I_{th}	20 A		
	230V	8 kW		
	400V	14 kW		
	690V	24 kW		
DC-12 Switching DC Loads				
L/R < 1ms, Resistive Loads IEC 60947	24V	12 A	12 A	
	48V	9 A	9 A	
	110V	3.5 A	3.5 A	
	220V	0.55 A	0.55 A	
	440V	0.2 A	0.2 A	
DC-13 IEC 60947, Solenoids and contactors	24V	5 A	5 A	3 A
	48V	2 A	2 A	1.5 A
	125V	0.7 A	0.7 A	0.6 A
	220V	0.25 A	0.25 A	0.3 A
	440V	0.12 A	0.12 A	0.2 A
	660V	0.14 A	0.1 A	0.1 A
		Yes	Yes ❶	

	Location of welded N.O. contacts	State of N.C. Contacts if N.O. contact welds			
		Main	Front aux.	Left side aux.	Right side aux.
Positively Guided Contacts ❷	Main	Open	Open ❶	Open	Open
	Front aux.	Open	Open ❶	Open	Open
	Left side aux.	Open	Open ❶	Open	Open
	Right side aux.	Open	Open ❶	Open	Open

❶ If the accessory is a pneumatic timer or latch, there is no positive guidance; the accessory contacts are independent.

❷ Defined in IEC 947-5-1 annex L. Positive guidance is a relationship between contacts of opposite types (i.e., N.O. and N.C.).

			Cat. No. 700S-CF	Aux./Pneumatic Timer Contact (Front-mounted)
Mechanical Life		[Mil]	15	15
Electrical Life	AC-15 (240V, 3 A)	[Mil]	1.5	1.5
Weight	AC Op. Mechanism	[g]	390	—
Terminal Cross-Sections				
Terminal Type				
Terminal Size per IEC 947-1			2 x A4	2 x A4
 Solid/Stranded ❸	1 Conductor	[mm²]	1.5…6	0.5…2.5
	2 Conductor	[mm²]	1.5…6	0.75…2.5
Max. Wire Size per UL/CSA		[AWG]	16…10	18…14
Tightening Torque		[lb.-in.]	8.9…22	8.9…13.3
Tightening Torque		[N•m]	1…2.5	1…1.5

❸ For 16 or more strands, end ferrule is required

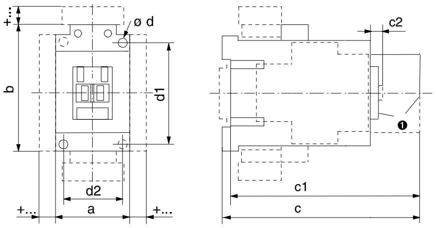
DC Switching Ratings for 700S-CF Main Poles in Series (Resistive Load at 60° C)

	1 pole	2 poles	3 poles
24/48 V	25/20 A	25 A	25 A
125 V	6 A	25 A	25 A
220 V	1.5 A	8 A	25 A
440 V	0.4 A	1 A	3 A

Industrial Relays

Approximate Dimensions

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended for manufacturing purposes.



AC Safety Control Relays

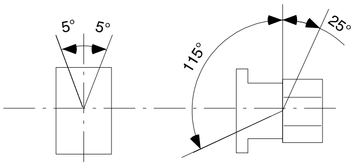
a	b	c	c1	c2	Ød	d1	d2	Cat. No.
45 (1-25/32)	81 (3-3/16)	119.5 (4-3/4)	114.5 (4-43/64)	6 (1/4)	2 - 4.5 (2 - 3/16)	60 (2-23/64)	35 (1-25/64)	**700S-CF**

DC Safety Control Relays

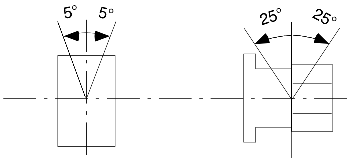
a	b	c	c1	c2	Ød	d1	d2	Cat. No.
45 (1-25/32)	81 (3-3/16)	145.5 (5-49/64)	140.5 (5-37/64)	6 (1/4)	2 - 4.5 (2 -3/16)	60 (2-23/64)	35 (1-25/64)	**700S-CF**

Mounting Positions

Mounting Position



AC Safety Control Relays



DC Safety Control Relays

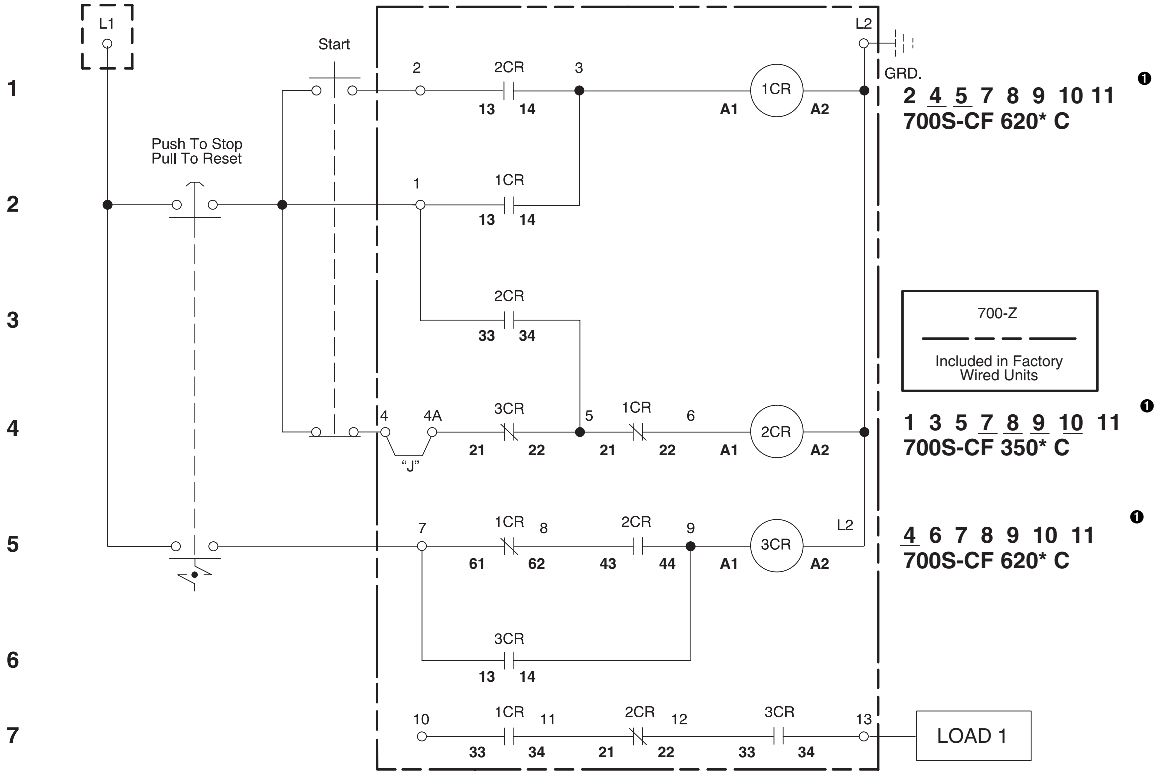
Safety Relay Circuit With 5 Safety Outputs

- Use for E-stop control. E-stop will work properly if any one fault occurs (a fault could be one welded contact or one undesired open connection such as a loose wire).
- High output switching capability and long contact life.
- Circuit complies with EN 954 categories 1, 2, 3, 4
- Prevents restart of the 5 safety outputs if there is a single fault anywhere in the system.

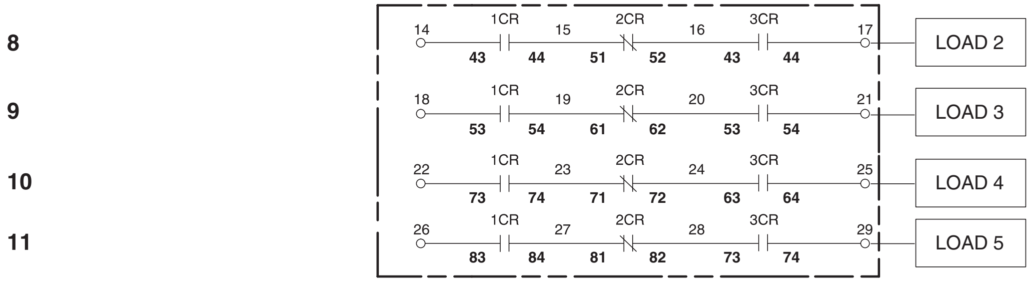
Use (3) 700S-CF relays and this diagram to construct the circuit, or contact your local Allen Bradley sales office for pre-assembled module

Basic Circuit

(1) Output Circuit (3 Relays, 9 Terminal Blocks)



(5) Output Circuit (3 Relays, 17 Terminal Blocks)



❶ Numbers shown are the line numbers where the contacts for this relay appear.

800H-FRXTQH24RA1 ITEM # 51

30.5 mm Push Buttons

Type 4/4X/13, Corrosion-Resistant/Watertight/Oiltight

2-Position Push-Pull/Twist Release Units, Illuminated

Illuminated 2-Position Push-Pull/Twist
Cat. No. 800H-FRXTP16RA1

Type	Lamp	Volts	Color	Operator Position			Push-Pull/ Twist Release
					Maintained	Maintained	
				Contacts	Out	In	Cat. No.
Full Voltage	Incandescent	120 AC/DC	Red	N.O. - N.C.L.B. ❶	O X	X O	800H-FRXTQ10RA1 ❷
		24 AC/DC					800H-FRXTQ24RA1 ❷
	LED	120 AC/DC					800H-FRXTQH10RA1 ❷
		24 AC/DC					800H-FRXTQH24RA1 ❷
Transformer	Incandescent	120 AC	Red	N.O. - N.C.L.B. ❶	O X	O X O	800H-FRXTP16RA1 ❷
		240 AC					800H-FRXTP26RA1 ❷
	LED	120 AC					800H-FRXTPH16RA1 ❷
		240 AC					800H-FRXTPH26RA1 ❷

Note: X=Closed/O=Open

3-Position Push-Pull Units, Illuminated

Illuminated 3-Position Push-Pull
Cat. No. 800H-FRXMP16A7

Operator Position				Operator Position			
Momentary	Maintained		Maintained	Momentary	Maintained		Momentary
Contacts	Out	Center	In	Contacts	Out	Center	In
N.C. - N.C.L.B. ❶	X X	O X	O O	N.C. - N.C.L.B. ❶	X X	O X	O O

Type	Lamp	Volts	Color	Push-Pull	Push-Pull
				Cat. No.	Cat. No.
Full Voltage	Incandescent	120 AC/DC	Red	800H-FRXMQ10RA7	800H-FRXNQ10RA7
		24 AC/DC		800H-FRXMQ24RA7	800H-FRXNQ24RA7
	LED	120 AC/DC		800H-FRXMQH10RA7	800H-FRXNQH10RA7
		24 AC/DC		800H-FRXMQH24RA7	800H-FRXNQH24RA7
Transformer	Incandescent	120 AC	Red	800H-FRXMP16RA7	800H-FRXNP16RA7
	LED			800H-FRXMPH16RA7	800H-FRXNPH16RA7

Note: X=Closed/O=Open

❶ Normally closed late break contact. When button is pushed from the OUT to IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.

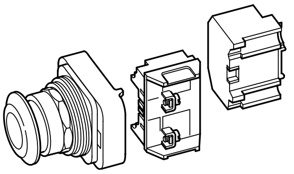
❷ Meets EN-418 and IEC 60947-5-5 standards for emergency stop applications.

Accessories — Page 10-85
Lamp Information — Page 10-95

Legend Plates — Page 10-96
Approximate Dimensions — Page 10-99

2-Position Push-Pull/Twist Release and 3-Position Push-Pull Units, Illuminated

800H		– FRX	M	PH	16	R	A1
	a	*b*	*c*	*d*	*e*	*f*	*g*



a

Finger-Safe Guards	
Code	**Description**
Blank	No Guards
C	Guards on Terminals

b

Head Type	
Code	**Description**
FRX	Mushroom Head
FRXJ	Jumbo Mushroom Head

c

Operator Function			
2-Position ❶			
Code	**Description**		
T	Push-Pull/Twist		
3-Position			
Code	**Operator Position**		
	Out	**Ctr.**	**In**
M	★	‡	‡
N	★	‡	★
★ Momentary			‡Maintained

d

Illumination Options	
Transformer	
Code	**Description**
P	Incandescent
PF	Flashing Incandescent ❷
PH	LED ❸

d (cont'd)

Illumination Options	
Full Voltage	
Code	**Description**
Q	Incandescent
QF	Flashing Incandescent ❷
QH	LED ❸
Resistor	
Code	**Description**
Q	Incandescent
Neon	
Code	**Description**
R	Neon ❹
Dual Input	
Code	**Description**
D	Diode Type ❺
DH	Diode Type LED ❸❺
DT	Transformer — Relay Type
DTH	Transformer — Relay Type LED ❸

e

Voltage	
Transformer	
Code	**Description**
36	48V AC 50/60 Hz
16	120V AC 50/60 Hz
26	240V AC 50/60 Hz
76	277V AC 50/60 Hz
46	480V AC 50/60 Hz
56	600V AC 50/60 Hz

e (cont'd)

Voltage	
Full Voltage	
Code	**Description**
06	6V AC/DC
12	12V AC/DC
24	24V AC/DC
32	32V AC/DC ❻
48	48V AC/DC
10	120V AC/DC ❼
13	130V AC/DC ❻
20	240V AC/DC ❻
Resistor	
Code	**Description**
11	120V AC/DC Resistor
Neon	
Code	**Description**
10	120V AC/DC
20	240V AC/DC
Dual Input	
Code	**Description**
16	120V AC
24	24V AC/DC ❽

f

Color Cap	
Code	**Color**
X	No Cap ❾
A	Amber
B	Blue
C	Clear
G	Green
R	Red
W	White

g

Contact Blocks	
Code	**Description**
Blank	No Contacts on operator
Standard	
D1	1 N.O.
D2	1 N.C.
D4	1 N.C.L.B.
A	1 N.O. - 1 N.C.
A1	1 N.O. - 1 N.C.L.B.
A2	2 N.O.
A5	2 N.C.L.B.
A7	1 N.C. - 1 N.C.L.B.
Pen*TUFF* (Low Voltage)	
D1V	1 N.O.
D2V	1 N.C.
D4V	1 N.C.L.B.
AV	1 N.O. - 1 N.C.
Class I, Div. 2/Zone 2	
Logic Reed	
D1R	1 N.O.
D2R	1 N.C.
AR	1 N.O. - 1 N.C.
A2R	2 N.O.
A4R	2 N.C.
Sealed Switch	
D1P	1 N.O.
D2P	1 N.C.
AP	1 N.O. - 1 N.C.
Stackable Sealed Switch	
D1Y	1 N.O.
D2Y	1 N.C.
A2Y	2 N.O.
A4Y	2 N.C.
AY	1 N.O. - 1 N.C.
Note: See Table 1 for Target description.	

Table 1. Target Selection

2-Position			**Contact Description**	**3-Position**			
g Code	**Out**	**In**		**Out**	**Ctr.**	**In**	**g Code**
D1_	O	X	N.O.	—	—	—	—
D4_	X	O	N.C.L.B.	—	—	—	—
A/AV/AR/AP/AY	O X	X O	N.O. N.C.	O X	O O	X O	A/AV/AR/AP/AY
A1	O X	X O	N.O. N.C.L.B.	O X	O X	X O	A1
A2_	O O	X X	N.O. N.O.	O O	O O	X X	A2_
A5	X X	O O	N.C.L.B N.C.L.B	X X	X X	O O	A5
A4_	X X	O O	N.C. N.C.	— —	— —	— —	—
—	— —	— —	N.C. N.C.L.B.	X X	O X	O O	A7

Note: X=Closed/O=Open

❶ 2-position push-pull and push-pull/twist-to-release devices with N.C.L.B. contacts meet EN-418 and IEC 60947-5-5 standards for emergency stop applications.

❷ Flashing lamps are only available for 6V full voltage units and all Transformer units.

❸ LEDs available in red, green, amber, blue, and white. White LEDs only available in 6V and 24V full voltage and all transformer units. LED color must match lens color, except clear lens supplied with white LED and white lens supplied with amber LED. All LEDs except 120V have an internal shunt resistor for use with solid-state outputs.

❹ Neon is available in amber or clear.

❺ Diode type dual input provides circuit isolation via opposing diodes. Not recommended for use with solid-state outputs and neon indicators.

❻ 32V and 130V are LED only. 240V is incandescent only.

❼ 120V LED is AC only and does not contain internal shunt resistor. For AC/DC and internal shunt resistor, order 130V AC/DC LED (code 13).

❽ Dual input diode only.

❾ Not valid with head type **J**.

800T-N209RE1 ITEM # 52

General Accessories, Continued

Miscellaneous

Photo	Description	Cat. No.
 *Mounting Ring Wrench* *Cat. No. 800T-N245*	**Mounting Ring Wrench** This wrench will simplify tightening or loosening the octagonal mounting ring used on Bulletin 800T units. This wrench is double ended and can be used for 18 mm and 30 mm pilot light mounting rings.	800T-N245
 *E-Stop Jumbo Push-Pull Cap* *Cat. No. 800T-N209RE1*	**Jumbo Push-Pull Cap** For use on Bulletin 800T or 800H push-pull operators. Fits on illuminated and non-illuminated devices.	800T-N209RE1
 *Bonding Bracket Kit* *Cat. No. 800T-N300*	**Bonding Bracket** The bonding bracket establishes an electrical circuit between the mounting surface and metal operator bushing for grounding purposes; recommended for installations which require CSA approval. Necessary mounting hardware is included. Order 800T-N300 for back-of-panel bracket. Order 800T-N300F for front-of-panel bracket.	800T-N300 800T-N300F
 *Lamp Removal Tool* *Cat. No. 800E-ALR1*	**Lamp Removal Tool** This tool is used for installing or replacing bayonet base type lamps, including LEDs.	800E-ALR1

871TM 3-Wire DC Extended Sensing

Stainless Steel Face/Threaded Stainless Steel Barrel

871TM DC Micro
Quick-Disconnect Style
12mm

871TM DC Micro
Quick-Disconnect Style
18mm

871TM DC Micro
Quick-Disconnect Style
30mm

C€ c UL us

Features

- 3-wire operation
- 3-conductor, 4-pin connection
- 10–30V DC
- Short circuit, overload, false pulse, reverse polarity, and transient noise protection
- Normally open or normally closed output
- Equal sensing for both steel and aluminum
- CE marked for all applicable directives

Specifications

Load Current	≤200mA
Capacitive Load	≤1µF
Leakage Current	≤0.1mA
Operating Voltage	10–30V DC
Voltage Drop	≤2.0V DC at 200mA
Repeatability	≤5% at constant temperature
Hysteresis	10% typical
False Pulse Protection	Incorporated
Transient Noise Protection	Incorporated
Reverse Polarity Protection	Incorporated
Short Circuit Protection	Incorporated (trigger at 340mA typical)
Overload Protection	Incorporated
Approvals	CE marked for all applicable directives and cULus certified
Enclosure	IP67
Connections	Quick-Disconnect: 4-pin micro style
LED	Yellow: Output energized/360° LED visibility
Operating Temperature	–25°C to +70°C (–13°F to +158°F)
Shock	30g, 11ms
Vibration	55Hz, 1mm amplitude, 3 planes

Correction Factors

Target Material	Correction Factor
Steel	1.0
Stainless Steel (1mm thick)	0.1
Brass	1.2
Aluminum	1.0
Copper	0.8

Note: Due to the extended sensing capabilities of these products, special mounting/installation considerations may be necessary, please refer to publication 871TM–UM001A–EN–P.

871TM 3-Wire DC Extended Sensing

Stainless Steel Face/Threaded Stainless Steel Barrel

Product Selection

Barrel Dia.	Nominal Sensing Distance—mm (in)	Shielded	Output Configuration		Max Switching Frequency (Hz)	Catalog Number	
						PUR Cable Style	Micro QD Style
12mm	6 (0.23)	Y	N.O.	NPN	400	871TM–M6NN12–A2	871TM–M6NN12–D4
				PNP		871TM–M6NP12–A2	871TM–M6NP12–D4
	10 (0.39)	N		NPN		871TM–N10NN12–A2	871TM–N10NN12–D4
				PNP		871TM–N10NP12–A2	871TM–N10NP12–D4
	6 (0.23)	Y	N.C.	NPN		871TM–M6CN12–A2	871TM–M6CN12–D4
				PNP		871TM–M6CP12–A2	871TM–M6CP12–D4
	10 (0.39)	N		NPN		871TM–N10CN12–A2	871TM–N10CN12–D4
				PNP		871TM–N10CP12–A2	871TM–N10CP12–D4
18mm	10 (0.39)	Y	N.O.	NPN	200	871TM–M10NN18–A2	871TM–M10NN18–D4
				PNP		871TM–M10NP18–A2	871TM–M10NP18–D4
	20 (0.79)	N		NPN		871TM–N20NN18–A2	871TM–N20NN18–D4
				PNP		871TM–N20NP18–A2	871TM–N20NP18–D4
	10 (0.39)	Y	N.C.	NPN		871TM–M10CN18–A2	871TM–M10CN18–D4
				PNP		871TM–M10CP18–A2	871TM–M10CP18–D4
	20 (0.79)	N		NPN		871TM–N20CN18–A2	871TM–N20CN18–D4
				PNP		871TM–N20CP18–A2	871TM–N20CP18–D4
30mm	20 (0.79)	Y	N.O.	NPN	80	871TM–M20NN30–A2	871TM–M20NN30–D4
				PNP		871TM–M20NP30–A2	871TM–M20NP30–D4
	40 (1.57)	N		NPN		871TM–N40NN30–A2	871TM–N40NN30–D4
				PNP		871TM–N40NP30–A2	871TM–N40NP30–D4
	20 (0.79)	Y	N.C.	NPN		871TM–M20CN30–A2	871TM–M20CN30–D4
				PNP		871TM–M20CP30–A2	871TM–M20CP30–D4
	40 (1.57)	N		NPN		871TM–N40CN30–A2	871TM–N40CN30–D4
				PNP		871TM–N40CP30–A2	871TM–N40CP30–D4
Recommended Standard QD Cordset (–2 = 2m (6.5ft))							889D–F4AC–2

QD Cordsets and Accessories

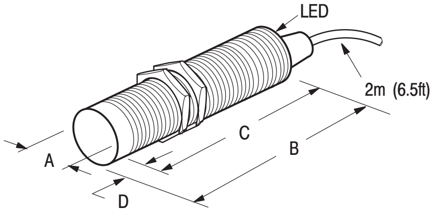
Description	Page Number
Other Cordsets Available	R8–2
Terminal Chambers	R8–2
Mounting Brackets	R2–196 – R2–200
End Caps	R2–205, R2–206
Mounting Nuts	R2–207 – R2–208

871TM 3-Wire DC Extended Sensing

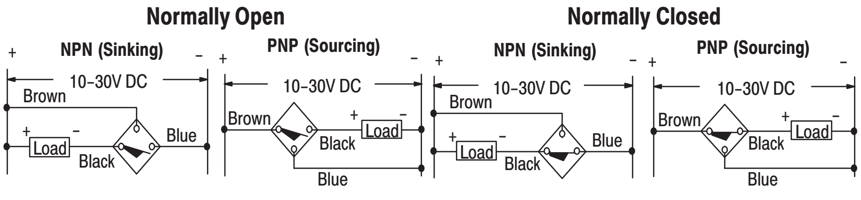
Stainless Steel Face/Threaded Stainless Steel Barrel

Dimensions—mm (inches)

Cable Style

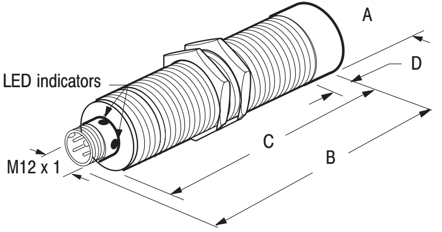


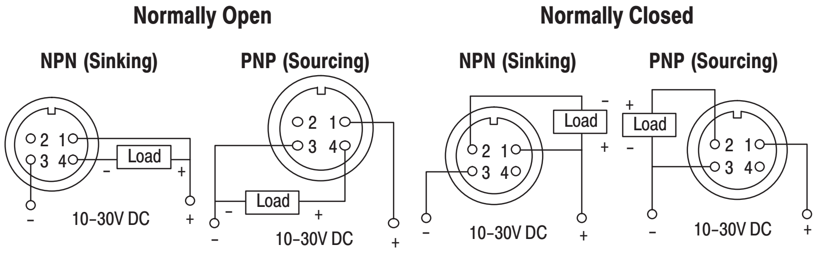
Wiring Diagrams



Thread Size	Shielded	mm (inches)			
		A	B	C	D
M12 X 1	Y	12.0 (0.47)	50 (1.96)	50 (1.96)	—
	N			45 (1.77)	5 (0.19)
M18 X 1	Y	18.0 (0.71)		50 (1.96)	—
	N			43 (1.69)	7 (0.27)
M30 X 1.5	Y	30.0 (1.18)		50 (1.96)	—
	N			40 (1.57)	10 (0.39)

Micro QD Style





Thread Size	Shielded	mm (inches)			
		A	B	C	D
M12 X 1	Y	12.0 (0.47)	60 (2.36)	41 (1.61)	—
	N			36 (1.42)	5 (0.20)
M18 X 1	Y	18.0 (0.71)	63.5 (2.5)	42.5 (1.67)	—
	N			35.5 (1.40)	7 (0.28)
M30 X 1.5	Y	30.0 (1.18)	63.5 (2.5)	42.5 (1.67)	—
	N			32.5 (1.28)	10 (0.39)

Cordsets and Patchcords, DC Micro Style

18 and 22 AWG, ToughLink ™ or ToughWeld ™

889D-F4HC-5
889D-R4HC-10

ITEM # 73 & 74

DC Micro Style

4-Pin DC Micro Cordset

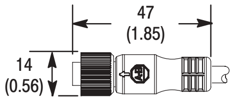
Features

- Ratcheting coupling nut for vibrating resistance
- ToughLink TPE yellow jacket offers excellent oil and chemical resistance
- ToughWeld CPE yellow jacket provides excellent resistance to weld slag
- Heavy duty construction for rugged environments

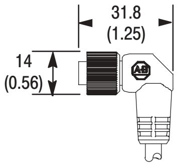
Specifications

Certifications	UL recognized and CSA certified
Mechanical	
Coupling Nut	Epoxy-coated zinc
Material	Molded oil-resistant santoprene body
Contacts	Gold over nickel-plated brass
Cable	Allen-Bradley ToughLink TPE or ToughWeld CPE yellow jacket, 18 AWG or 22 AWG conductors, 300V; UL recognized and CSA certified
Bend Radius	10x diameter
Cable Diameter	ToughLink: 8 mm (0.32 in); ToughWeld: 9 mm (0.35 in)
Electrical	
Cable Rating	ToughLink: UL AWM style 20328 600V VW–1 105C to –50C water resistant, CSA AWM I/II A/B 105C 600V FT2 ToughWeld: UL –50C SJOOW 90C dry and 60C water resistant, CSA –50C SJOOW 90C FT1
Assembly Rating	250V, 3 A
Environmental	
Enclosure Type Rating	IP 67, NEMA 6P, 1200 psi (8270 kPa) washdown
Operating Temperature—C (F)	ToughLink: –40…+105° (–40…+221°) ToughWeld: –20…90° (–4…+194°)

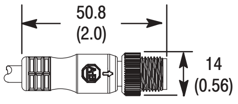
Dimensions—mm (in)



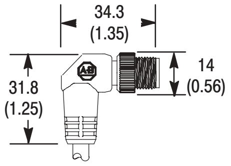
Straight Female



Right Angle Female

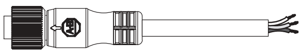


Straight Male

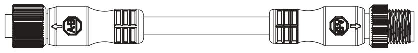


Right Angle Male

Dimensions are approximate. Illustrations are not drawn to scale.

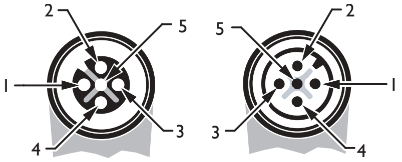


Example of Cordset



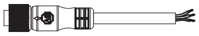
Example of Patchcord

Pinout and Color Code

	Face View Pinout	
	4-Pin	
		
Color Code	**Female**	**Male**
A	1 Brown 2 White	3 Blue 4 Black

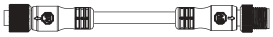
Product Selection

Cordsets



Pin Count	Material	Assembly Rating	Color Code	Cat. No.			
				Straight Female	Right Angle Female	Straight Male	Right Angle Male
4-Pin	ToughLink (TPE)	22 AWG 250V 3 A	A	889D–F4HC–*	889D–R4HC–*	889D–M4HC–*	889D–E4HC–*
	ToughWeld (CPE)	18 AWG 250V 3 A	A	889D–F4WE–*	889D–R4WE–*	—	—

Patchcords



Pin Count	Material	Assembly Rating	Cat. No.			
			Straight Female Straight Male	Straight Female Right Angle Male	Right Angle Female Straight Male	Right Angle Female Right Angle Male
4-Pin	ToughLink (TPE)	22 AWG 250V 3 A	889D–F4HCDM–‡	889D–F4HCDE–‡	889D–R4HCDM–‡	889D–R4HCDE–‡
	ToughWeld (CPE)	18 AWG 250V 3 A	889D–F4WEDM–‡	889D–F4WEDE–‡	889D–R4WEDM–‡	—

* Replace symbol with 1 (1 m), 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.

‡ Replace symbol with 1 (1 m), 2 (2 m), [illegible] m), 4 (4 [illegible] 5 (5 m) or 6 (6 m) for standard lengths.

889M-F12X9AE-5 | ITEM # 77

Cordsets and Patchcords, M23 Style

18 or 18/22 AWG, Black or Yellow PVC

M23 Style

12-Pin M23 Cordset

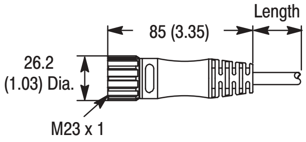
Features

- 12-pin configuration for SafeShield light curtains and other applications
- 12-pin/11-conductor on 19-pin for passive distribution and other box applications
- Subtle black or highly visible yellow PVC jacket offers good oil and chemical resistance

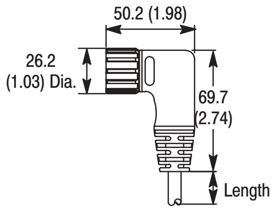
Specifications

Mechanical	
Coupling Nut	Nickel-plated brass
Connector	Molded oil-resistant PUR
Contacts	Gold over nickel-plated brass
Cable	Oil resistant yellow PVC jacket, 18AWG conductors, 60V UL recognized and CSA certified
Bend Radius	10 x diameter
Cable Diameter	10 mm (0.41 in)
Electrical	
Cable Rating	300V
Assembly Rating	9- & 12-pin: 300V, 4 A 11-pin: 63V, 6 A; 19-pin: 63V, 12 A
Environmental	
Enclosure Type Rating	IP 67, NEMA 6P, 1200 psi (8270 kPa) washdown
Operating Temperature—C (F)	–20…+80° (–4…+176°)

Dimensions—mm (in)

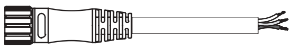


Straight Internal Threads

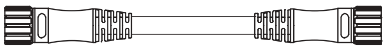


Right Angle Internal Threads

Dimensions are approximate. Illustrations are not drawn to scale.



Example of Cordset

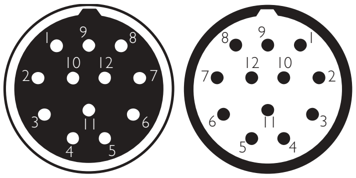
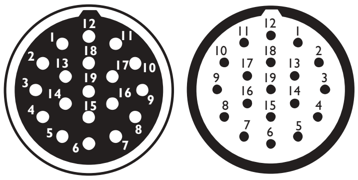


Example of Patchcord

Cordsets and Patchcords, M23 Style

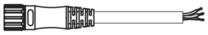
18 or 18/22 AWG, Black or Yellow PVC

Pinout and Color Code

	Face View Pinout	
	9-, 11-, or 12-Pin	19-Pin
Color Code	 Female Male	 Female Male
A	**9-Pin** 1 Brown 2 NA 3 Blue 4 White 5 NA 6 Green 7 Yellow 8 Grey 9 Pink 10 Red 11 NA 12 Green/Yellow	1 Violet 2 Red 3 Grey 4 Red/Blue 5 Green 6 Blue 7 Grey/Pink 8 White/Green 9 White/Yellow 10 White/Grey 11 Black 12 Green/Yellow 13 Yellow/Brown 14 Brown/Green 15 White 16 Yellow 17 Pink 18 Grey/Brown 19 Brown
B	**11-Pin** 1 White 2 Green 3 Yellow 4 Grey 5 Pink 6 Red 7 Black 8 Violet 9 Blue 10 Blue 11 Brown 12 Green/Yellow	—
C	**12-Pin** 1 Brown 2 Blue 3 Grey 4 Pink 5 Red 6 Yellow 7 White 8 Red/Blue 9 Black 10 Violet 11 Grey/Pink 12 Green	—

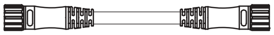
Product Selection

Cordsets



Pin Count	Color Code	Jacket Color	Assembly Rating	Cat. No.			
				Straight Female	Right Angle Female	Straight Male	Right Angle Male
9-Pin	A	Yellow	18 AWG	889M–F12X9AE–*	889M–R12X9AE–*	—	—
11-Pin	B	Black	3/18 & 8/22 AWG	889M–F11RM–*	889M–R11RM–*	889M–U11RM–*	889M–V11RM–*
12-Pin	C	Yellow	18 AWG	889M–F12AH–*	889M–R12AH–*	—	—
19-Pin	A	Black	3/18 & 16/22 AWG	889M–F19RM–*	889M–R19RM–*	889M–U19RM–*	889M–V19RM–*

Patchcords



Pin Count	Jacket Color	Assembly Rating	Cat. No.			
			Straight Female Straight Male	Straight Female Right Angle Male	Right Angle Female Straight Male	Right Angle Female Right Angle Male
11-Pin	Black	3/18 & 8/22 AWG	889M–F11RMMU–‡	889M–F11RMMV–‡	889M–R11RMMU–‡	889M–R11RMMV–‡
12-Pin	Yellow	18 AWG	889M–F12AHMU–§	—	—	—
19-Pin	Black	3/18 & 16/22 AWG	889M–F19RMMU–‡	889M–F19RMMV–‡	889M–R19RMMU–‡	889M–R19RMMV–‡

* Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 0M3 (0.), 1 (1 m), 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
§ Replace symbol with 0M3 (0.), 0M6 (0.6 m), 1 (1 m), 2 (2 m) or 3 (3 m) for standard cable lengths.

1489-A1C050
1489-A1C100
1489-A1C150

ITEM # 16, 17 & 18

Bulletin 1489 Circuit Breakers

Industrial Circuit Breakers for North American Applications

The Bulletin 1489 line includes:

- UL 489, CSA 22.2 No. 5.1
  - 240V AC 0.5...40 A
  - 480V/277V AC 0.5...20 A
- Miniature Circuit Breaker for IEC Applications EN 60 947-2
  - 415V AC 0.5...40 A

Features

- Designed Manufactured and Listed to UL489 (CSA 22.2 no. 5.1)
- Thermal-Magnetic protection
- All ratings are HACR rated
- 10 kA Interrupting rating
- Finger –Safe Design (front)
- DIN Rail Mounting
- Wire Connections line and load
- Optional Ring Terminal Connections (convertible)

Table of Contents

Approvals

- CE marked
- UL 489
- CSA 22.2 No. 5.1
- HACR
- SWD (0.5...20 A) Switching Duty for flourescent lighting applications
- IEC 60 947-2

Description

Bulletin 1489 Circuit Breakers for Branch Circuit protection are available in one (1)-, two (2)-, and three (3)-pole construction and are rated 0.5 to 40 A at 240V AC and 0.5 to 20 A at 480Y/277V AC for North American applications (UL 489 and CSA 22.2 No. 5.1). For IEC applications the products are rated 415V AC 0.5 to 40 A.

Thermal Magnetic Circuit Breakers

The Bulletin 1489 Thermal Magnetic Circuit Breakers are general-purpose devices suitable for the majority of industrial, inverse time circuit breaker applications.

They combine thermal and magnetic trip actions and provide accurate overload and short-circuit protection for conductors and connected equipment.

Circuit Breaker Application Information

Selection of a Bulletin 1489 circuit breaker with appropriate circuit protection includes consideration of:

- Circuit Voltage
- Circuit Frequency
- Available Short Circuit Current
- Continuous Current Rating
- Application Considerations
- Special Operating Conditions

The following discussion is based upon National Electric Code and UL requirements. Similar considerations are appropriate for Canadian applications.

Circuit Voltage

The Bulletin 1489 circuit breakers are rated by voltage class. Applications should not exceed the listed voltage and current range (see Table 1).

Circuit Frequency

The Bulletin 1489 circuit breakers may be applied to frequencies of 50 Hz and 60 Hz without derating. For applications above 60 Hz, contact Rockwell Automation with specific application information for the derating of the circuit breakers.

Available Short Circuit Current

The Bulletin 1489 circuit breakers should only be applied in those applications in which the available short-circuit (or fault) current is less than or equal to 10,000 A.

Table 1. Voltage and Current Ranges

Region	Max. Voltage	Current Range
IEC Regions	415V AC	0.5...40 A
North America (UL 489 & CSA 22.2 No. 5.1)	240V AC	0.5...40 A
	480Y/277V AC	0.5...20 A

Continuous Current Rating

Standard current ratings are: 0.5 A, 1 A, 1.5 A, 2 A, 3 A, 4 A, 5 A, 6 A, 7 A, 8 A, 10 A, 15 A, 16 A, 20 A, 25 A, 30 A, 32 A, 35A, and 40 A.

The Bulletin 1489 circuit breakers are rated in RMS amperes at a 40°C (104°F) ambient temperature per the UL 489 (CSA 22.2 No. 5.1) standard. This temperature is generally used as the average temperature within an industrial enclosure. If a circuit breaker is applied in a temperature that exceeds the 40°C (104°F) ambient, then the circuit breaker should be derated. For IEC 60 947-2 standard the products carry an ambient rating of 30°C. Follow standard IEC application considerations for temperature rating in different ambient temperatures.

The characteristic trip curves are shown on page 6 . The trip bands shown for each breaker represent current tripping limits for a circuit breaker and are within the limits established by UL. For a specific current at 40°C (104°F), a circuit breaker will open ("clear the circuit") automatically at some total time that will be within the "Minimum" and "Maximum" time shown on the curves. For example, figure 1 shows that a one-pole, 15 A, Bulletin 1489 circuit breaker trips in not less than 10 sec. and not more than 120 sec. on a 30 A current. Because the UL standard defines this time spread, users should not specify exact tripping time. The lower current portion of the curves (upper left) depict the time to trip due to thermal action and reflect overload protection of the wire and connect load. The higher current portion of the curves (lower right) depicts the trip due to magnetic action of the circuit breaker and reflects protection due to short circuit level currents.

Application Considerations

The following is a discussion of application considerations related to North American applications. When applying product to IEC regional requirements, follow IEC practices and guidelines.

The selection of a specific ampere rating for a specific application is dependent on the type of load and duty cycle and is governed by the National Electric Code (Canadian Electric Code) and UL/CSA. In general, the codes require that overcurrent protection is at the current supply and at points where wire sizes are reduced. In addition, the codes state that conductors be protected according to their current carrying capacity. There are specific situations that require application consideration, such as motor circuit, and guidelines for the selection for transformer protection.

The Bulletin 1489 circuit breakers are “non 100 percent rated” as defined by UL 489, para 7.1.4.2. As such, the circuit breaker's rating should be loaded to no more than 80% if used with continuous loads.

Branch Circuits:

Bulletin 1489 circuit breakers may be used to protect branch circuits. A branch circuit is the wiring portion of a system extending beyond the final overcurrent device protecting the circuit.

Guidelines established in NEC, CEC, UL, and CSA should be used to determine the specific device. For example:

1) Motor Branch Circuit

Bulletin 1489 circuit breakers are not horsepower rated because they are able to safely interrupt currents far in excess of the locked rotor value for a selected motor. This ability is recognized in the codes and standards and is also established by the UL and CSA tests described in UL 489 and CSA 22.2 No. 5.1 standards.

The size of a Bulletin 1489 circuit breaker should be determined following the guidelines for an Inverse Time Circuit Breaker.

References: NEC 430.51 and UL 489. Also see CEC and appropriate Canadian Standards.

2) Transformer Protection

Bulletin 1489 circuit breakers may be used for transformer protection following the guidelines established.

References: NEC 450 and UL 489. Also see CEC and appropriate Canadian Standards.

3) Heater Load, Lighting, and Other Load Protection

Bulletin 1489 circuit breakers may be used for protection of heater loads, lighting loads, and other loads following the guidelines established.

References: NEC Article 31 and UL 508A. Also see CEC and appropriate Canadian Standards.

Coordinated Overcurrent Protection

Where an orderly shutdown is required to minimize the hazards to personnel and equipment, a system of coordination based upon the faulted or overloaded circuit is isolated by selective operation of only the overcurrent protective device closest to the overcurrent condition. The user should select devices that meet this requirement.

References: NEC 240.12. Also see CEC.

Determining Ratings

The standard tripping characteristic for Bulletin 1489 is Type C. Type C has a magnetic trip activated at 5…10 times the rated current of the circuit breaker. The reference temperature for the thermal tripping characteristics is 40° C. The Type C characteristic will suit most applications.

In rare occurrences when the Type C characteristic does not fully meet the application, the following additional magnetic trip characteristic is available:

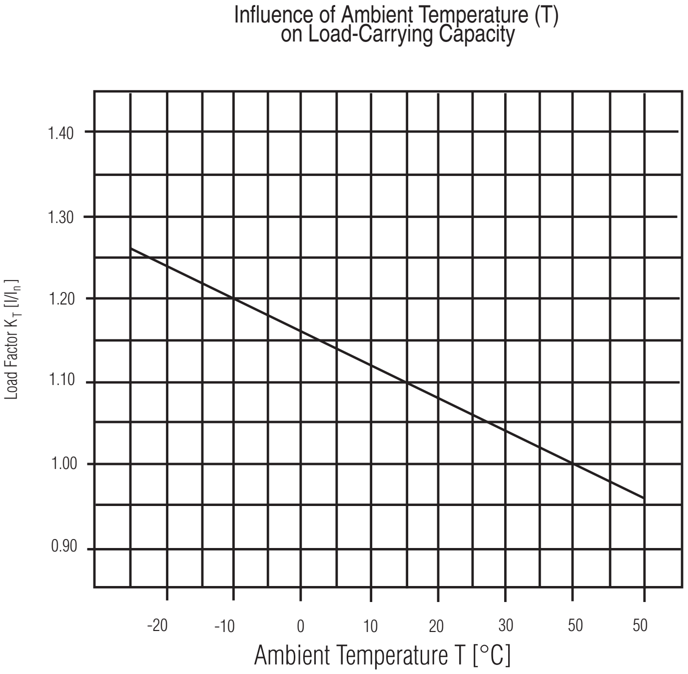
Type D allows for transients approximately twice as high as the standard Type C.

Use the following table and graph to determine the current rating for the breaker if the ambient is significantly different than 40°C.

Device Marked Current Rating in (A) @ 40° C	I_n (A) at higher Ambient Temperature						
	15° C	20° C	25° C	30° C	40° C	50° C	55° C
0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5
1.0	1.1	1.1	1.1	1.0	1	1.0	0.9
1.5	1.7	1.6	1.6	1.6	1.5	1.4	1.4
2.0	2.2	2.2	2.1	2.1	2	1.9	1.9
3.0	3.3	3.2	3.2	3.1	3	2.9	2.8
4.0	4.4	4.3	4.2	4.2	4	3.8	3.8
5.0	5.5	5.4	5.3	5.2	5	4.8	4.7
6.0	6.6	6.5	6.4	6.2	6	5.8	5.6
7.0	7.7	7.6	7.4	7.3	7	6.7	6.6
8.0	8.8	8.6	8.5	8.3	8	7.7	7.5
10.0	11.0	10.8	10.6	10.4	10	9.6	9.4
13.0	14.3	14.0	13.8	13.5	13	12.5	12.2
15.0	16.5	16.2	15.9	15.6	15	14.4	14.1
16.0	17.6	17.3	17.0	16.6	16	15.4	15.0
20.0	22.0	21.6	21.2	20.8	20	19.2	18.8
25.0	27.5	27.0	26.5	26.0	25	24.0	23.5
30.0	33.0	32.4	31.8	31.2	30	28.8	28.2
32.0	35.2	34.6	33.9	33.3	32	30.7	30.1
40.0	44.0	43.2	42.4	41.6	40	38.4	37.6

Note: The table shows the corrected values of the rated current dependent on the ambient temperature.

Ambient Temperature Graph



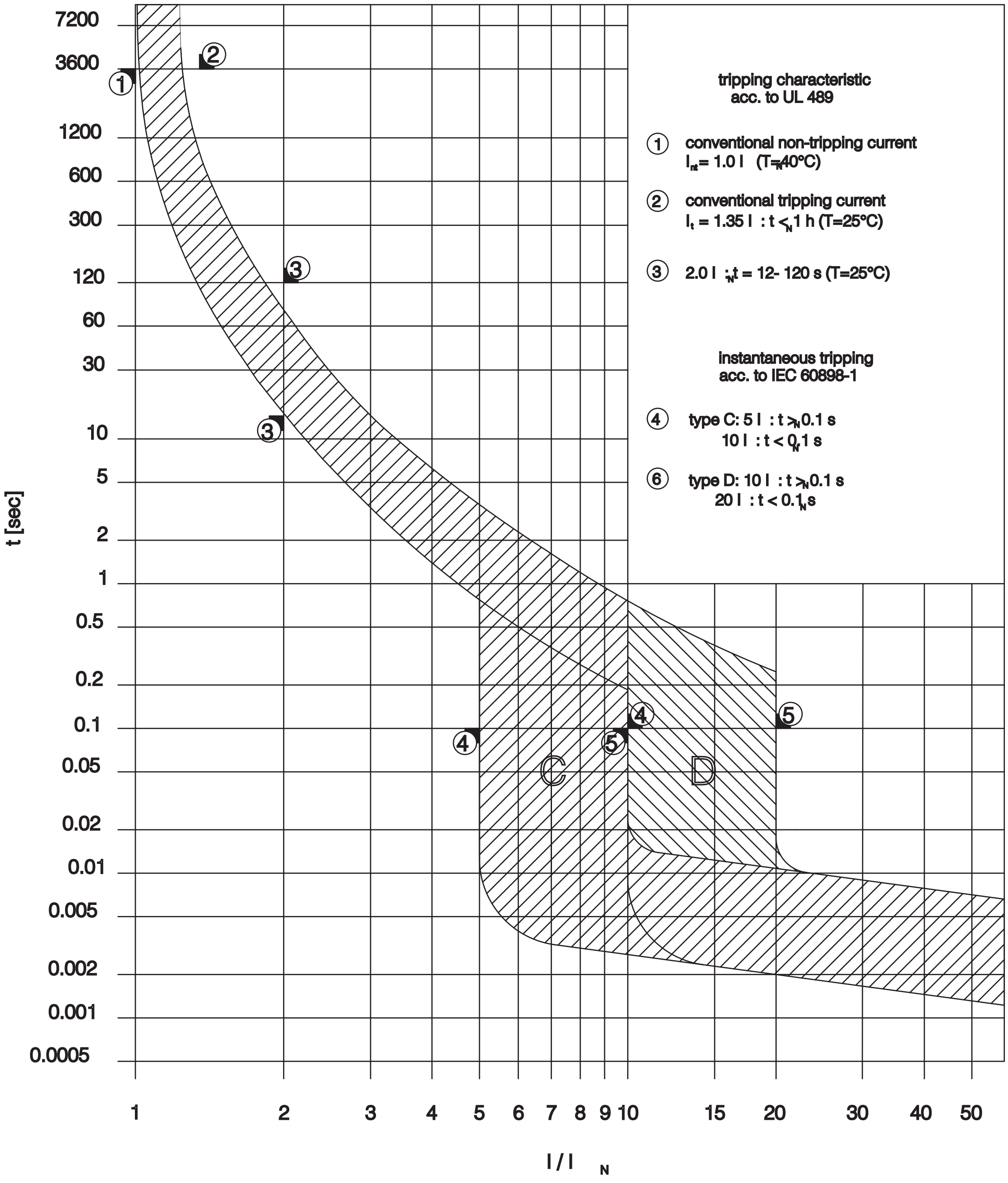
Maximum load I_L at Ambient Temperature T:

$I_L(T) = I_n K_T (T)$

Time-Current Characteristic Bulletin 1489

Type C and D

Ambient Temperature 40°C



Bulletin 1489 Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

1489	-	A	1	C	005	R
		a	b	c	d	e

a

Body Style	
Code	**Description**
A	Standard configuration, 10 000 A interrupting

b

Poles	
Code	**Description**
1	1-Pole
2	2-Pole
3	3-Pole

c

Trip Curve	
Code	**Trip Curve**
C	Trip Curve C
D	Trip Curve D

d

Rated Current (I_n)	
Code	**Voltage (V)**
005	0.5
010	1
015	1.5
020	2
030	3
040	4
050	5
060	6
070	7
080	8
100	10
130	13
150	15
160	16
200	20
250	25
300	30
320	32
350	35
400	40

e

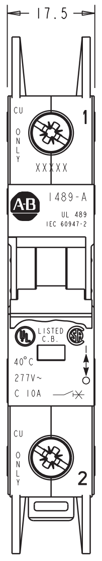
Factory Modifications	
Code	**Description**
(empty)	Standard Terminal
R	Ring Terminal (Check for availability)

Bulletin 1489 1-Pole Miniature Circuit Breakers

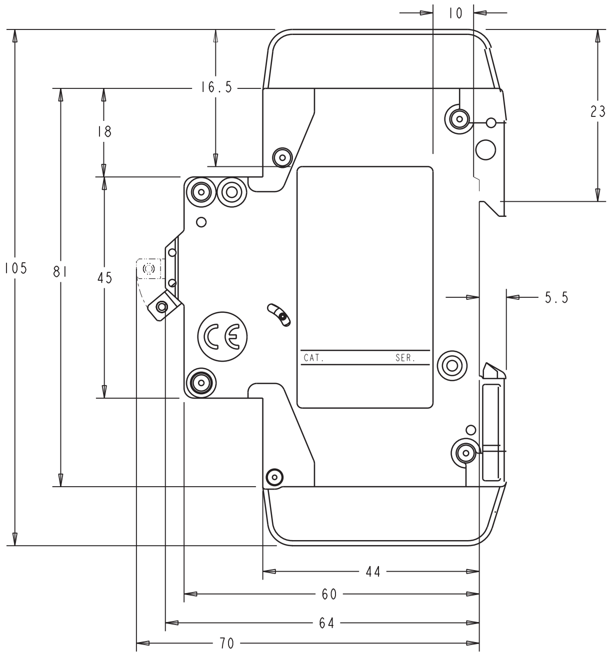
No. of Poles	IEC Maximum Voltage V AC	Trip Curve	UL/CSA Max. Volt.	Rated Current	Standard Wire Configuration Cat. No.	Ring Terminal Configuration Cat. No.
1	415	C	480Y/277	0.5	1489-A1C005	1489-A1C005R
				1	1489-A1C010	1489-A1C010R
				1.5	1489-A1C015	1489-A1C015R
				2	1489-A1C020	1489-A1C020R
				3	1489-A1C030	1489-A1C030R
				4	1489-A1C040	1489-A1C040R
				5	1489-A1C050	1489-A1C050R
				6	1489-A1C060	1489-A1C060R
				7	1489-A1C070	1489-A1C070R
				8	1489-A1C080	1489-A1C080R
				10	1489-A1C100	1489-A1C100R
				13	1489-A1C130	1489-A1C130R
				15	1489-A1C150	1489-A1C150R
				16	1489-A1C160	1489-A1C160R
				20	1489-A1C200	1489-A1C200R
			240	25	1489-A1C250	1489-A1C250R
				30	1489-A1C300	1489-A1C300R
				32	1489-A1C320	1489-A1C320R
				35	1489-A1C350	1489-A1C350R
				40	1489-A1C400	1489-A1C400R
		D	480Y/277	0.5	1489-A1D005	1489-A1D005R
				1	1489-A1D010	1489-A1D010R
				1.5	1489-A1D015	1489-A1D015R
				2	1489-A1D020	1489-A1D020R
				3	1489-A1D030	1489-A1D030R
				4	1489-A1D040	1489-A1D040R
				5	1489-A1D050	1489-A1D050R
				6	1489-A1D060	1489-A1D060R
				7	1489-A1D070	1489-A1D070R
				8	1489-A1D080	1489-A1D080R
				10	1489-A1D100	1489-A1D100R
				13	1489-A1D130	1489-A1D130R
				15	1489-A1D150	1489-A1D150R
				16	1489-A1D160	1489-A1D160R
				20	1489-A1D200	1489-A1D200R
			240	25	1489-A1D250	1489-A1D250R
				30	1489-A1D300	1489-A1D300R
				32	1489-A1D320	1489-A1D320R
				35	1489-A1D350	1489-A1D350R
				40	1489-A1D400	1489-A1D400R

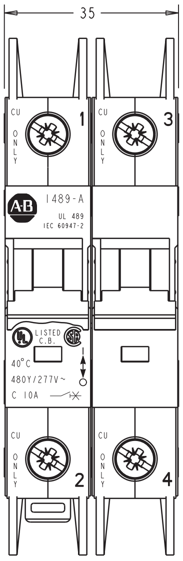
Bulletin 1489 Circuit Breaker Approximate Dimensions

Note: Dimensions are not intended for manufacturing purposes.

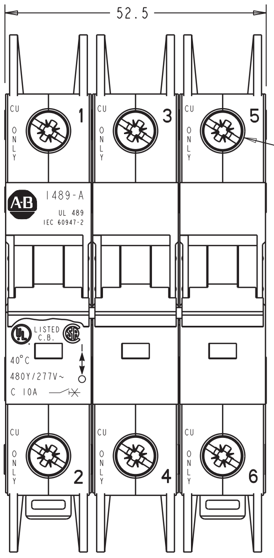


1492-A1C005





1492-A2C005



1492-A3C005

CATALOG NUMBER	LINE/LOAD TERMINAL STYLE	ACCESS HOLE DIA. IN HOUSING mm	TERMINAL SCREW HEAD DIA. mm	COMMENT: TERMINAL SCREW
WITHOUT "R" SUFFIX	CABLE	8.2	10	NON REMOVABLE
WITH "R" SUFFIX	RING LUG	8.2	8	REMOVABLE

Note: Dimensions are in millimeters (mm).

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

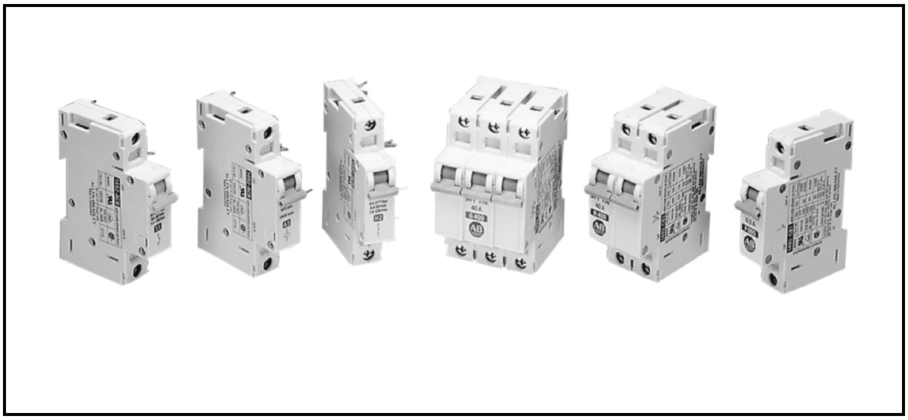
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1489-SG001A-EN-P – October 2005

1492-CB1G250
1492-CB2G100

ITEM # 14 & 15

1492-CB



Description

Bulletin 1492 Energy Limiting circuit breakers are thermal magnetic type **supplementary** overcurrent protective devices. Bulletin 1492-CB circuit breakers are available in 1-, 2-, and 3-pole units rated from 0.5…50 A. AC units are rated 65V DC as standard. 2- and 3- pole devices are connected internally and at the handle for simultaneous operation. Wire termination is achieved by a clamping style, self-lifting box lug on all Bulletin 1492-CB units. Both line and load side termination points will accept #16…6 AWG (1.5…16 mm^2) copper wires.

Features

- Energy Limiting Design — protects downstream components better than conventional breakers during short circuits
- Field-mountable options for selective applications
- True IP2X Finger-Safe design (top and sides)
- International approvals — CE Marked, meets UL, CSA, and IEC (VDE) standards for worldwide acceptance
- Ratings to 480V AC and 10,000 A Interrupt Capacity (refer to page 12-98)
- AC and DC voltage ratings — in one convenient device
- A positively trip-free mechanism (breaker operation cannot be defeated by holding the handle in the ON position)
- 3 trip curves: F, G, and H
- Time delay (H characteristic) for high inrush currents during inductive start-ups such as transformers and power supplies
- Superior shock and vibration resistance capabilities — helps to prevent nuisance tripping
- Mounts on DIN Rail or optional through door brackets
- On standard AC/DC versions (F, G, H) line and load connections may be reversed

Trip Curves

1492-CB Trip Curves are available in publication 1492-2.5.

The Benefits of Limiting Let-Through-Energy

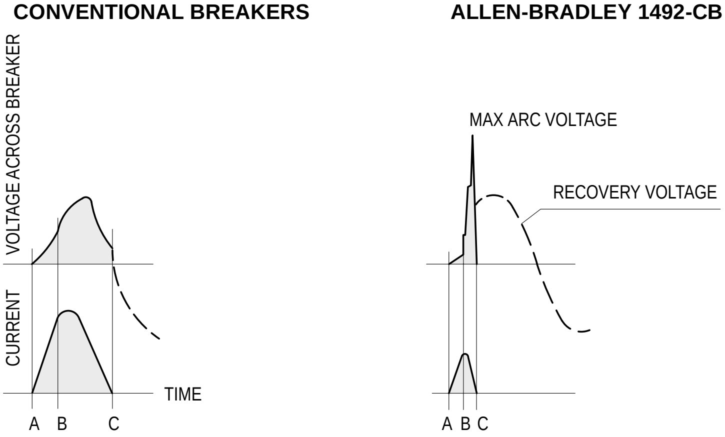
1492-CB vs. Conventional Breakers

The 1492-CB line features the unique ability to achieve short circuit interruptions far more effectively than conventional breakers.

In *conventional circuit breakers*, short circuit interruption time required is approximately one or two half cycles of an AC sine wave. When the contacts open, the resulting arc continues to burn until the current level passes through zero. The arc may re-ignite because of the insufficient width of the contact gap. The current that flows until the arc is extinguished produces a heating effect proportional to the I^{2}t value *(let-through-energy)* of the fault current. The 1492-CB Energy Limiting circuit breaker is designed to substantially reduce the amount of *let-through-current* and the resulting *let-through-energy* that can damage protected components. The 1492-CB has the ability to interrupt short circuit current within the first half cycle of the fault.

Short Circuit Interruption Diagrams

Short Circuit Interruption 10 kA — 120 Volts AC
Instant of initiation: 15° after voltage zero



A = Instant when the short is initiated
B = Instant when the contacts open and the arc is initiated
C = Instant when the arc extinguishes and the current ceases to flow

1492-CB, Continued

The Benefits of Limiting Let-Through-Energy (Continued)

Limiting let-through-energy will protect against the harmful effects of overcurrent and is focused primarily on avoiding the following:

- Excessive Heat
- Mechanical Damage

Both of these factors are proportional to the square of the current. Thermal energy is proportional to the square of the RMS value and magnetic forces are proportional to the square of the peak value. The most effective way to provide protection is to substantially limit *let-through-energy*. This provides the following advantages:

- Far less damage at the location of the short circuit.
- Fast electric separation of a faulty unit from the system, especially power supplies connected in parallel that are switched off when the voltage of the power bus drops below a certain level.
- Far less wear on the circuit breaker itself. This means more safe interruptions.
- Better protection of all components in the short circuit path.
- Far wider range of selective action when used with an upstream protective device. (No nuisance shut downs from feeder line interruptions, causing a blackout in all connected branches.)

Applications

Bulletin 1492-CB Energy Limiting circuit breakers have a wide range of trip characteristics for a wide range of applications.

- F trip characteristic (3…5 x *I*n) ❶ for low fault tolerant loads, such as PLC outputs, solid state control equipment, and also for selective action with an upstream fault device
- G trip characteristic (6…10 x *I*n) ❶ for standard duty loads, such as relay coils, control circuitry, and test equipment
- H trip characteristic (12…20 x *I*n) ❶ for high inrush loads, such as power supplies, heaters, and transformer primaries

A type F has a fault level inrush current interruption approximately half that of type G. The type H has a fault level interruption approximately twice that of type G.

Accessories

Accessory Notes

Note: Maximum of two accessories per device.

Auxiliary Contacts

Refer to Specifications on page 12-97 for ratings. Each auxiliary contact module contains one (1) contact, either Normally Open or Normally Closed. Actuation of the contact is determined by the handle position of the adjacent poles.

Signal Contacts

Refer to Specifications on page 12-97 for ratings. Each contact module contains one contact that will be linked internally with the adjacent poles, but not through the handle. Contacts are actuated by a fault condition on the protected poles, not by the manual operation of them.

Note: The difference between an auxiliary contact and a signal contact is the protected poles adjacent to the signal contact may be manually shut off without affecting the status of the signal contact, whereas the auxiliary contact is activated either by manual (possibly to service a panel) or automatic operation (fault) of the protected poles. Manual operation of the protected poles does not alter the contact state of the signal contact (which may be connected to an alarm circuit for fault indication only).

Relay Trip (Shunt-Trip)

Refer to the table below for ratings. The Relay trip module can be used to trip the adjacent current carrying poles from a remote location by applying a voltage (pick-up voltage) to the Relay trip terminals. Contacts operate between 8 and 16 milliseconds after the pick-up voltage has been applied.

Type	Pick-Up Voltage Range	Impedance
A1	5…15 V AC/DC	1.1 Ω
A2	10…24V AC/DC	4.7 Ω
A3	20…48V AC/DC	16 Ω
A4	40…110V AC/DC	63 Ω
A5	90…240V AC/DC	395 Ω

Switched Neutral Module (not field-mountable)

Refer to Specifications on page 12-97 for ratings. This module is used to open the neutral line of the circuit as a result of the condition of the protected poles. It is used as a safety measure (required by some standards) for the protection of networks with a grounded neutral system. The switched neutral pole opens after and closes before the adjacent protected pole (i.e., early make, late break). Automatic actuation is a result of the adjacent pole trip mechanism and manual actuation is by the linked handles.

---

❶ *I*n = rated current. The time/current trip characteristic k1…k2 x *I*n is defined such that inrush current k1 x *I*n has a time delay that exceeds 10 ms, and k2 x *I*n has a time delay that is less than 10 ms.

1492-CB, Continued

How to Order 1492-CB

The following information must be known to select the proper circuit breaker:

- What is the full load amperage that will be available in the system?
- Is it a 1-, 2-, or 3-phase system?
- What are the start-up or inrush properties of the load?
- Will the system require additional shaping options (e.g., auxiliary contacts, signal contacts)?

After defining these few parameters, the selection can be done by following the chart below. All options are field-mountable except the neutral switch, which comes installed from the factory.

Selection Information

You can order a basic 1-, 2-, or 3-pole circuit breaker from the following tables and add an accessory module to meet your specific application requirements.

1492 – CB 3 G 200 – N ❶❹

Bulletin Number

Energy Limiting Circuit Breaker	
CB	Screw Terminal

Number of Poles		Rated Voltage ❷ By Trip Characteristic	
		F, G, H	DF, DG, DH
1	1 pole	277V AC 65V DC	120V DC
2	2 poles	480V AC 65V DC	240V DC
3	3 poles	480V AC 65V DC	360V DC

Switched Neutral Module	
N ❸	277V 65 A

Trip Characteristic	
Code	Magnetic Trip Range
F	3…5 x *In*
G	6…10 x *In*
H	12…20 x *In*
DF ❸❹	4.2…7 x *In*
DG ❸❹	8.5…14 x *In*
DH ❸❹	17…28 x *In*

In = Rated Current

Trip Char.	Current Rating Code (Standard Trip Characteristic is Type G)																		
F	005	010	015	020	030	040	050	060	070	100	120	150 ❸	160 ❸	200 ❸	250 ❸	300 ❸	320 ❸	400 ❸	500 ❸
G	005	010	015	020	030	040	050	060	070	100	120	150	160	200	250	300	320	400	500
H	005	010	015	020	030	040	050	060	070	[illegible]	120	150	160	200	[illegible]	300	320	400	500
DF ❸❹	005	010	015	020	030	040	050	060	070	[illegible]	120	150	160	200	[illegible]	300	320	400	—
DG ❸❹	005	010	015	020	030	040	050	060	070	100	120	150	160	200	250	300	320	400	—
DH ❸❹	—	—	—	—	—	—	—	060	070	100	120	150	160	200	250	300	320	400	—
Amp Rating	0.5	1	1.5	2	3	4	5	6	7	10	12	15	16	20	25	30	32	40	50

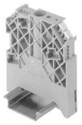
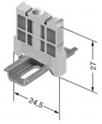
❶ This alphanumeric character is for the optional neutral module.
❷ Rated volts are UL Recognized.
❸ Minimum order of 10 breakers required.
❹ **Attention:** Do not use these DC versions in AC networks. Polarity markings must be observed with the DC versions.

1492-EAJ35 | ITEM # 59

IEC Terminal Block Accessories

End Anchors and End Retainers/Partition Plates/Separation Plates

End Anchors and End Retainers

Photo	Dimensions Width x Length x Height	Tightening Torque	Markers	Used With	Color	Cat. No.	Pcs/ Pkg
	0.31 x 2.20 x 1.85 in (8 x 56 x 47 mm)	4.4 lb•in (0.5 Nm)	1492-M7X12 1492-M8X5	199-DR1, 199-DR2, 1492-DR4, 1492-DR5, 1492-DR6, 1492-DR7, 1492-DR8, 1492-DR9	Gray	1492-EAJ35	
	0.48 x 2.20 x 2.48 in (12.2 x 56 x 63 mm)	4.4 lb•in (0.5 Nm)	1492-M7X12 1492-M5X5	199-DR1, 199-DR2, 1492-DR4, 1492-DR5, 1492-DR6, 1492-DR7, 1492-DR8, 1492-DR9	Gray	1492-EAHJ35	50
	0.31 x 1.06 x 1.06 in (8 x 27 x 27 mm)	3.5 lb•in (0.9 Nm)	1492-M5X5	1492-DR3	Gray	1492-EAJ15	50
	0.24 x 2.19 x 1.63 in (6 x 55.6 x 41.5 mm)	—	1492-M5X10 1492-M5X5	199-DR1, 199-DR2, 1492-DR4, 1492-DR5, 1492-DR6, 1492-DR7, 1492-DR8, 1492-DR9	Gray	1492-ERL35	20
	0.20 x 0.96 x 0.75 in (5 x 24.5 x 19 mm)	—	1492-M5X10 1492-M5X5	1492-DR3	Gray	1492-ERL15	20

Partition Plates

Dimensions Width x Length x Height	Used With	Color	Cat. No.	Pcs/ Pkg
0.005 x 3.15 x 2.48 in (0.13 x 80 x 63 mm)	1492-JD3, JD3C, JD3F, JD3DF, JD3DR, JD3RB…, JD3RC…, JD3SS	Gray	1492-PPJD3	20
0.005 x 3.54 x 2.51 in (0.13 x 90.1 x 63.8 mm)	1492-JD3P…, JDG3P…	Natural	1492-PPJD3P	20
0.08 x 1.57 x 1.20 in (2 x 40 x 30.5 mm)	1492-WM3, WM4, WMG3, WMG4	Gray	1492-PPM3	50
0.014 x 2.28 x 1.51 in (0.35 x 58 x 38.3 mm)	1492-WMD1	Gray	1492-PPMD1	50
0.06 x 1.85 x 1.57 in (1.5 x 47 x 40 mm)	1492-W3, W4, WG4	Gray	1492-PP3	50
0.06 x 2.17 x 1.81 in (1.5 x 55 x 46 mm)	1492-W6, W10, W16S, W4TW, WG6, WG10S, WG16S	Gray	1492-PP10	50
0.014 x 2.88 x 1.85 in (0.35 x 73.2 x 47.1 mm)	1492-WTF3…, WTS3…	Natural	1492-PPTS3	50
0.06 x 1.93 x 2.36 in (1.5 x 49 x 60 mm)	1492-J3, J4, J6, J10, J2Q, J3TW, J3F, JG2Q, JG3, JG3TW, JKD3, JKD3TP, J3P, J3PTP, JTC3	Gray	1492-EBJ16	20
		Blue	1492-EBJ16-B	20
		Yellow	1492-EBJ16-Y	20

Separation Plates

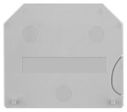
Dimensions Width x Length x Height	Used With	Color	Cat. No.	Pcs/ Pkg
0.014 x 1.76 x 1.57 in (0.35 x 44.8 x 40.0 mm)	1492-W3, W4	Natural	1492-SP3	50

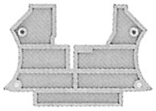
1492-EBJ3 ITEM # 60

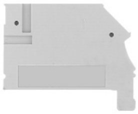
IEC Terminal Block Accessories

End Barriers

For Screw Type Products



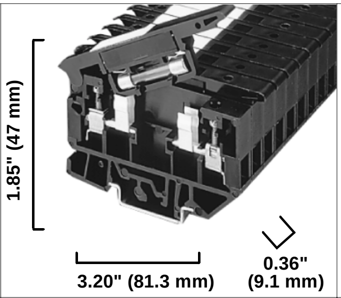
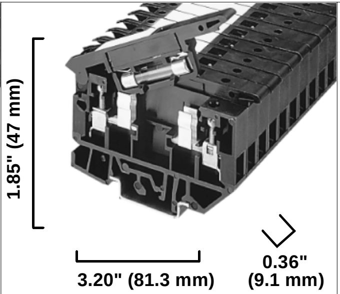
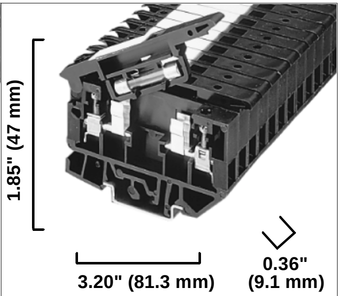




Dimensions Width x Length x Height	Used With	Color	Cat. No.	Pcs/Pkg
0.06 x 1.31 x 2.36 in (1.5 x 33.35 x 60 mm)	1492-J3, J4, J6, J10, J2Q, J3TW, J4M, J3F, JG2Q, JG3, JG3TW, JKD3, JKD3TP, J3P, J3PTP, JTC3…	Gray	1492-EBJ3	0
		Blue	1492-EBJ3-B	50
		Yellow	1492-EBJ3-Y	50
0.06 x 1.93 x 2.36 in (1.5 x 49 x 60 mm)	1492-J16, J35	Gray	1492-EBJ16	20
		Blue	1492-EBJ16-B	20
		Yellow	1492-EBJ16-Y	20
0.06 x 2.15 x 2.72 in (1.5 x 54.5 x 69 mm)	1492-JD3, JD3C, JD3F, JD3DF, JD3DR, JD3RB…, JD3RC001, JD3SS	Gray	1492-EBJD3	20
		Blue	1492-EBJD3-B	20
		Yellow	1492-EBJD3-Y	20
0.06 x 1.31 x 2.36 in (1.5 x 33.35 x 60 mm)	1492-JPO	Gray	1492-EBJO	20
0.10 x 1.45 x 1.77 in (2.5 x 36.7 x 45 mm)	1492-JC3	Gray	1492-BKJC3	10 Start Barriers / 10 End Barriers
0.10 x 1.78 x 2.28 in (2.5 x 45.2 x 58 mm)	1492-JDC3	Gray	1492-BKJDC3	10 Start Barriers / 10 End Barriers
0.06 x 3.15 x 2.31 in (1.5 x 80.2 x 58.8 mm)	1492-JD3P, JD3PTP, JD3PSS, JD3PSSTP, JDG3P, JDG3PTP, JDG3PSS, JDG3PSSTP	Gray	1492-EBJD3P	20
0.06 x 1.10 x 0.97 in (1.5 x 28 x 24.6 mm)	1492-WM3	Gray	1492-EBM3	50
0.06 x 1.22 x 1.09 in (1.5 x 31 x 27.7 mm)	1492-WM4	Gray	1492-EBM4	50
0.06 x 1.65 x 1.32 in (1.5 x 42 x 33.5 mm)	1492-WMD1	Gray	1492-EBMD1	50
0.06 x 1.46 x 1.38 in (1.5 x 37 x 35 mm)	1492-W3, W4, WG4	Gray	1492-EB3	50
		Yellow	1492-EB3-Y	50
0.06 x 1.77 x 1.61 in (1.5 x 45 x 41 mm)	1492-W6, W10, W16S, WG6, WG10S, WG16S	Gray	1492-EB10	50
		Yellow	1492-EB10-Y	50
0.06 x 1.65 x 2.19 in (1.5 x 42 x 55.5 mm)	1492-WR3	Gray	1492-EBR3	50
0.06 x 1.79 x 1.64 in (1.5 x 45.4 x 41.6 mm)	1492-W4TW	Gray	1492-EB3TW	50
0.06 x 3.51 x 1.74 in (1.5 x 89.1 x 44.1 mm)	1492-WTF3…	Gray	1492-EBTF3	50
0.06 x 2.61 x 1.74 in (1.5 x 66.2 x 44.1 mm)	1492-WTS3…	Gray	1492-EBTS3	50
0.11 x 2.81 x 1.96 in (2.8 x 71.4 x 49.8 mm)	1492-H4, H5, H6, H7	Black	1492-N37	50

1492-H4
1492-H5

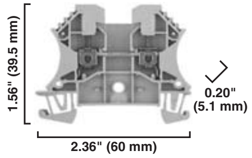
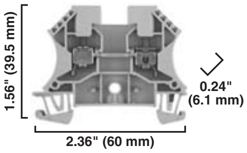
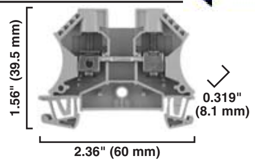
ITEM # 51 & 52

	1492-H4			**1492-H5**			**1492-H6**		
Dimensions are not intended to be used for manufacturing purposes. **Note:** Height dimension is measured from top of rail to top of terminal block.									
Specifications	*Single-circuit fusible terminal block with neon blown fuse indicator.*			*Single-circuit fusible terminal block with LED blown fuse indicator.*			*Single-circuit fusible terminal block without a blown fuse indicator.*		
Approvals	UR	**CSA**	**IEC**	UR	**CSA**	**IEC**	UR	**CSA**	**IEC**
Voltage Rating	300V AC/DC	300V AC/DC	500V AC/DC	300V AC/DC	300V AC/DC	500V AC/DC	300V AC/DC	300V AC/DC	500V AC/DC
Maximum Current	12 A	12 A	12 A	12 A	12 A	12 A	12 A	12 A	12 A
Wire Range (Rated Cross Section)	#30… #12 AWG	#30… #12 AWG	0.05… 4 mm^2	#30… #12 AWG	#30… #12 AWG	0.05… 4 mm^2	#30… #12 AWG	#30… #12 AWG	0.05… 4 mm^2
Indicator Type	Neon			LED			Non-Indicating		
Leakage Current	2 mA @ 300V			2 mA @ 24V			—		
Working Voltage	100…300V AC			10…57V AC/DC			Per Fuse Rating		
Fuse Size (Not Supplied)	1/4" x 1-1/4"			1/4" x 1-1/4"			1/4" x 1-1/4"		
Wire Strip Length	0.38" (9.7 mm)			0.38" (9.7 mm)			0.38" (9.7 mm)		
Recommended Tightening Torque	3…7 lb-in. (0.3…0.8 Nm)			3…7 lb-in. (0.3…0.8 Nm)			3…7 lb-in. (0.3…0.8 Nm)		
Density	33 pcs./ft (109/m)			33 pcs./ft (109/m)			33 pcs./ft (109/m)		
Insulation Temperature Range	–40…+221°F (–40…+105°C)			–40…+221°F (–40…+105°C)			–40…+221°F (–40…+105°C)		
Terminal Blocks	**Cat. No.**		**Pcs./ Pkg.**	**Cat. No.**		**Pcs./ Pkg.**	**Cat. No.**		**Pcs./ Pkg.**
Terminal Block	1492-H4		25	1492-H5		25	1492-H6		25
Accessories (page 12-172)	**Cat. No.**		**Pcs./ Pkg.**	**Cat. No.**		**Pcs./ Pkg.**	**Cat. No.**		**Pcs./ Pkg.**
Mounting Rails: 1 m Symmetrical DIN (Steel)	199-DR1		10	199-DR1		10	199-DR1		10
1 m Symmetrical DIN (Aluminum)	1492-DR5		10	1492-DR5		10	1492-DR5		10
1 m Hi-Rise Sym. DIN (Aluminum)	1492-DR6		2	1492-DR6		2	1492-DR6		2
1 m Angled Hi-Rise Sym. DIN (Steel)	1492-DR7		2	1492-DR7		2	1492-DR7		2
End Barrier	1492-N37		50	1492-N37		50	1492-N37		50
End Anchors: DIN Rail — Normal Duty	1492-EA35		50	1492-EA35		50	1492-EA35		50
DIN Rail — Heavy Duty	1492-EAH35		10	1492-EAH35		10	1492-EAH35		10
Jumpers: Side Jumper — 10-pole Uninsulated	1492-N49		10	1492-N49		10	1492-N49		10
Side Jumper — Insulating Sleeve	1492-SJS		10	1492-SJS		10	1492-SJS		10
Other Accessories: Group Marking Carrier	1492-GM35		10	1492-GM35		10	1492-GM35		10
Marking Systems: Snap-in Marker Card	1492-SM8X12		5	1492-SM8X12		5	1492-SM8X12		5

Accessories — Page 12-172

Screw Connection Terminal Blocks

Standard Feed-Through Blocks

	1492-J3	1492-J4	1492-J6
Dimensions are not intended to be used for manufacturing purposes. **Note:** Height dimension is measured from top of rail to top of terminal block.			

Specifications	*Feed-Through Terminal Block*				*Feed-Through Terminal Block*				*Feed-Through Terminal Block*			
Certifications	RU	CSA	IEC	EEx e II	RU	CSA	IEC	EEx e II	RU	CSA	IEC	EEx e II
Voltage Rating	600V AC/DC		800V AC/DC	550V AC/DC	600V AC/DC		800V AC/DC	750V AC/DC	600V AC/DC		800V AC/DC	550V AC/DC
Maximum Current	25 A	20 A	24 A	21 A	35 A		32 A	28 A	50 A		41 A	36 A
Wire Range (Rated Cross Section)	30… 12 AWG	26… 12 AWG	2.5 mm^2	2.5 mm^2 (20… 14 AWG)	22… 10 AWG		4 mm^2	4 mm^2 (20… 12 AWG)	20… 8 AWG		6 mm^2	6 mm^2 (20… 10 AWG)
Wire Strip Length	0.39 in (10 mm)				0.39 in (10 mm)				0.47 in (12 mm)			
Recommended Tightening Torque	3.7…7.1 lb•in (0.4…0.8 Nm)				4.4…8.8 lb•in (0.5…1.0 Nm)				7.1…12.4 lb•in (0.8…1.4 Nm)			
Density (Blocks per ft/meter)	59 per ft/196 per meter				49 per ft/163 per meter				37 per ft/123 per meter			
Housing Temperature Range	–58…+248 °F (–50…+120 °C)				–58…+248 °F (–50…+120 °C)				–58…+248 °F (–50…+120 °C)			

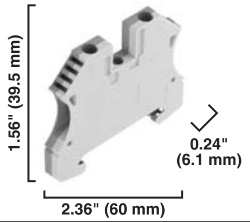
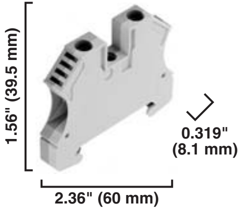
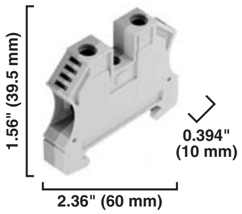
Terminal Blocks	Cat. No.	Pcs/ Pkg	Cat. No.	Pcs/ Pkg	Cat. No.	Pcs/ Pkg
Color: Gray	1492-J3	100	1492-J4	100	1492-J6	100
Red	1492-J3-RE	100	1492-J4-RE	100	1492-J6-RE	100
Blue	1492-J3-B	100	1492-J4-B	100	1492-J6-B	100
Black	1492-J3-BL	100	1492-J4-BL	100	1492-J6-BL	100
Green	1492-J3-G	100	1492-J4-G	100	1492-J6-G	100
Yellow	1492-J3-Y	100	1492-J4-Y	100	1492-J6-Y	100
Orange	1492-J3-OR	100	1492-J4-OR	100	1492-J6-OR	100
Brown	1492-J3-BR	100	1492-J4-BR	100	1492-J6-BR	100
White	1492-J3-W	100	1492-J4-W	100	1492-J6-W	100
Accessories	Cat. No.	Pcs/ Pkg	Cat. No.	Pcs/ Pkg	Cat. No.	Pcs/ Pkg
Mounting Rails: 1 m Symmetrical DIN (Steel)	199-DR1	10	199-DR1	10	199-DR1	10
1 m Symmetrical DIN (Aluminum)	1492-DR5	10	1492-DR5	10	1492-DR5	10
1 m Hi-Rise Sym. DIN (Aluminum)	1492-DR6	2	1492-DR6	2	1492-DR6	2
1 m Angled Hi-Rise Sym. DIN (Steel)	1492-DR7	2	1492-DR7	2	1492-DR7	2
End Barriers Gray	1492-EBJ3	50	1492-EBJ3	50	1492-EBJ3	50
Blue	1492-EBJ3-B	50	1492-EBJ3-B	50	1492-EBJ3-B	50
Yellow	1492-EBJ3-Y	50	1492-EBJ3-Y	50	1492-EBJ3-Y	50
End Anchors and Retainers: Screwless End Retainer	1492-ERL35	20	1492-ERL35	20	1492-ERL35	20
DIN Rail — Normal Duty	1492-EAJ35	100	1492-EAJ35	100	1492-EAJ35	100
DIN Rail — Heavy Duty	1492-EAHJ35	50	1492-EAHJ35	50	1492-EAHJ35	50
Jumpers:✶ Screw Center Jumper — 10 pole	1492-CJJ5-10	20	1492-CJJ6-10	20	1492-CJJ8-10	20
Screw Center Jumper — 4 pole	1492-CJJ5-4	50	1492-CJJ6-4	50	1492-CJJ8-4	50
Screw Center Jumper — 3 pole	1492-CJJ5-3	50	1492-CJJ6-3	50	1492-CJJ8-3	50
Screw Center Jumper — 2 pole	1492-CJJ5-2	50	1492-CJJ6-2	50	1492-CJJ8-2	50
Plug-in Center Jumper — 50 Pole	1492-CJLJ5-50	10	1492-CJLJ6-41 (41-pole)	10	—	—
Plug-in Center Jumper — 10 Pole	1492-CJLJ5-10	20	1492-CJLJ6-10	20	—	—
Plug-in Center Jumper — 9 Pole	1492-CJLJ5-9	20	—	—	—	—
Plug-in Center Jumper — 8 Pole	1492-CJLJ5-8	20	—	—	—	—
Plug-in Center Jumper — 7 Pole	1492-CJLJ5-7	20	—	—	—	—
Plug-in Center Jumper — 6 Pole	1492-CJLJ5-6	20	—	—	—	—
Plug-in Center Jumper — 5 Pole	1492-CJLJ5-5	20	—	—	—	—
Plug-in Center Jumper — 4 Pole	1492-CJLJ5-4	60	1492-CJLJ6-4	60	—	—
Plug-in Center Jumper — 3 Pole	1492-CJLJ5-3	60	1492-CJLJ6-3	60	—	—
Plug-in Center Jumper — 2 Pole	1492-CJLJ5-2	60	1492-CJLJ6-2	60	—	—
Insulated Side Jumper — 24 Pole	1492-SJ5B-24	50	—	—	—	—
Insulated Side Jumper — 10 Pole	1492-SJ5B-10	50	—	—	—	—
Screw Type Jumper Notching Tool	1492-T1	1	1492-T1	1	1492-T1	1
Other Accessories: Partition Plate	1492-EBJ16	20	1492-EBJ16	20	1492-EBJ16	20
Test Plug Socket	1492-TPS23	20	1492-TPS23L	50	1492-TPS23L	50
Test Plug	1492-TP23	20	1492-TP23	20	1492-TP23	20
Test Plug (Stackable)	1492-TPJ5	25	1492-TPJ6	25	—	—
Electrical Warning Plate	1492-EWPJ5	25	1492-EWPJ5	25	1492-EWPJ8	50
Group Marking Carrier	1492-GM35	25	1492-GM35	25	1492-GM35	25
Marking Systems: Snap-in Marker Cards	1492-M5X12 (144/card) 1492-M5X5 (200/card)	5 5	1492-M6X12 (120/card) 1492-M6X5 (200/card)	5 5	1492-M7X12 (108/card) 1492-M8X5 (160/card)	5 5

✶ Use of Center Jumpers may affect spacings, requiring derating of terminal blocks. See page 12-148 for details.

1492-JG6 ITEM # 57

Screw Connection Terminal Blocks

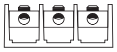
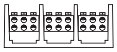
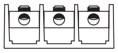
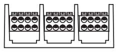
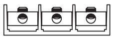
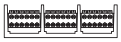
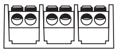
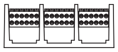
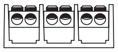
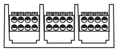
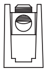
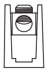
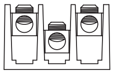
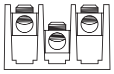
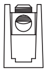
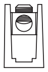
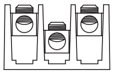
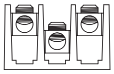
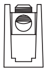
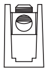
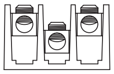
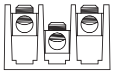
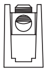
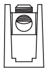
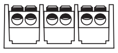
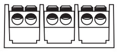
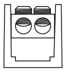
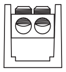
Grounding Blocks, Continued

	1492-JG4				1492-JG6				1492-JG10			
Dimensions are not intended to be used for manufacturing purposes. **Note:** Height dimension is measured from top of rail to top of terminal block.												
Specifications	*Feed-Through Ground Block*				*Feed-Through Ground Block*				*Feed-Through Ground Block*			
Certifications	UL	CSA	IEC	EEx e II	UL	CSA	IEC	EEx e II	UL	CSA	IEC	EEx e II
Voltage Rating	—	—	—	—	—	—	—	—	—	—	—	—
Maximum Current	Grounding				Grounding				Grounding			
Wire Range (Rated Cross Section)	22…10 AWG		4 mm^2	4 mm^2 (20…12 AWG)	22…8 AWG		6 mm^2	6 mm^2 (20…10 AWG)	22…6 AWG		10 mm^2	10 mm^2 (16…8 AWG)
Wire Strip Length	0.39 in (10 mm)				0.47 in (12 mm)				0.47 in (12 mm)			
Recommended Tightening Torque	4.4…8.8 lb•in (0.5…1.0 Nm)				7.1…14.2 lb•in (0.8…1.6 Nm)				10.6…21.2 lb•in (1.2…2.4 Nm)			
Mounting Torque — Center Screw	4.4…7.1 lb•in (0.5…0.8 Nm)				4.4…8.9 lb•in (0.5…1.0 Nm)				4.4…8.9 lb•in (0.5…1.0 Nm)			
Density (Blocks per ft/meter)	49 per ft/163 per meter				37 per ft/123 per meter				30 per ft/100 per meter			
Housing Temperature Range	–58…+248 °F (–50…+120 °C)				–58…+248 °F (–50…+120 °C)				–58…+248 °F (–50…+120 °C)			
Terminal Blocks	**Cat. No.**			**Pcs/ Pkg**	**Cat. No.**			**Pcs/ Pkg**	**Cat. No.**			**Pcs/ Pkg**
Color: Green/Yellow	1492-JG4			100	1492-JG6			50	1492-JG10			50
Accessories	**Cat. No.**			**Pcs/ Pkg**	**Cat. No.**			**Pcs/ Pkg**	**Cat. No.**			**Pcs/ Pkg**
Mounting Rails: 1 m Symmetrical DIN (Steel)	199-DR1			10	199-DR1			10	199-DR1			10
1 m Symmetrical DIN (Aluminum)	1492-DR5			10	1492-DR5			10	1492-DR5			10
1 m Hi-Rise Sym. DIN (Aluminum)	1492-DR6			2	1492-DR6			2	1492-DR6			2
1 m Angled Hi-Rise Sym. DIN (Steel)	1492-DR7			2	1492-DR7			2	1492-DR7			2
End Barrier	Not Required			—	Not Required			—	Not Required			—
End Anchors and End Retainers: Screwless End Retainer	1492-ERL35			20	1492-ERL35			20	1492-ERL35			20
DIN Rail — Normal Duty	1492-EAJ35			100	1492-EAJ35			100	1492-EAJ35			100
DIN Rail — Heavy Duty	1492-EAHJ35			50	1492-EAHJ35			50	1492-EAHJ35			50
Other Accessories: Group Marking Carrier	1492-GM35			25	1492-GM35			25	1492-GM35			25
Marking Systems: Snap-in marker cards	1492-M6X12 (120/card)			5	1492-M7X12 (108/card)			5	1492-M7X12 (108/card)			5
Snap-in marker cards	1492-M6X5 (200/card)			5	1492-M8X5 (160/card)			5	1492-M8X5 (160/card)			5

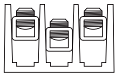
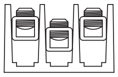
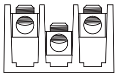
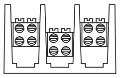
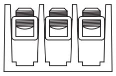
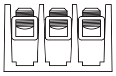
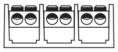
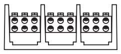
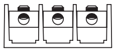
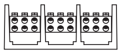
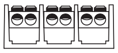
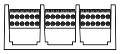
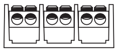
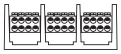
1492-PD31123
1492-PBC3

ITEM # 11 &
12

Aluminum Connectors, Continued

Cat. No.	Line					Load			
	No. of Poles	Amperage	Connector Configuration	Wire Range for Line	Wires Per Pole for Line	Connector Configuration	Wire Range for Load	Wires Per Pole for Load	Power Block Cover
1492-PD3163	3	335		400MCM- #6 (185…16)	1		#4…#14 (25…2.5)	6	1492-PBC2
1492-PD3183	3	335		400MCM- #6 (185…16)	1		#2…#14 (35…2.5)	8	1492-PBC8
1492-PD31123	3	380		500MCM- #6 (240…25)	1		#2…#14 (35…2.5)	12	1492-PBC3
1492-PD32127	3	760		500MCM- #6 (240…25)	2		#4…#14 (25…2.5)	12	1492-PBC3
1492-PD3287	3	760		500MCM- #6 (240…25)	2		#2/0…#14 (70…2.5)	8	1492-PBC3
1492-50Y	1	115		#2…#14 (35…2.5)	1		#2…#14 (35…2.5)	1	1492-PBC4
1492-50X	3	115		#2…#14 (35…2.5)	1		#2…#14 (35…2.5)	1	1492-PBC1
1492-100Y	1	175		2/0…#14 (70…2.5)	1		2/0…#14 (70…2.5)	1	1492-PBC4
1492-100X	3	175		2/0…#14 (70…2.5)	1		2/0…#14 (70…2.5)	1	1492-PBC1
1492-BE	1	255		250MCM- #6 (120…16)	1		250MCM- #6 (120…16)	1	1492-PBC5
1492-PD3113	3	310		350MCM- #6 (185…16)	1		350MCM- #6 (185…16)	1	1492-PBC2
1492-BF	1	420		600MCM- #4 (300…25)	1		600MCM- #4 (300…25)	1	1492-PBC6
1492-PD3226	3	620		350MCM- #6 (185…16)	3		350MCM- #6 (185…16)	3	1492-PBC3
1492-BG	1	760		500MCM- #4 (240…25)	2		500MCM- #4(240…25)	2	1492-PBC7

Copper Connectors

Cat. No.	Line					Load			
	No. of Poles	Amperage	Connector Configuration	Wire Range for Line	Wires Per Pole for Line	Connector Configuration	Wire Range for Load	Wires Per Pole for Load	Power Block Cover
1492-PD3C111	3	150		1/0...#16 (50…0.75)	1		1/0...#16 (50…0.75)	1	1492-PBC1
1492-PD3C141	3	175		2/0…#14 (70…2.5)	1		#4…#14 (25…2.5)	4	1492-PBC1
1492-PD3C112	3	255		250MCM-#6 (120…16)	1		250MCM-#6 (120…16)	1	1492-PBC2
1492-PD3C263	3	350		2/0…#14 (70…2.5)	2		#4…#14 (25…2.5)	6	1492-PBC2
1492-PD3C163	3	380		500MCM-#4 (240…25)	1		#2…#14 (35…2.5)	6	1492-PBC2
1492-PD3C2127	3	760		500MCM-#4 (240…25)	2		#2…#14 (35…2.5)	12	1492-PBC3
1492-PD3C287	3	760		500MCM-#4 (240…25)	2		#2…#14 (35…2.5)	8	1492-PBC3

Dimensions are in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.

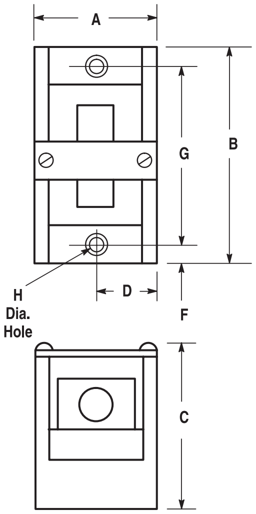


Figure 1

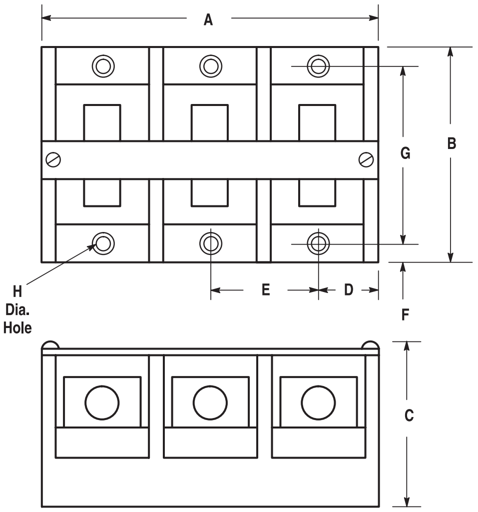


Figure 2

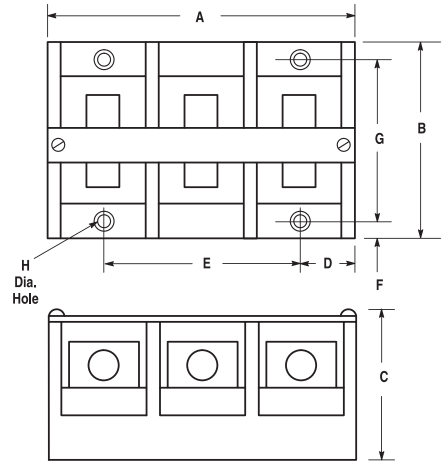


Figure 3

Cat. No.	Figure	A	B	C	D	E	F	G	H
1492-PDM3111	3*	2.03 (51.56)	2.29 (58.17)	1.62 (41.15)	0.38 (9.68)	1.27 (32.26)	0.19 (4.83)	1.93 (49.02)	0.201 (5.11)
1492-PDM3141	3*	2.03 (51.56)	2.29 (58.17)	1.62 (41.15)	0.38 (9.68)	1.27 (32.26)	0.19 (4.83)	1.93 (49.02)	0.201 (5.11)
1492-50Y	1	1.13 (28.7)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	—	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-100Y	1	1.13 (28.7)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	—	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-50X	3	2.75 (69.85)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	1.62 (41.2)	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-100X	3	2.75 (69.85)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	1.62 (41.2)	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-50XF	3	2.75 (69.85)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	1.62 (41.2)	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-50YF	1	1.13 (28.7)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	—	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-100XF	3	2.75 (69.85)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	1.62 (41.2)	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-100YF	1	1.13 (28.7)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	—	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-PD3C111	3	2.75 (69.85)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	1.62 (41.2)	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-PD3C141	3	2.75 (69.85)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	1.62 (41.2)	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-PD3141	3	2.75 (69.85)	2.88 (73.15)	1.88 (47.8)	0.56 (14.22)	1.62 (41.2)	0.31 (7.87)	2.25 (57.15)	0.205 (5.21)
1492-BE	1	1.94 (49.28)	4 (101.6)	2.72 (69.1)	0.97 (24.64)	—	0.31 (7.87)	3.38 (85.85)	0.203 (5.16)
1492-PD3C112	2	5 (127)	4 (101.6)	2.72 (69.1)	0.97 (24.64)	1.53 (38.86)	0.31 (7.87)	3.38 (85.85)	0.203 (5.16)
1492-PD3113	2	5 (127)	4 (101.6)	2.72 (69.1)	0.97 (24.64)	1.53 (38.86)	0.31 (7.87)	3.38 (85.85)	0.203 (5.16)
1492-PD3263	2	5 (127)	4 (101.6)	2.72 (69.1)	0.97 (24.64)	1.53 (38.86)	0.31 (7.87)	3.38 (85.85)	0.203 (5.16)
1492-PD3163	2	5 (127)	4 (101.6)	2.72 (69.1)	0.97 (24.64)	1.53 (38.86)	0.31 (7.87)	3.38 (85.85)	0.203 (5.16)
1492-PD3C163	2	5 (127)	4 (101.6)	2.72 (69.1)	0.97 (24.64)	1.53 (38.86)	0.31 (7.87)	3.38 (85.85)	0.203 (5.16)
1492-PD3C263	2	5 (127)	4 (101.6)	2.72 (69.1)	0.97 (24.64)	1.53 (38.86)	0.31 (7.87)	3.38 (85.85)	0.203 (5.16)
1492-BF	1	2.28 (57.91)	4.75 (120.65)	2.92 (74.2)	1.12 (28.45)	—	0.31 (7.87)	4.13 (104.9)	0.203 (5.16)
1492-PD3183	2	6.04 (153.42)	4.75 (120.65)	2.92 (74.2)	1.12 (28.45)	1.88 (47.75)	0.31 (7.87)	4.13 (104.9)	0.203 (5.16)
1492-BG	1	3.17 (80.25)	5.50 (139.7)	3.23 (82.0)	1.58 (40.13)	—	0.38 (9.68)	4.75 (120.65)	0.265 (6.73)
1492-PD31123	2	8.54 (216.92)	5.50 (139.7)	3.23 (82.0)	1.58 (40.13)	2.69 (68.58)	0.38 (9.68)	4.75 (120.65)	0.265 (6.73)
1492-PD3287	2	8.54 (216.92)	5.50 (139.7)	3.23 (82.0)	1.58 (40.13)	2.69 (68.58)	0.38 (9.68)	4.75 (120.65)	0.265 (6.73)
1492-PD32127	2	8.54 (216.92)	5.50 (139.7)	3.23 (82.0)	1.58 (40.13)	2.69 (68.58)	0.38 (9.68)	4.75 (120.65)	0.265 (6.73)
1492-PD3226	2	8.54 (216.92)	5.50 (139.7)	3.23 (82.0)	1.58 (40.13)	2.69 (68.58)	0.38 (9.68)	4.75 (120.65)	0.265 (6.73)
1492-PD3C2127	2	8.54 (216.92)	5.50 (139.7)	3.23 (82.0)	1.58 (40.13)	2.69 (68.58)	0.38 (9.68)	4.75 (120.65)	0.265 (6.73)
1492-PD3C287	2	8.54 (216.92)	5.50 (139.7)	3.23 (82.0)	1.58 (40.13)	2.69 (68.58)	0.38 (9.68)	4.75 (120.65)	0.265 (6.73)

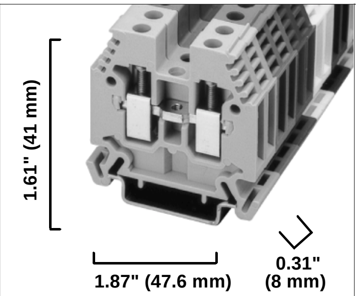
* No Marker Strip.

1492-W16 | ITEM # 58

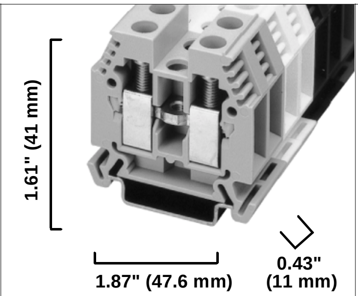
Dimensions are not intended to be used for manufacturing purposes.

Note: Height dimension is measured from top of rail to top of terminal block.

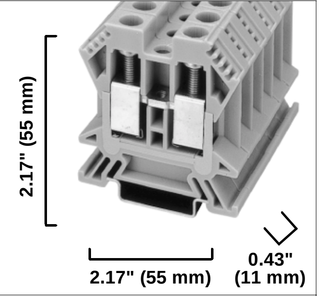
1492-W10



1492-W16S



1492-W16



	1492-W10				1492-W16S				1492-W16		
Specifications	*Single-circuit terminal block.*				*Single-circuit terminal block.*				*Single-circuit terminal block.*		
Approvals	**UR**	**EEx e II**	**CSA**	**IEC**	**UR**	**EEx e II**	**CSA**	**IEC**	**UR**	**CSA**	**IEC**
Voltage Rating	600V AC/DC	550V	600V AC/DC	800V AC/DC	600V AC/DC	550V	600V AC/DC	800V AC/DC	600V AC/DC	600V AC/DC	750V AC/DC
Maximum Current	50 A	50 A	50 A	57 A	85 A	96 A	85 A	76 A	70 A	105 A	85 A
Wire Range (Rated Cross Section)	#22… #8 AWG	10 mm^2	#22… #8 AWG	0.5… 10 mm^2	#14… #4 AWG	16 mm^2	#14… #4 AWG	2.5… 16 mm^2	#14… #4 AWG	#14… #4 AWG	1.5… 16 mm^2
Wire Strip Length	0.51" (13 mm)				0.51" (13 mm)				0.51" (13 mm)		
Recommended Tightening Torque	12.2…13.4 lb-in. (1.4 Nm)				18…20 lb-in. (2.1 Nm)				22.1 lb-in. (2.5 Nm)		
Density	38 pcs./ft (125/m)				27 pcs./ft (90/m)				27 pcs./ft (90/m)		
Insulation Temperature Range	–40…+195°F (–40…+90°C)				–40…+195°F (–40…+90°C)				–40…+195°F (–40…+90°C)		

Terminal Blocks	**Cat. No.**	**Pcs./Pkg.**	**Cat. No.**	**Pcs./Pkg.**	**Cat. No.**	**Pcs./Pkg.**
Color: Gray	1492-W10	50	1492-W16S	50	1492-W16	50
Red	1492-W10-RE	50	1492-W16S-RE	50	—	—
Blue	1492-W10-B	50	1492-W16S-B	50	1492-W16-B	50
Black	1492-W10-BL	50	1492-W16S-BL	50	—	—
Green	1492-W10-G	50	1492-W16S-G	50	—	—
Yellow	1492-W10-Y	50	1492-W16S-Y	50	1492-W16-Y	50
Orange	1492-W10-OR	50	1492-W16S-OR	50	—	—
White	1492-W10-W	50	1492-W16S-W	50	—	—
Brown	1492-W10-BR	50	1492-W16-BR	50	—	—

Accessories (page 12-172)	**Cat. No.**	**Pcs./Pkg.**	**Cat. No.**	**Pcs./Pkg.**	**Cat. No.**	**Pcs./Pkg.**
Mounting Rails: 1 m Symmetrical DIN (Steel)	199-DR1	10	199-DR1	10	199-DR1	10
1 m Symmetrical DIN (Aluminum)	1492-DR5	10	1492-DR5	10	1492-DR5	10
1 m Hi-Rise Sym. DIN (Aluminum)	1492-DR6	2	1492-DR6	2	1492-DR6	2
1 m Angled Hi-Rise Sym. DIN (Steel)	1492-DR7	2	1492-DR7	2	1492-DR7	2
End Barrier	1492-EB10	50	1492-EB10	50	1492-EB16	50
End Anchors: DIN Rail — Normal Duty	1492-EA35	50	1492-EA35	50	1492-EA35	50
DIN Rail — Heavy Duty	1492-EAH35	10	1492-EAH35	10	1492-EAH35	10
Jumpers: Side Jumper — 10-pole Insulated	1492-SJ8-10	10	—	—	—	—
Center Jumper — 40-pole	1492-CJ8-40	5	—	—	—	—
Center Jumper — 10-pole	1492-CJ8-10	10	1492-CJS11-10	10	1492-CJ11-10	10
Center Jumper — 3-pole	1492-CJ8-3	10	1492-CJS11-3	10	1492-CJ11-3	10
Center Jumper — 2-pole	1492-CJ8-2	10	1492-CJS11-2	10	1492-CJ11-2	10
Center Jumper Link	1492-CJL8	10	—	—	—	—
Center Jumper Cover — White ❶	1492-CJCW6	20	—	—	—	—
Other Accessories: Partition Plate	1492-PP10	50	1492-PP10	50	1492-PP16	50
Test Plug	1492-TP28	10	—	—	—	—
Test Plug Adapter	1492-TA40	10	1492-TA40L	10	—	—
Electrical Warning Plate (4-pole)	1492-EWP8-4	10	1492-EWP11-4	10	1492-EWP11-4	10
Group Marking Carrier	1492-GM35	10	1492-GM35	10	1492-GM35	10
Marking Systems: Snap-in Marker Card	1492-SM8X12	5	1492-SM6X12	5	1492-SM6X12	5
Individual Marker Tabs (single char.)	1492-MP ❷	5	1492-MP ❷	5	1492-MP ❷	5

❶ May only be used as a marking surface. Cannot be installed over a center jumper.
❷ Cat. no. is not complete. See page 12-173.

Allen-Bradley

MicroLogix™ 1500 Programmable Controllers

Bulletin 1764

1764-28BXB
1764-LRP
1769-ECR
1769-IF4
1769-OF2
1769-IQ16
1769-OB16

ITEM # 33,34, 35, 36,
37, 38 & 39

User Manual

Rockwell
Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Reproduction of the contents of this copyrighted publication, in whole or part, without written permission of Rockwell Automation, is prohibited.

Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard, avoid a potential hazard, and recognize the consequences of a potential hazard:

WARNING Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Summary of Changes

The information below summarizes the changes to this manual since the last printing.

To help you find new and updated information in this release of the manual, we have included change bars as shown to the right of this paragraph.

The table below lists the sections that document new features and additional or updated information on existing features.

For this information:	See
Series C support for up to 16 expansion I/O modules	Chapter 1
List of controller series, OS FRN numbers, and RSLogix versions	Page 1-5
Updated list of recommended surge suppressors	Page 3-6
Ethernet Connectivity	Page 4-23
Typical CPU hold-up time	Page A-1
Updated system loading and heat dissipation worksheets	Appendix F
System loading graphs for 1769 power supplies, including 1769-PA4 and 1769-PB4	pages F-5 through F-7

Preface

Chapter 1

Hardware Overview

Chapter 2

Installing Your Controller

Chapter 3

Wiring Your Controller

Chapter 4

Communication Connections

Chapter 5

Using Trim Pots and the Data Access Tool (DAT)

Chapter 6

Using Real-Time Clock and Memory Modules

Appendix A

Specifications

Appendix B

Replacement Parts

Appendix C

Troubleshooting Your System

Appendix D

Upgrading Your Operating System

Appendix E

Understanding Communication Protocols

Appendix F

System Loading and Heat Dissipation

Glossary

Index

Read this preface to familiarize yourself with the rest of the manual. It provides information concerning:

- who should use this manual
- the purpose of this manual
- related documentation
- conventions used in this manual
- Rockwell Automation support

Who Should Use this Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use MicroLogix 1500 controllers.

You should have a basic understanding of electrical circuitry and familiarity with relay logic. If you do not, obtain the proper training before using this product.

Purpose of this Manual

This manual is a reference guide for MicroLogix 1500 controllers. It describes the procedures you use to install, wire, and troubleshoot your controller. This manual:

- explains how to install and wire your controllers
- gives you an overview of the MicroLogix 1500 controller system

Refer to publication 1762-RM001, *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual* for the MicroLogix 1200 and 1500 instruction set and for application examples to show the instruction set in use. Refer to your programming software user documentation for more information on programming your MicroLogix 1500 controller.

Related Documentation

The documents listed on page P-2 contain additional information concerning Rockwell Automation products. If you would like a copy, you can:

- download a free electronic version from the internet: www.ab.com/micrologix or www.theautomationbookstore.com
- purchase a printed manual by:
  - contacting your local distributor or Rockwell Automation representative
  - visiting www.theautomationbookstore.com and placing your order
  - calling 1.800.963.9548 (USA/Canada) or 001.330.725.1574 (Outside USA/Canada)

For	Read this Document	Document Number
A technical overview of the MicroLogix 1500 and related products	MicroLogix 1500 Programmable Controllers Technical Data	1764-TD001
Information on the MicroLogix 1500 Controllers instruction set	MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual	1762-RM001
Information on mounting and wiring the MicroLogix 1500 Base Units, including a mounting template for easy installation	MicroLogix 1500 Programmable Controllers Base Unit Installation Instructions	1764-IN001
An overview of Compact I/O	Compact I/O System Overview	1769-SO001
More information on Compact I/O Power Supplies and Cables	1769 Compact I/O Power Supplies and Communication Bus Expansion Cables Technical Data	1769-TD001
More information on Compact Analog I/O and Temperature Input Modules	Compact Analog I/O and Temperature Input Modules Technical Data	1769-TD004
Detailed information on using Compact I/O Analog Modules	Compact I/O Analog Modules User Manual	1769-UM002
Detailed information on installing, configuring, and using 1769-IT6 Thermocouple/mV Input Modules	Compact I/O 1769-IT6 Thermocouple/mV Input Module User Manual	1769-UM004
Detailed information on installing, configuring, and using 1769-IR6 RTD/Resistance Input Modules	Compact I/O 1769-IR6 RTD/Resistance Input Module User Manual	1769-UM005
Detailed information on installing, configuring, and using 1769-HSC High Speed Counter Modules	Compact 1769-HSC High Speed Counter Module User Manual	1769-UM006
A description on how to install and connect an AIC+. This manual also contains information on network wiring.	Advanced Interface Converter (AIC+) User Manual	1761-6.4
Information on how to install, configure, and commission a DNI	DeviceNet™ Interface User Manual	1761-6.5
Information on installing, connecting, and configuring an ENI	Ethernet Interface User Manual	1761-UM001
Information on installing, configuring, and using a DeviceNet Scanner	Compact™ I/O 1769-SDN DeviceNet Scanner User Manual	1761-UM009
Information on DF1 open protocol.	DF1 Protocol and Command Set Reference Manual	1770-6.5.16
In-depth information on grounding and wiring Allen-Bradley programmable controllers	Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1
A description of important differences between solid-state programmable controller products and hard-wired electromechanical devices	Application Considerations for Solid-State Controls	SGI-1.1
An article on wire sizes and types for grounding electrical equipment	National Electrical Code - Published by the National Fire Protection Association of Boston, MA.	
A complete listing of current documentation, including ordering instructions. Also indicates whether the documents are available on CD-ROM or in multi-languages.	Allen-Bradley Publication Index	SD499
A glossary of industrial automation terms and abbreviations	Allen-Bradley Industrial Automation Glossary	AG-7.1

Common Techniques Used in this Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.

Rockwell Automation Support

Rockwell Automation offers support services worldwide, with over 75 Sales/Support Offices, 512 authorized Distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Rockwell Automation representatives in every major country in the world.

Local Product Support

Contact your local Rockwell Automation representative for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

Before you contact Rockwell Automation for technical assistance, we suggest you please review the troubleshooting information contained in this publication first.

If the problem persists, call your local Rockwell Automation representative or contact Rockwell Automation in one of the following ways:

Phone	United States/Canada	1.440.646.5800
	Outside United States/Canada	You can access the phone number for your country via the Internet: 1. Go to http://www.ab.com 2. Click on *Product Support* (http://support.automation.rockwell.com) 3. Under *Support Centers*, click on *Contact Information*
Internet	⇒	1. Go to http://www.ab.com 2. Click on *Product Support* (http://support.automation.rockwell.com)

Your Questions or Comments on this Manual

If you find a problem with this manual, or you have any suggestions for how this manual could be made more useful to you, please contact us at the address below:

Rockwell Automation
Automation Control and Information Group
Technical Communication, Dept. A602V
P.O. Box 2086
Milwaukee, WI 53201-2086

or visit our internet page at:

http://www.rockwellautomation.com

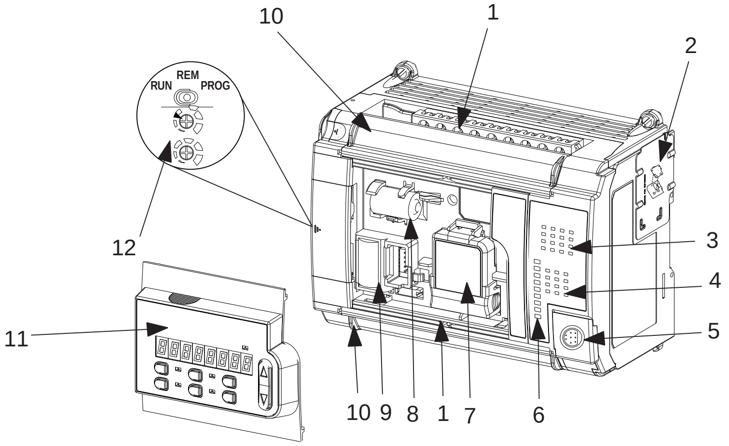
For the latest information on MicroLogix controllers, visit www.ab.com/micrologix

Hardware Overview

Hardware Features

The MicroLogix 1500 programmable controller is composed of a base unit, which contains a power supply, input and output circuits, and a processor. The controller is available with 24 or 28 points of embedded I/O. Additional I/O may be added using Compact™ I/O.

The hardware features of the controller are:



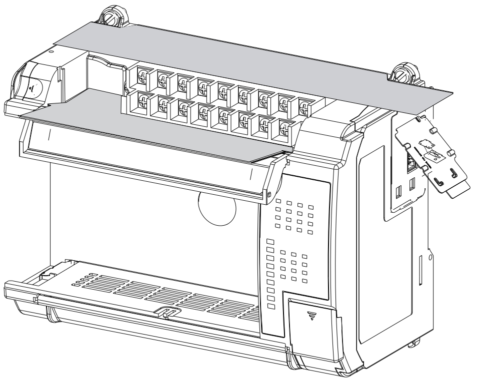
Feature	Description	Feature	Description
1	Removable Terminal Blocks	7	Memory Module/Real-Time Clock(1)
2	Interface to Expansion I/O, Removable ESD Barrier	8	Replacement Battery(1)
3	Input LEDs	9	Battery
4	Output LEDs	10	Terminal Doors and Label
5	Communication Port	11	Data Access Tool(1)
6	Status LEDs	12	Mode Switch, Trim Pots

(1) Optional.

MicroLogix 1500 Component Descriptions

A controller is composed of a processor (1764-LSP or enhanced 1764-LRP with RS-232 port) and one of the base units listed below. The FET transistor outputs are available on the 1764-28BXB base only.

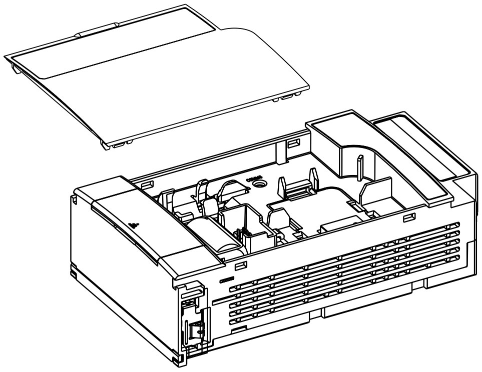
Base Units



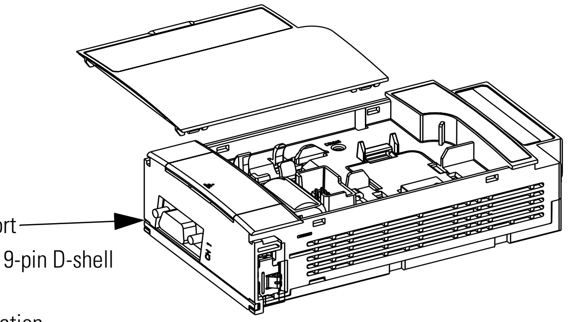
Catalog Number	Line Power	Inputs	Outputs	High Speed I/O
1764-24AWA	120/240V ac	(12) 120V ac	(12) Relay, 2 isolated relays per unit	n/a
1764-24BWA	120/240V ac	(8) Standard 24V dc (4) Fast 24V dc	(12) Relay, 2 isolated relays per unit	(4) 20 kHz input
1764-28BXB	24V dc	(8) Standard 24V dc (8) Fast 24V dc	(6) Relay, 2 isolated relays per unit (4) Standard 24V dc FET (2) Fast 24V dc FET	(8) 20 kHz input (2) 20 kHz output

Processors

Processor (Catalog Number 1764-LSP)



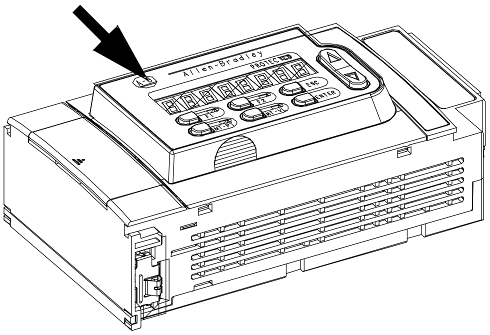
Processor (Catalog Number 1764-LRP)



Communications Port

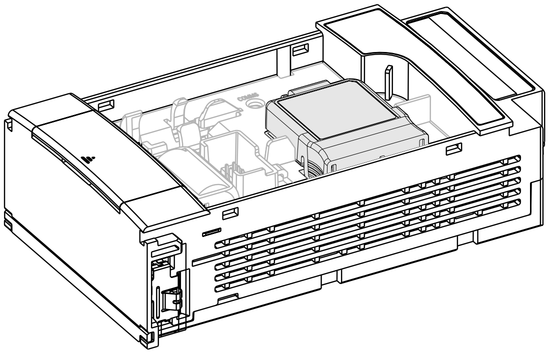
- DTE (male) 9-pin D-shell connector
- 30V dc isolation

Data Access Tool (Catalog Number 1764-DAT)



1764-DAT mounted on 1764-LSP processor.

Memory Modules/Real-Time Clock



Memory module mounted on 1764-LSP processor.

The following memory modules and real-time clock modules are available:

Catalog Number	Function	Memory Size
1764-RTC	Real-Time Clock	not applicable
1764-MM1	Memory Module	8K
1764-MM1RTC	Memory Module and Real-Time Clock	8K
1764-MM2(1)	Memory Module	16K
1764-MM2RTC(1)	Memory Module and Real-Time Clock	16K

(1) For 1764-LRP programs greater than 8k, use the 1764-MM2 or 1764-MM2RTC.

Cables

Use only the following communication cables in Class I, Division 2 hazardous locations.

Table 1.1 Cables for Use in Class I, Division 2 Hazardous Environment

1761-CBL-PM02 Series C or later	2707-NC8 Series B or later
1761-CBL-HM02 Series C or later	2707-NC9 Series B or later
1761-CBL-AM00 Series C or later	2707-NC10 Series B or later
1761-CBL-AP00 Series C or later	2707-NC11 Series B or later

Programming

Programming the MicroLogix 1500 programmable controller is done using RSLogix™ 500, Rev. 4.0 or later. Certain features are only available when using the most current version of the software, as noted in System Requirements for Using Expansion Modules on page 1-7.

The following table lists the firmware release numbers, feature and functionality enhancements, and the required version of RSLogix 500 and RSLogix 500 Starter software.

Table 1.B Required Software Version by FRN Number

Controller	Firmware Release	Available for Sale Date	Catalog Number Series	Catalog Number Revision	OS FRN Number	Feature and Functionality Changes	Required Version of RSLogix 500/RSLogix 500 Starter Software
1764-LSP	Initial Release	February 1999	A	B	2	Initial Release	3.01.00
	Enhancement	October 1999	A	C	3	Power Supply and Expansion Cable Compatibility	3.01.00
	Series B Release	March 2000	B	A	4	String Data File Type, ASCII Instruction Set, Modbus RTU Slave Protocol, Ramping (when using PWM outputs), Static Data File Protection, RTC Messaging	4.00.00
	Enhancement	October 2000	B	B	5	PTO Controlled Stop, Memory Module Program Compare Bit Enhancement	4.50.00
	Series C Release	September 2001	C	A	6	Floating Point Data File Support, Programmable Limit Switch (PLS), Real Time Clock Adjust (Copy Word), Absolute Value, Gray Code, Recipe, Message Instruction Support for 1769-SDN	5.10.00
1764-LRP	Initial Release	March 2000	B	A	4	Initial Release - Same Functionality as 1764-LSP	4.00.00
	Enhancement	October 2000	B	B	5	PTO Controlled Stop, Memory Module Program Compare Bit Enhancement	4.50.00
	Series C Release	September 2001	C	A	6	Floating Point Data File Support, Programmable Limit Switch (PLS), Real Time Clock Adjust (Copy Word), Absolute Value, Gray Code, Recipe, Message Instruction Support for 1769-SDN	5.10.00

Communication Options

The MicroLogix 1500 can be connected to a personal computer. It can also be connected to the DH-485 network using an Advanced Interface Converter (1761-NET-AIC), to an Ethernet network using an Ethernet Interface (1761-NET-ENI), or to a DeviceNet™ network using a DeviceNet Interface (1761-NET-DNI) or through the DeviceNet Scanner module (1769-SDN). The controller can also be connected to Modbus™ SCADA networks as an RTU slave. See Communication Connections on page 4-1 for more information on connecting to the available communication options.

The 1764-LRP processor provides an additional communication port. Each of the communications ports can be independently configured for any supported communication protocol. (Channel 0 is on the base unit and Channel 1 is on the 1764-LRP processor.)

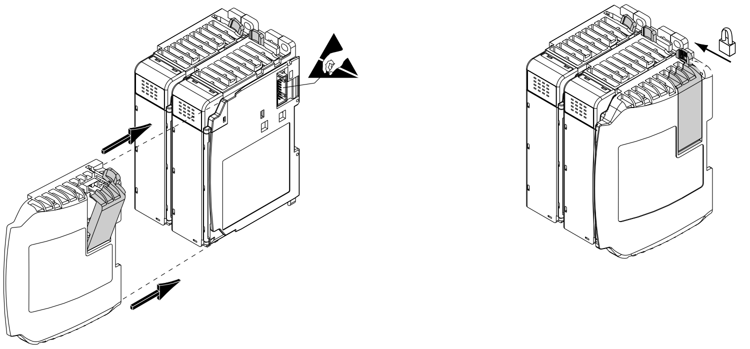
Compact™ Expansion I/O

Compact expansion I/O (Bulletin 1769) can be connected to the MicroLogix 1500 Controller. A maximum of either 8 or 16 expansion I/O modules can be used, depending upon your system. See System Requirements for Using Expansion Modules on page 1-7.

See System Loading and Heat Dissipation on page F-1 for more information on system configurations.

End Cap

An end cap terminator (catalog number 1769-ECR or 1769-ECL) must be used at the end of the group of I/O modules attached to the MicroLogix 1500 Controller. The end cap terminator is not provided with the base or processor units. It is required when using expansion I/O.



This illustration shows the right end cap (1769-ECR). The left end cap (1769-ECL) is shown on page 1-10.

Expansion Power Supply and Cables

With Operating System Revision Number (FRN) 3 or higher, you can connect an additional bank of I/O to your controller. Using an expansion power supply increases the system's capacity for adding expansion I/O modules. The additional I/O bank is connected to the controller via a specially designed cable. The additional I/O bank must include a power supply and an end cap.

TIP

Depending on the system configuration, each controller can support up to 16 expansion I/O modules. See the System Requirements for Using Expansion Modules below. Also see System Guidelines on page 1-9 for system limitations and illustrations of expansion I/O banks.

System Requirements for Using Expansion Modules

To support a maximum of 8 I/O modules in an additional I/O bank, you must have the following:

Table 1.3 Requirements to Support a Maximum of 8 I/O Modules

Product	Catalog Number	
MicroLogix 1500 Processor	1764-LSP, Series A, Revision C or higher 1764-LSP, Series B or higher 1764-LRP, Series B or higher	
MicroLogix 1500 Base Unit	1764-24AWA, Series A or higher 1764-24BWA, Series A or higher 1764-28BXB, Series A or higher	
Operating System Version	Firmware Revision Number (FRN) 3 or higher(1)	
Programming Software	1764-LSP, Series A	RSLogix 500, Version 3.01.09 or higher,
	1764-LSP, Series B 1764-LRP, Series B	RSLogix 500, Version 4.00.00 or higher.
	1764-LSP, Series C 1764-LRP, Series C	RSLogix 500, Version 5.00.00 or higher.
1 Power Supply (optional)	1769-PA2, 1769-PA4 1769-PB2, 1769-PB4	
1 Cable (optional)	1769-CRL1, 1769-CRL3, 1769-CRR1, 1769-CRR3	
1 End Cap (required)	1769-ECL, 1769-ECR	

(1) You can check the FRN by looking at word S:59 (Operating System FRN) in the Status File.

To support a maximum of 16 I/O modules in an additional I/O bank, you must have the following:

Table 1.4 Requirements to Support a Maximum of 16 I/O Modules

Product	Catalog Number
MicroLogix 1500 Processor	1764-LSP, Series C or higher 1764-LRP, Series C or higher
MicroLogix 1500 Base Unit	1764-24AWA, Series B or higher 1764-24BWA, Series B or higher 1764-28BXB, Series B or higher
Operating System Version	Firmware Revision Number (FRN) 6 or higher(1)
Programming Software	RSLogix 500, Version 5.10.00 or higher.
1 Power Supply (optional)	1769-PA2, 1769-PA4, 1769-PB2, 1769-PB4
1 Cable (optional)	1769-CRL1, 1769-CRL3, 1769-CRR1, 1769-CRR3
1 End Cap (required)	1769-ECL, 1769-ECR

(1) You can check the FRN by looking at word S:59 (Operating System FRN) in the Status File.

IMPORTANT

If your processor is at an older revision, you *must* upgrade the operating system to FRN 3 or higher to use an expansion cable and power supply (or to FRN 6 or higher to allow up to 16 expansion modules). On the Internet, go to **http://www.ab.com/micrologix** to download the operating system upgrade. Navigate to MicroLogix 1500 for further instructions and downloads.

MicroLogix 1500 base units are ***not*** field upgradeable from Series A to Series B.

Adding an I/O Bank

System Guidelines

A maximum of one 1769 Expansion Cable can be used in a MicroLogix 1500 system, allowing for two banks of I/O modules (one connected directly to the controller, and the other connected via the cable). Each I/O bank requires its own power supply (Bank 1 uses the controller's embedded power supply).

ATTENTION

LIMIT OF ONE EXPANSION POWER SUPPLY

The expansion power supply cannot be connected directly to the controller. It must be connected using an expansion cable. Only one power supply (embedded in the base unit or an expansion power supply) may be used on an I/O bank. Exceeding these limitations may damage the power supply and result in unexpected operation.

ATTENTION

REMOVE POWER

Remove system power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine operation
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector.

Refer to your power supply and I/O module's documentation for instructions on how to set up your system.

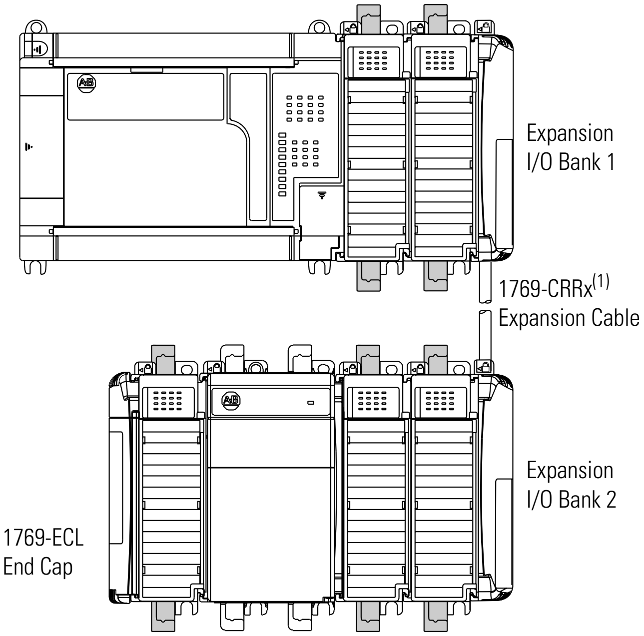
IMPORTANT

See the System Requirements for Using Expansion Modules on page 1-7 to determine the maximum number of expansion I/O modules you can use in your MicroLogix system.

Also see System Loading and Heat Dissipation on page F-1 for more information on system configurations.

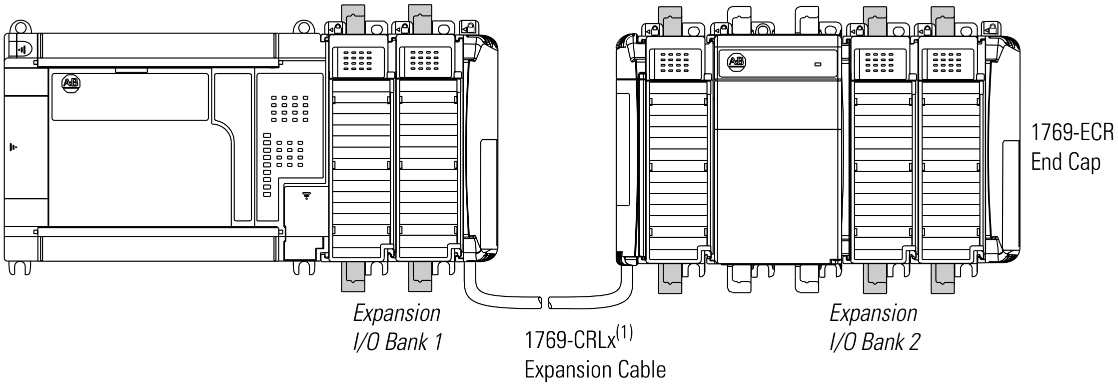
The following illustrations show a MicroLogix 1500 with an expansion I/O bank.

Vertical Orientation



(1) The x in this catalog number can be either a 1 or a 3 representing the length of the cable: 1 = 1 foot (305 mm) and 3 = 3.28 feet (1 meter).

Horizontal Orientation

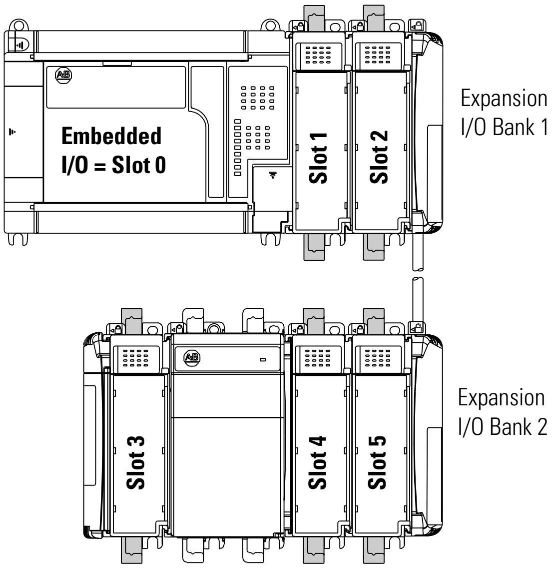


(1) The x in this catalog number can be either a 1 or a 3 representing the length of the cable: 1 = 1 foot (305 mm) and 3 = 3.28 feet (1 meter).

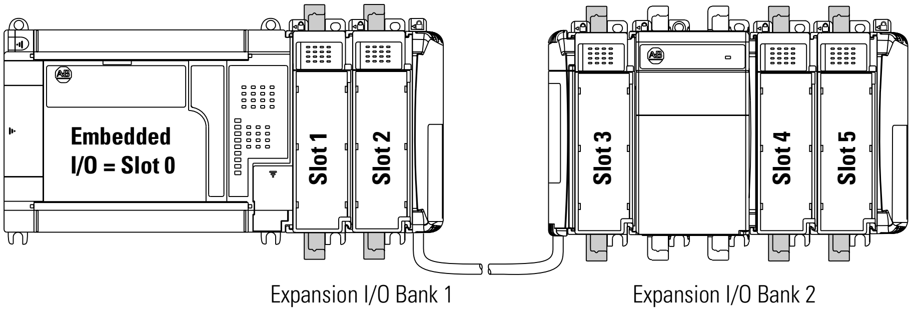
Addressing Expansion I/O

The expansion I/O is addressed as slots 1 through 16 (the controller's embedded I/O is addressed as slot 0). Power supplies and cables are not counted as slots. Modules are counted from left to right on each bank as shown in the illustrations below. For more information on addressing, refer to the *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001.

Vertical Orientation



Horizontal Orientation



Expansion I/O Power Failure

Expansion I/O errors represent failures of the I/O bus or the modules themselves. The error codes are listed in the *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001.

Installing Your Controller

This chapter shows you how to install your controller system. The only tools you require are a Flat or Phillips head screwdriver and drill. Topics include:

- agency certifications
- compliance to European Union Directives
- using in hazardous locations
- master control relay
- power considerations
- preventing excessive heat
- controller spacing
- mounting the controller

Agency Certifications

- UL 508
- C-UL under CSA C22.2 no. 142
- Class I, Division 2, Groups A, B, C, D
  (UL 1604, C-UL under CSA C22.2 no. 213)
- CE compliant for all applicable directives

Compliance to European Union Directives

This product has the CE mark and is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2
  EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2
  EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- *Industrial Automation Wiring and Grounding Guidelines for Noise Immunity*, publication 1770-4.1
- *Guidelines for Handling Lithium Batteries*, publication AG-5.4
- *Automation Systems Catalog*, publication B111

Installation Considerations

Most applications require installation in an industrial enclosure (Pollution Degree 2(1)) to reduce the effects of electrical interference (Over Voltage Category II(2)) and environmental exposure. Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the *Industrial Automation Wiring and Grounding Guidelines* publication 1770-4.1.

ATTENTION

Vertical mounting of the controller is not recommended due to heat build-up considerations.

ATTENTION

Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the base or processor unit could cause damage. Do not drill holes above a mounted controller if the protective debris strips are removed or the processor is installed.

---

(1) Pollution Degree 2 is an environment where normally only non-conductive pollution occurs except that occasionally temporary conductivity caused by condensation shall be expected.

(2) Overvoltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the products insulation.

Safety Considerations

Safety considerations are an important element of proper system installation. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance. We recommend reviewing the following safety considerations.

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off.
- Do not connect or disconnect components unless power has been switched off, or the area is known to be non-hazardous.
- This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.
- All wiring must comply with N.E.C. article 501-4(b).

WARNING

When installing any peripheral device (for example, push buttons, lamps) into a hazardous environment, ensure that they are Class I, Division 2 certified, or determined to be safe for the environment.

Use only the following communication cables in Class I, Division 2 hazardous locations.

Table 2.1 Cables for Use in Class I, Division 2 Hazardous Environment

1761-CBL-PM02 Series C or later	2707-NC8 Series B or later
1761-CBL-HM02 Series C or later	2707-NC9 Series B or later
1761-CBL-AM00 Series C or later	2707-NC10 Series B or later
1761-CBL-AP00 Series C or later	2707-NC11 Series B or later

Disconnecting Main Power

WARNING

EXPLOSION HAZARD

Do not replace components or disconnect equipment unless power has been switched off.

The main power disconnect switch should be located where operators and maintenance personnel have quick and easy access to it. In addition to disconnecting electrical power, all other sources of power (pneumatic and hydraulic) should be de-energized before working on a machine or process controlled by a controller.

Safety Circuits

WARNING

EXPLOSION HAZARD

Do not connect or disconnect connectors while circuit is live.

Circuits installed on the machine for safety reasons, like overtravel limit switches, stop push buttons, and interlocks, should always be hard-wired directly to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Power Distribution

There are some points about power distribution that you should know:

- The master control relay must be able to inhibit all machine motion by removing power to the machine I/O devices when the relay is de-energized. It is recommended that the controller remain powered even when the master control relay is de-energized.
- If you are using a dc power supply, interrupt the load side rather than the ac line power. This avoids the additional delay of power supply turn-off. The dc power supply should be powered directly from the fused secondary of the transformer. Power to the dc input and output circuits should be connected through a set of master control relay contacts.

Periodic Tests of Master Control Relay Circuit

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to assure they will stop machine motion when needed.

Power Considerations

The following explains power considerations for the micro controllers.

Isolation Transformers

You may want to use an isolation transformer in the ac line to the controller. This type of transformer provides isolation from your power distribution system to reduce the electrical noise that enters the controller and is often used as a step-down transformer to reduce line voltage. Any transformer used with the controller must have a sufficient power rating for its load. The power rating is expressed in volt-amperes (VA).

Power Supply Inrush

During power-up, the MicroLogix 1500 power supply allows a brief inrush current to charge internal capacitors. Many power lines and control transformers can supply inrush current for a brief time. If the power source cannot supply this inrush current, the source voltage may sag momentarily.

The only effect of limited inrush current and voltage sag on the MicroLogix 1500 is that the power supply capacitors charge more slowly. However, the effect of a voltage sag on other equipment should be considered. For example, a deep voltage sag may reset a computer connected to the same power source. The following considerations determine whether the power source must be required to supply high inrush current:

- The power-up sequence of devices in a system.
- The amount of the power source voltage sag if the inrush current cannot be supplied.
- The effect of voltage sag on other equipment in the system.

If the entire system is powered-up at the same time, a brief sag in the power source voltage typically will not affect any equipment.

Loss of Power Source

The power supply is designed to withstand brief power losses without affecting the operation of the system. The time the system is operational during power loss is called “program scan hold-up time after loss of power.” The duration of the power supply hold-up time depends on the type and state of the I/O, but is typically between 10 milliseconds and 3 seconds. When the duration of power loss reaches this limit, the power supply signals the processor that it can no longer provide adequate dc power to the system. This is referred to as a power supply shutdown. The processor then performs an orderly shutdown of the controller.

Input States on Power Down

The power supply hold-up time as described above is generally longer than the turn-on and turn-off times of the inputs. Because of this, the input state change from “On” to “Off” that occurs when power is removed may be recorded by the processor before the power supply shuts down the system. Understanding this concept is important. Write the user program, taking this effect into account.

Other Types of Line Conditions

Occasionally the power source to the system can be temporarily interrupted. It is also possible that the voltage level may drop substantially below the normal line voltage range for a period of time. Both of these conditions are considered to be a loss of power for the system.

Preventing Excessive Heat

For most applications, normal convective cooling keeps the controller within the specified operating range. Ensure that the specified temperature range is maintained. Proper spacing of components within an enclosure is usually sufficient for heat dissipation.

In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce “hot spots” near the controller.

Additional cooling provisions might be necessary when high ambient temperatures are encountered.

TIP ▶

Do not bring in unfiltered outside air. Place the controller in an enclosure to protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to protect against heat build-up within the enclosure.

Master Control Relay

A hard-wired master control relay (MCR) provides a reliable means for emergency machine shutdown. Since the master control relay allows the placement of several emergency-stop switches in different locations, its installation is important from a safety standpoint. Overtravel limit switches or mushroom-head push buttons are wired in series so that when any of them opens, the master control relay is de-energized. This removes power to input and output device circuits. Refer to the figures on pages 2-10 and 2-11.

ATTENTION

Never alter these circuits to defeat their function since serious injury and/or machine damage could result.

TIP

If you are using an external dc power supply, interrupt the dc output side rather than the ac line side of the supply to avoid the additional delay of power supply turn-off.

The ac line of the dc output power supply should be fused.

Connect a set of master control relays in series with the dc power supplying the input and output circuits.

Place the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. If you mount a disconnect switch inside the controller enclosure, place the switch operating handle on the outside of the enclosure, so that you can disconnect power without opening the enclosure.

Whenever any of the emergency-stop switches are opened, power to input and output devices should be removed.

When you use the master control relay to remove power from the external I/O circuits, power continues to be provided to the controller's power supply so that diagnostic indicators on the processor can still be observed.

The master control relay is not a substitute for a disconnect to the controller. It is intended for any situation where the operator must quickly de-energize I/O devices only. When inspecting or installing terminal connections, replacing output fuses, or working on equipment within the enclosure, use the disconnect to shut off power to the rest of the system.

TIP

Do not control the master control relay with the controller. Provide the operator with the safety of a direct connection between an emergency-stop switch and the master control relay.

Using Emergency-Stop Switches

When using emergency-stop switches, adhere to the following points:

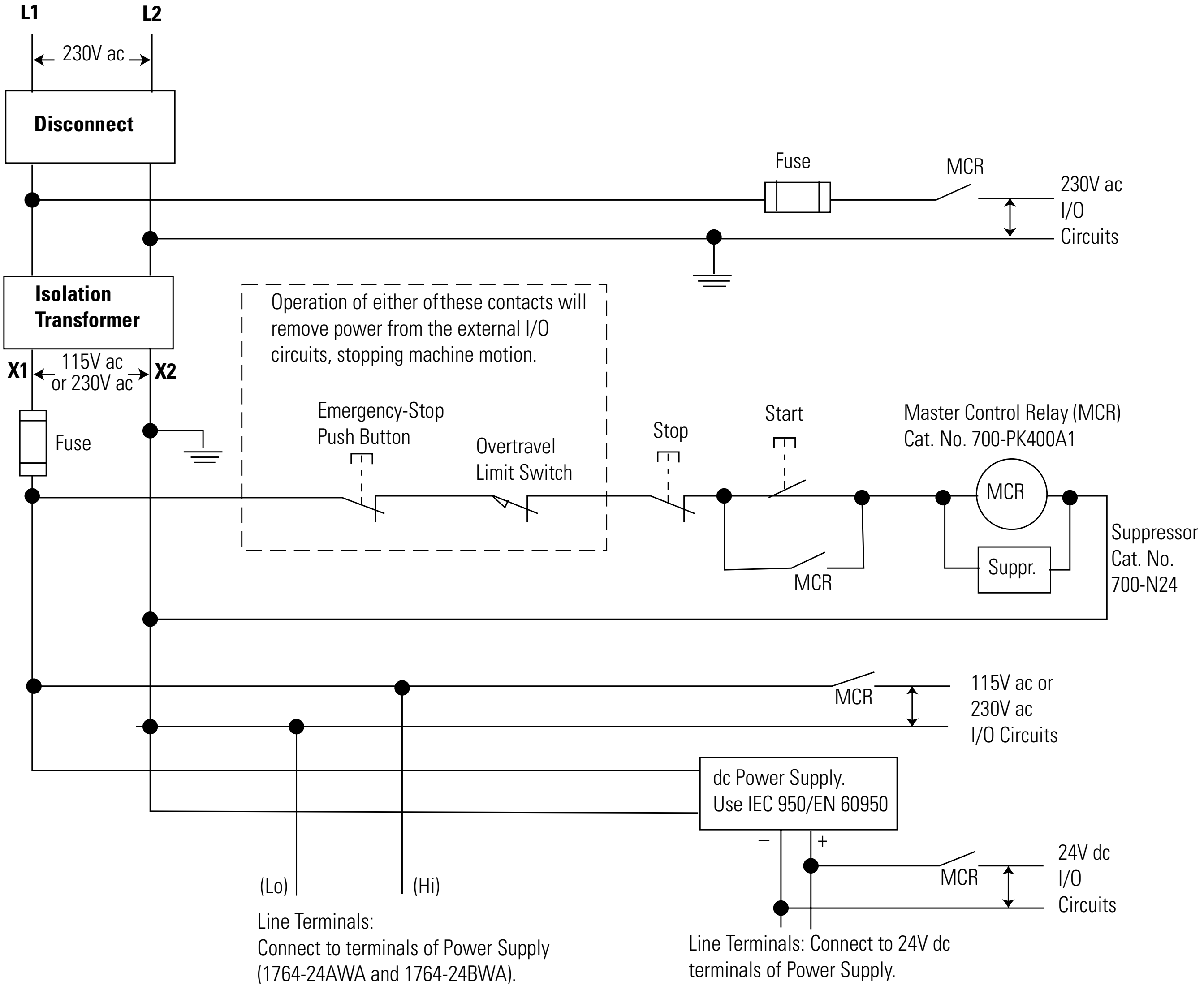
- Do not program emergency-stop switches in the controller program. Any emergency-stop switch should turn off all machine power by turning off the master control relay.
- Observe all applicable local codes concerning the placement and labeling of emergency-stop switches.
- Install emergency-stop switches and the master control relay in your system. Make certain that relay contacts have a sufficient rating for your application. Emergency-stop switches must be easy to reach.
- In the following illustration, input and output circuits are shown with MCR protection. However, in most applications, only output circuits require MCR protection.

The following illustrations show the Master Control Relay wired in a grounded system.

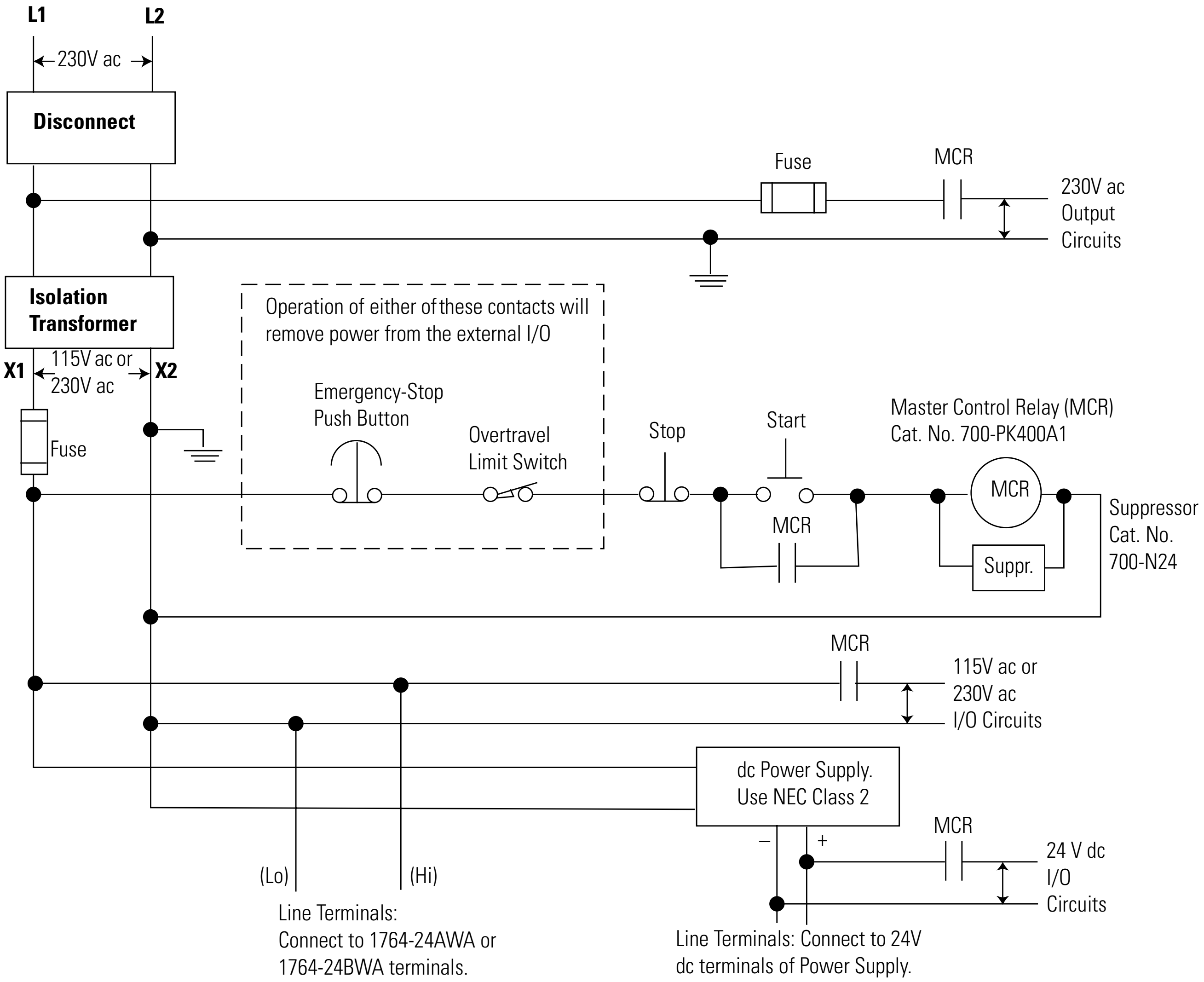
TIP

In most applications input circuits do not require MCR protection; however, if you need to remove power from all field devices, you must include MCR contacts in series with input power wiring.

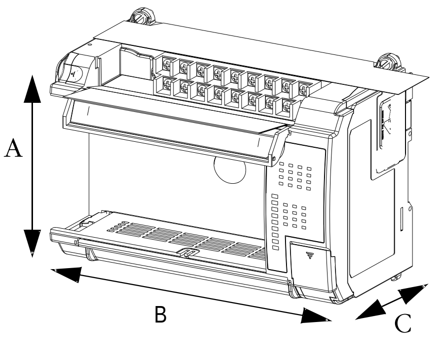
Schematic (Using IEC Symbols)



Schematic (Using ANSI/CSA Symbols)



Base Unit Mounting Dimensions

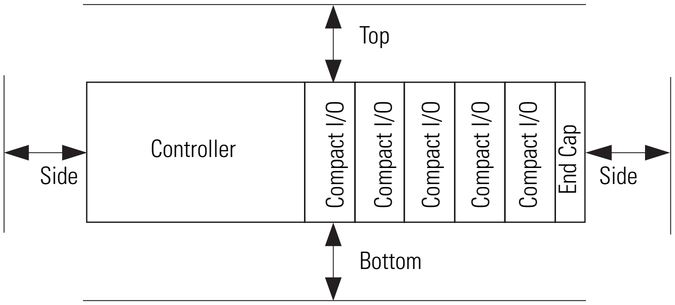


Dimension[1]	1764-24AWA	1764-24BWA	1764-28BXB
Height (A)	DIN latch open: 138 mm (5.43 in.), DIN latch closed: 118 mm (4.65 in.)		
Width (B)	168 mm (6.62 in.)		
Depth (C)	87 mm (3.43 in.)		

[1] See Controller Dimensions on page A-9 for more dimensional information.

Controller Spacing

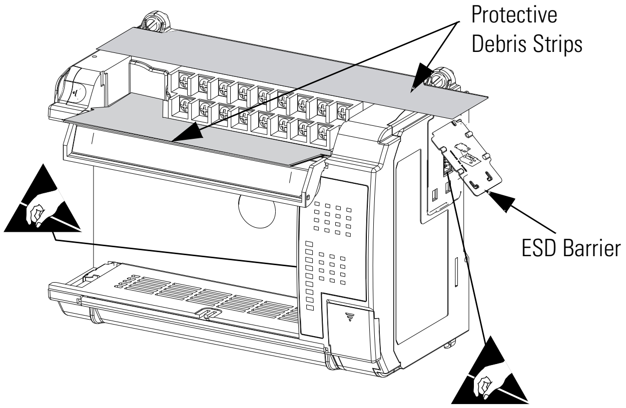
The base unit is designed to be mounted horizontally, with the Compact™ expansion I/O extending to the right of the base unit. Allow 50 mm (2 in.) minimum of space on all sides for adequate ventilation, as shown below.



Mounting the Controller

ATTENTION

Do not remove protective debris strips until after the base and all other equipment in the panel near the base is mounted and wiring is complete. The debris strips are there to prevent drill fragments, wire strands and other dirt from getting into the controller. Once wiring is complete, remove protective debris strips and install processor unit. Failure to remove strips before operating can cause overheating.



ATTENTION

Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the controller could cause damage. Do not drill holes above a mounted controller if the protective debris strips have been removed.

ATTENTION

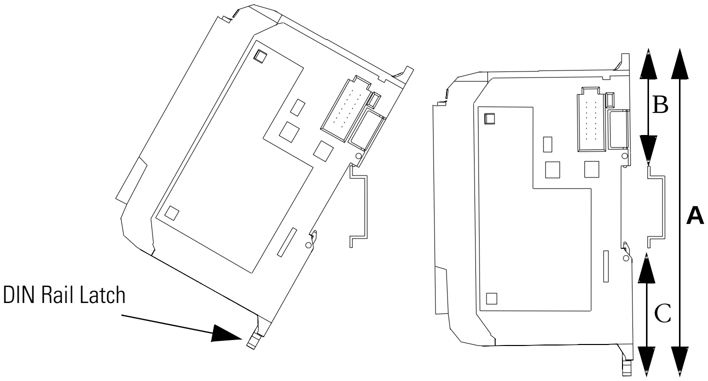
Electrostatic discharge can damage semiconductor devices inside the base unit. Do not touch the connector pins or other sensitive areas.

TIP

If additional I/O modules are required for the application, remove the ESD barrier to install expansion I/O modules. A maximum of 16 I/O modules may be connected to the base. (See page 1-7 for system requirements.) The I/O module's current requirements and power consumption may further limit the number of modules connected to the base. See System Loading and Heat Dissipation on page F-1. An end cap terminator (catalog number 1769-ECR or 1769-ECL) is required at the end of the group of I/O modules attached to the base.

Using a DIN Rail

The base unit and expansion I/O DIN rail latches lock in the open position so that an entire system can be easily attached to or removed from the DIN rail. The maximum extension of the latch is 15 mm (0.67 in.) in the open position. A flat-blade screw driver is required for removal of the base unit. The base can be mounted to EN50022-35x7.5 or EN50022-35x15 DIN rails. DIN rail mounting dimensions are shown below.



Dimension	Height
A	DIN latch open: 138 mm (5.43 in.), DIN latch closed: 118 mm (4.65 in.)
B	47.6 mm (1.875 in.)
C	47.6 mm (1.875 in) DIN latch closed 54.7 mm (2.16 in.) DIN latch open

To install your base unit on the DIN rail:

1. Mount your DIN rail. (Make sure that the placement of the base unit on the DIN rail meets the recommended spacing requirements, see Controller Spacing on page 2-12. Refer to the mounting template from the inside back cover of the *MicroLogix 1500 Programmable Controller Base Units Installation Instructions*, publication 1764-IN001.

2. Hook the top slot over the DIN rail.

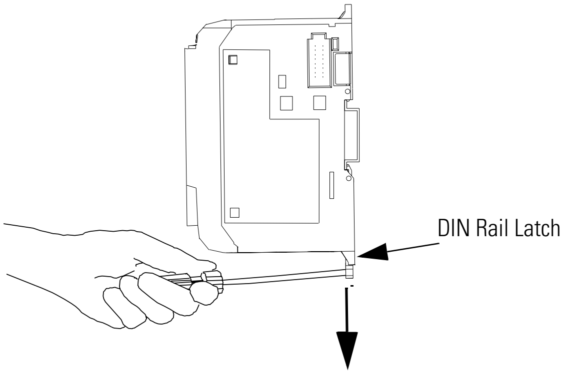
3. While pressing the base unit down against the top of the rail, snap the bottom of the base unit into position. Ensure DIN latches are in the up (secured) position.

4. Leave the protective debris strip attached until you are finished wiring the base unit and any other devices.

To remove your base unit from the DIN rail:

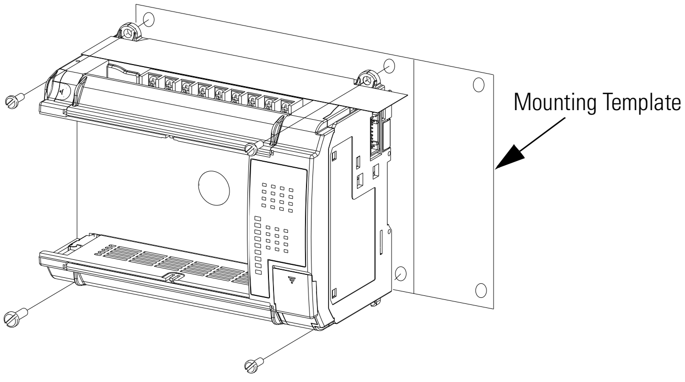
1. Place a flat-blade screwdriver in the DIN rail latch at the bottom of the base unit.

2. Holding the base unit, pry downward on the latch until the latch locks in the open position. Repeat this procedure with the second latch. This releases the base unit from the DIN rail.



Base Unit Panel Mounting

Mount to panel using #8 or M4 screws.



To install your base unit using mounting screws:

1. Remove the mounting template from the inside back cover of the *MicroLogix 1500 Programmable Controller Base Units Installation Instruction*, publication 1764-IN001.
2. Secure the template to the mounting surface. (Make sure your base unit is spaced properly, see Controller Spacing on page 2-12).
3. Drill holes through the template.
4. Remove the mounting template.
5. Mount the base unit.
6. Leave the protective debris strips attached until you are finished wiring the base unit and any other devices.

Installing Controller Components

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors if you touch bus connector pins. Follow these guidelines when you handle any module:

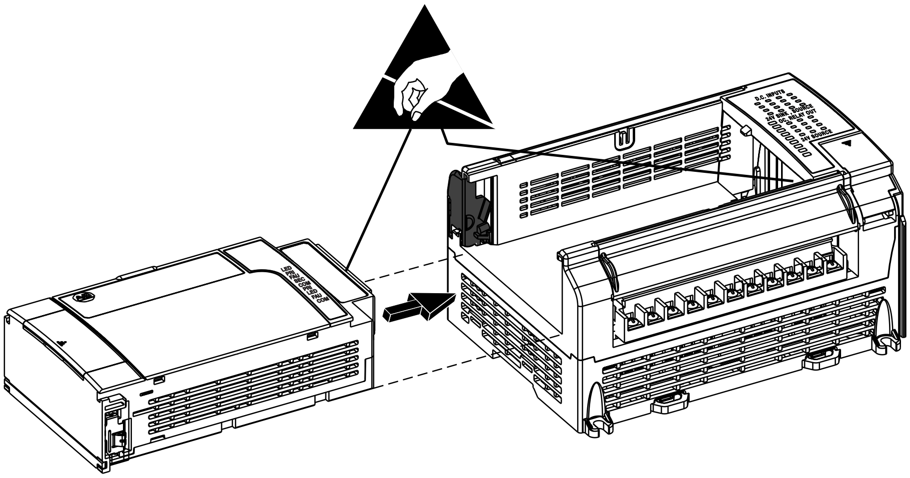
- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.

When not in use, keep the module in its static-shield bag.

ATTENTION

Be sure the base unit is free of all metal fragments before removing protective debris strips and installing the processor unit. Failure to remove strips before operating can cause overheating.

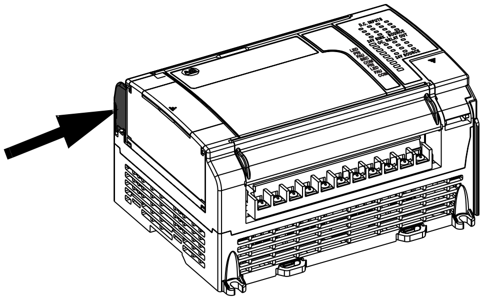
Processor



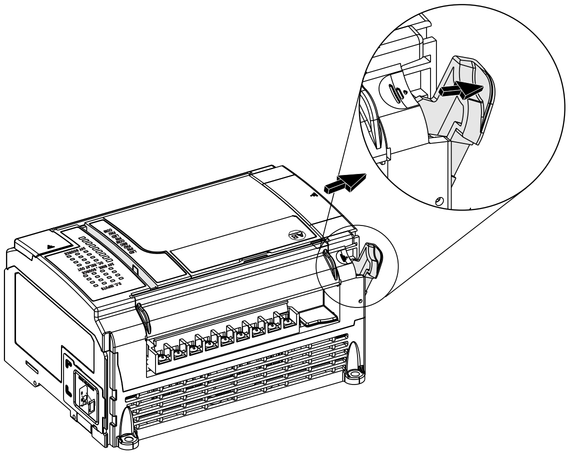
1. Be sure base unit power is off.
2. Slide the processor into the base unit using the guide rails for alignment.
3. Push until a click is heard. Be careful not to push on the connector when installing the 1764-LRP processor.

IMPORTANT	It is critical that the processor is fully engaged and locked into place.

4. Make sure the actuator is pushed closed.

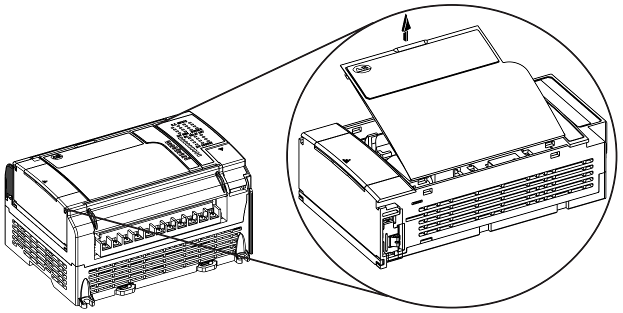


5. To remove the processor from the base unit, make sure base unit power is off. Push the actuator to the open position until the processor is ejected slightly. Once the processor has been ejected, it can be removed from the base unit.

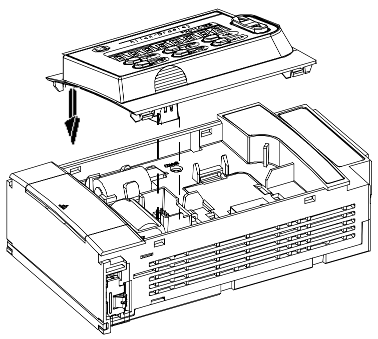


Data Access Tool (DAT)

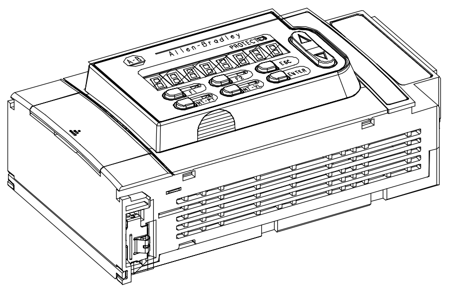
1. Remove cover from processor.



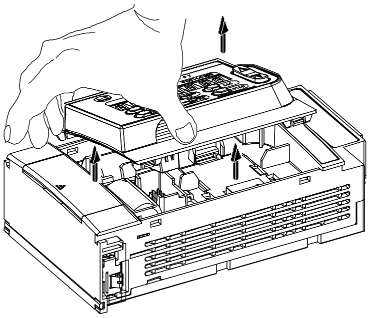
2. Holding the DAT in the proper orientation (as shown), place the DAT onto processor. Align DAT port on the processor with the plug on the DAT.



3. Firmly seat DAT on processor; make sure it seats into place.

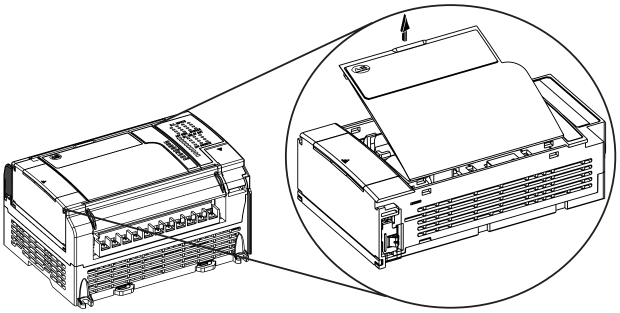


4. To remove DAT, grasp using finger areas and pull upward.



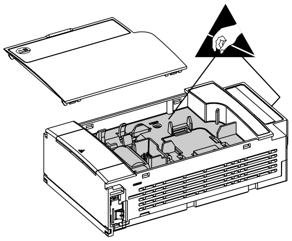
Memory Module/Real-Time Clock

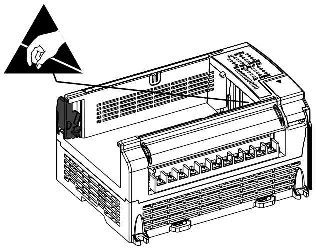
1. Remove the cover (or DAT if installed) from the processor as shown below.



ATTENTION

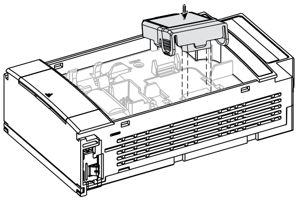
Electrostatic discharge can damage semiconductor devices inside the base and processor units. Do not touch the connector pins or other sensitive areas.



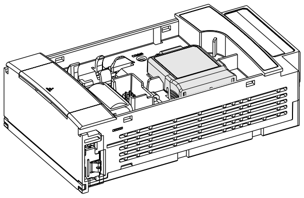


---

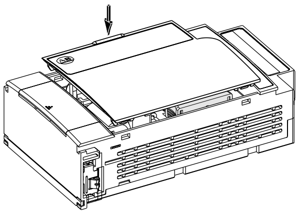
2. Align connector on the memory module with the connector pins on the processor.



3. Firmly seat the memory module in the processor making sure the locking tabs click into place.



4. Replace the cover (or DAT if used).



Compact I/O

Attach and Lock Module (Module-to-Controller or Module-to-Module)

A Compact I/O module can be attached to the controller or an adjacent I/O module before or after mounting to the panel or DIN rail. The module can be detached and replaced while the system is mounted to a panel or DIN rail.

ATTENTION

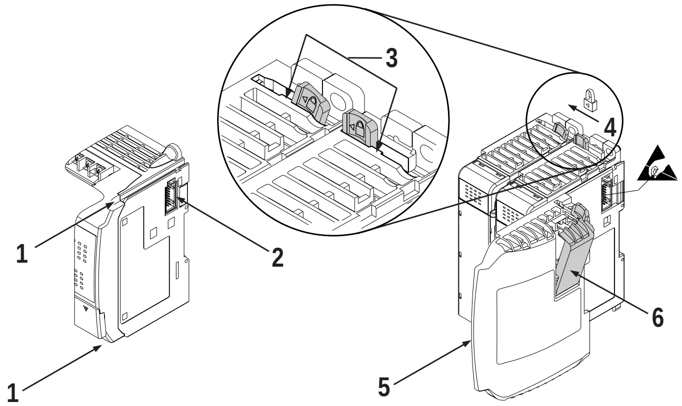
Remove power before removing or inserting an I/O module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing the controller to fault
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance, reducing product reliability.

ATTENTION

When attaching I/O modules, it is very important that they are securely locked together to ensure proper electrical connection.



To attach and lock modules:

TIP

Remove ESD barrier when attaching I/O modules to a MicroLogix 1500 base unit.

1. Disconnect power.
2. Check that the bus lever of the module to be installed is in the unlocked (fully right) position.
3. Use the upper and lower tongue-and-groove slots (1) to secure the modules together (or to a controller).
4. Move the module back along the tongue-and-groove slots until the bus connectors (2) line up with each other.
5. Push the bus lever back slightly to clear the positioning tab (3). Use your fingers or a small screw driver.
6. To allow communication between the controller and module, move the bus lever fully to the left (4) until it clicks. Ensure it is locked firmly in place.

ATTENTION

When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

7. Attach an end cap terminator (5) to the last module in the system by using the tongue-and-groove slots as before.

8. Lock the end cap bus terminator (6).

IMPORTANT A 1769-ECR right end cap (or a 1769-ECL left end cap if I/O bank is located below the controller) must be used to terminate the end of the serial communication bus.

See Controller Dimensions on page A-9 for mounting dimensions.

Chapter 3

Wiring Your Controller

This chapter describes how to wire your controller. Topics include:

- wiring requirements
- using surge suppressors
- grounding guidelines
- sinking and sourcing circuits
- wiring diagrams, input voltage ranges, and output voltage ranges
- minimizing noise

Wiring Requirements

Wire Type		**Wire Size**[1]	**Wiring Torque**
Solid	Cu-90°C (194°F)	#14 to #22 AWG	1.13 Nm (10 in-lb) rated 1.3 Nm (12 in-lb) maximum
Stranded	Cu-90°C (194°F)	#14 to #22 AWG	

(1) Two wires maximum per terminal screw.

ATTENTION

Be careful when stripping wires. Wire fragments that fall into the controller could cause damage. Once wiring is complete, be sure the base unit is free of all metal fragments before removing protective debris strips and installing the processor unit. Failure to remove strips before operating can cause overheating.

Wiring Recommendation

ATTENTION

Before you install and wire any device, disconnect power to the controller system.

ATTENTION

Calculate the maximum possible current in each power and common wire. Observe all electrical codes dictating the maximum current allowable for each wire size. Current above the maximum ratings may cause wiring to overheat, which can cause damage.

United States Only: If the controller is installed within a potentially hazardous environment, all wiring must comply with the requirements stated in the National Electrical Code 501-4 (b).

- Allow for at least 50 mm. (2 in.) between I/O wiring ducts or terminal strips and the controller.
- Route incoming power to the controller by a path separate from the device wiring. Where paths must cross, their intersection should be perpendicular.

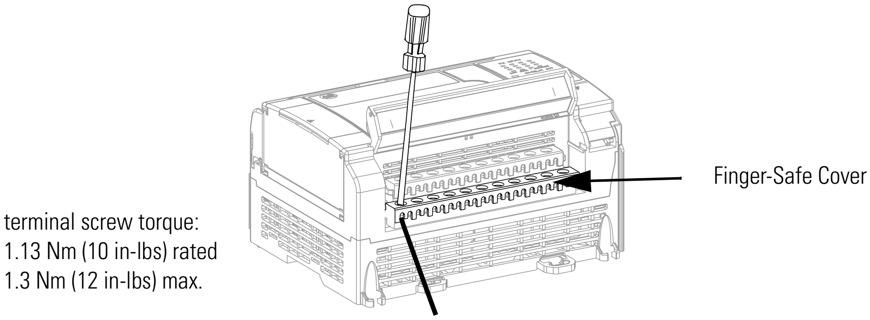
TIP

Do not run signal or communications wiring and power wiring in the same conduit. Wires with different signal characteristics should be routed by separate paths.

- Separate wiring by signal type. Bundle wiring with similar electrical characteristics together.
- Separate input wiring from output wiring.
- Label wiring to all devices in the system. Use tape, shrink-tubing, or other dependable means for labeling purposes. In addition to labeling, use colored insulation to identify wiring based on signal characteristics. For example, you may use blue for dc wiring and red for ac wiring.

Wiring without Spade Lugs

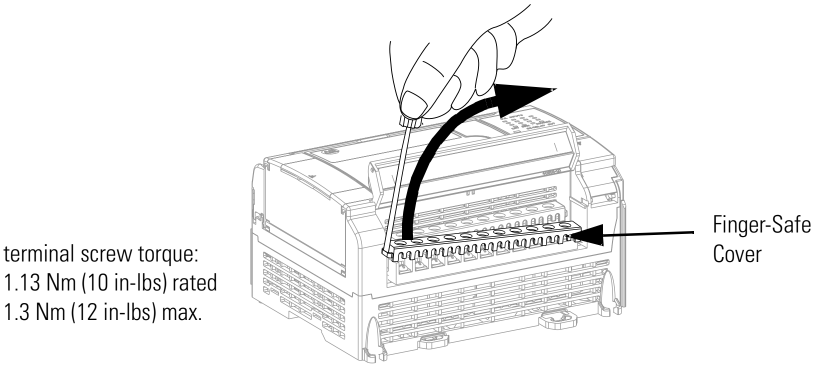
When wiring without spade lugs, it is recommended to keep the finger-safe covers in place. Loosen the terminal screw and route the wires through the opening in the finger-safe cover. Tighten the terminal screw making sure the pressure plate secures the wire.



Wiring with Spade Lugs

The diameter of the terminal screw head is 5.5 mm (0.220 in.). The input and output terminals of the MicroLogix 1500 base unit are designed for a 6.35mm (0.25 in.) wide spade (standard for #6 screw for up to 14 AWG) or a 4 mm (metric #4) fork terminal.

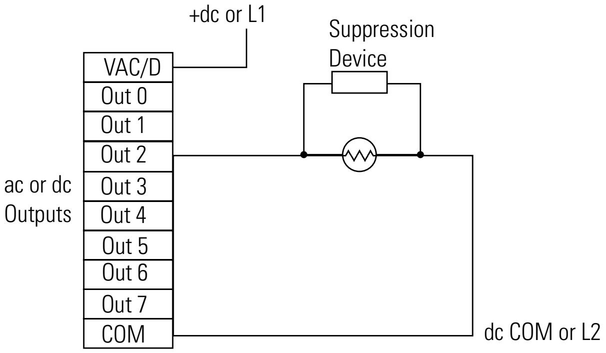
When using spade lugs, use a small, flat-blade screwdriver to pry the finger-safe cover from the terminal blocks as shown below. Then loosen the terminal screw.



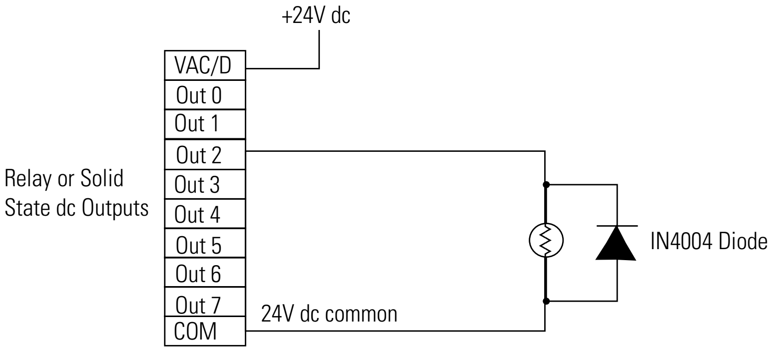
Using Surge Suppressors

Inductive load devices, such as motor starters and solenoids, require the use of some type of surge suppression to protect and extend the operating life of the controller's output contacts. Switching inductive loads without surge suppression can *significantly* reduce the life expectancy of relay contacts. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the output or relay contacts. You also reduce the effects of voltage transients and electrical noise from radiating into adjacent systems.

The following diagram shows an output with a suppression device. We recommend that you locate the suppression device as close as possible to the load device.

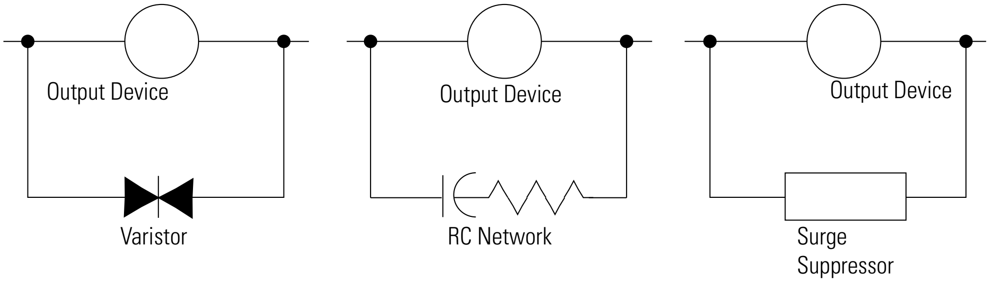


If the outputs are dc, we recommend that you use an 1N4004 diode for surge suppression, as shown below.



Suitable surge suppression methods for inductive ac load devices include a varistor, an RC network, or an Allen-Bradley surge suppressor, all shown below. These components must be appropriately rated to suppress the switching transient characteristic of the particular inductive device. See the table on page 3-6 for recommended suppressors.

Surge Suppression for Inductive ac Load Devices

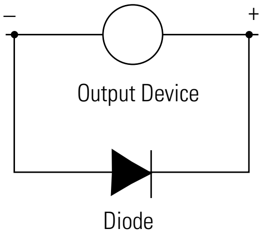


If you connect an expansion I/O triac output to control an inductive load, we recommend that you use varistors to suppress noise. Choose a varistor that is appropriate for the application. The suppressors we recommend for triac outputs when switching 120V ac inductive loads are a Harris MOV, part number V175 LA10A, or an Allen-Bradley MOV, catalog number 599-K04 or 599-KA04. Consult the varistor manufacturer's data sheet when selecting a varistor for your application

For inductive dc load devices, a diode is suitable. A 1N4004 diode is acceptable for most applications. A surge suppressor can also be used. See the table on page 3-6 for recommended suppressors.

As shown in the illustration below, these surge suppression circuits connect directly across the load device.

Surge Suppression for Inductive dc Load Devices



(A surge suppressor can also be used.)

Recommended Surge Suppressors

Use the Allen-Bradley surge suppressors shown in the following table for use with relays, contactors, and starters.

Suppressor Device	Coil Voltage	Catalog Number
Bulletin 509 Motor Starter Bulletin 509 Motor Starter	120V ac 240V ac	599-K04(1) 599-KA04(1)
Bulletin 100 Contactor Bulletin 100 Contactor	120V ac 240V ac	199-FSMA1(2) 199-FSMA2(2)
Bulletin 709 Motor Starter	120V ac	1401-N10
Bulletin 700 Type R, RM Relays	ac coil	None Required
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	12V dc 12V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	24V dc 24V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	48V dc 48V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	115-125V dc 115-125V dc	199-FSMA10
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	230-250V dc 230-250V dc	199-FSMA11
Bulletin 700 Type N, P, or PK Relay	150V max, ac or DC	700-N24(2)
Miscellaneous electromagnetic devices limited to 35 sealed VA	150V max, ac or DC	700-N24(2)

(1) Varistor – Not recommended for use on relay outputs.

(2) RC Type – Do not use with triac outputs.

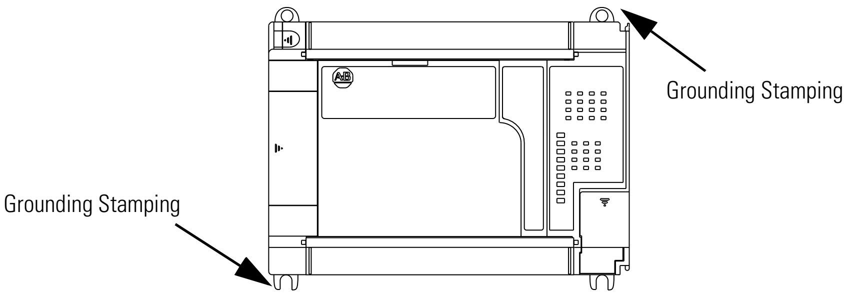
Grounding the Controller

In solid-state control systems, grounding and wire routing helps limit the effects of noise due to electromagnetic interference (EMI). Run the ground connection from the ground screw of the base unit to the electrical panel's ground bus prior to connecting any devices. Use AWG #14 wire. This connection must be made for safety purposes.

This product is intended to be mounted to a well grounded mounting surface such as a metal panel. Refer to the *Industrial Automation Wiring and Grounding Guidelines,* publication 1770-4.1, for additional information. Additional grounding connections from the mounting tabs or DIN rail, if used, are not required unless the mounting surface cannot be grounded. You must also provide an acceptable grounding path for each device in your application.

TIP

It is recommended to use all four mounting positions for panel mounting installation.



TIP

This ⏚ symbol denotes a protective earth ground terminal which provides a low impedance path between electrical circuits and earth for safety purposes and provides noise immunity improvement. This connection must be made for safety purposes

ATTENTION

Remove the protective debris strips before applying power to the controller. Failure to remove the strips may cause the controller to overheat.

Wiring Diagrams

This section shows the wiring diagrams for the MicroLogix 1500 controllers. Controllers with dc inputs can be wired as either sinking or sourcing configuration. (Sinking and sourcing does not apply to ac inputs.) See pages 3-12 through 3-15 for sinking and sourcing wiring diagrams.

TIP

This ⏚ symbol denotes a protective earth ground terminal which provides a low impedance path between electrical circuits and earth for safety purposes and provides noise immunity improvement. This connection must be made for safety purposes.

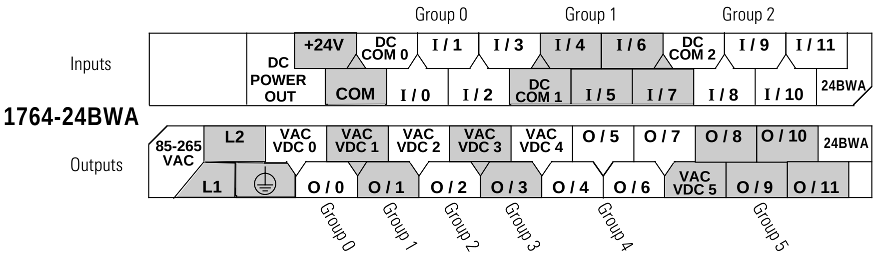
Miswiring - 1764-28BXB Only

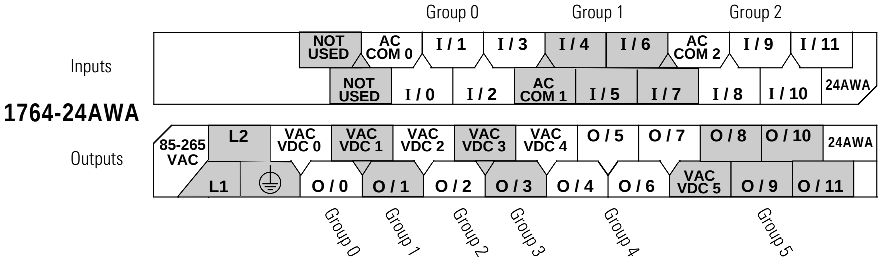
The following table shows miswiring conditions and the consequences of improper wiring:

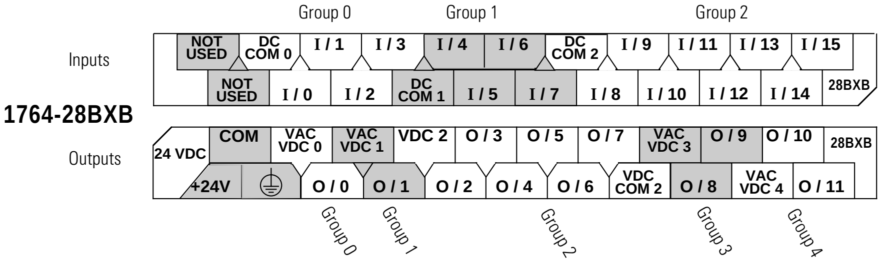
Condition	Result
Operating with Voltage Less than 20.4V dc	This will not damage the base unit. The base unit may not power up.
	IMPORTANT This is not recommended. You must verify that the line voltage remains within specified limits.
Reverse Wiring of the Line Terminals (0 to 30V dc)	Reverse wiring will not damage the base unit. The base unit will not power up.
Applied Voltage Level Exceeds the Published Recommended Value (i.e. applying 120V ac to 240V ac)	Exceeding the published recommended voltage may result in permanent damage to the base unit.

Terminal Block Layouts

The base unit terminal block layouts are shown below. The shading on the labels indicates how the terminals are grouped. A detail of the groupings is shown in the table following the terminal block layouts.







Terminal Groupings

Controller	Inputs		
	Input Group	**Common Terminal**	**Input Terminal**
1764-24BWA	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/7
	Group 2	DC COM 2	I/8 through I/11
1764-24AWA	Group 0	AC COM 0	I/0 through I/3
	Group 1	AC COM 1	I/4 through I/7
	Group 2	AC COM 2	I/8 through I/11
1764-28BXB	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/7
	Group 2	DC COM 2	I/8 through I/15

Controller	Outputs		
	Output Group	**Voltage Terminal**	**Output Terminal**
1764-24BWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2
	Group 3	VAC/VDC 3	O/3
	Group 4	VAC/VDC 4	O/4 through O/7
	Group 5	VAC/VDC 5	O/8 through O/11
1764-24AWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2
	Group 3	VAC/VDC 3	O/3
	Group 4	VAC/VDC 4	O/4 through O/7
	Group 5	VAC/VDC 5	O/8 through O/11
1764-28BXB	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VDC 2, VDC COM 2	O/2 through O/7
	Group 3	VAC/VDC 3	O/8 and O/9
	Group 4	VAC/VDC 4	O/10 and O/11

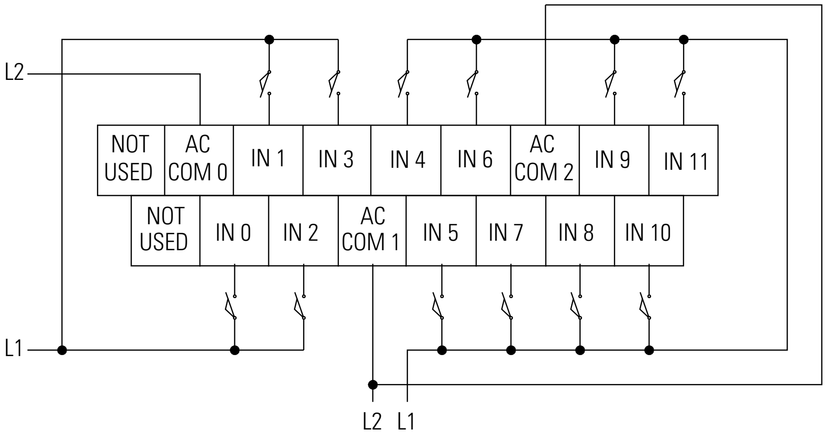
Sinking and Sourcing Input Circuits

Any of the MicroLogix 1500 DC embedded input groups can be configured as sinking or sourcing depending on how the DC COM is wired on the group. See pages 3-12 through 3-15 for sinking and sourcing wiring diagrams.

Type	Definition
Sinking Input *connection of a PNP sourcing device*	The input energizes when high-level voltage is applied to the input terminal (active high). Connect the power supply VDC (-) to the DC COM terminal.
Sourcing Input *connection of an NPN sinking device*	The input energizes when low-level voltage is applied to the input terminal (active low). Connect the power supply VDC (+) to the DC COM terminal.

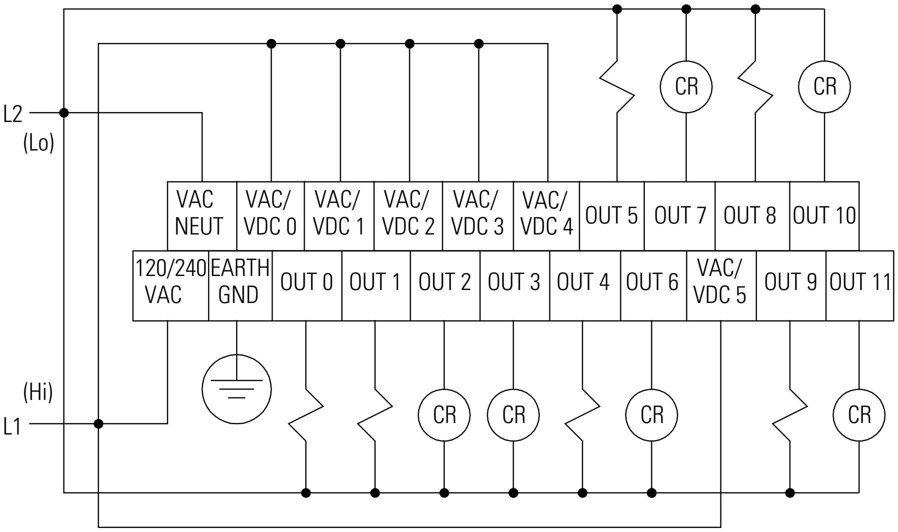
1764-24AWA Wiring Diagram

Input Terminals



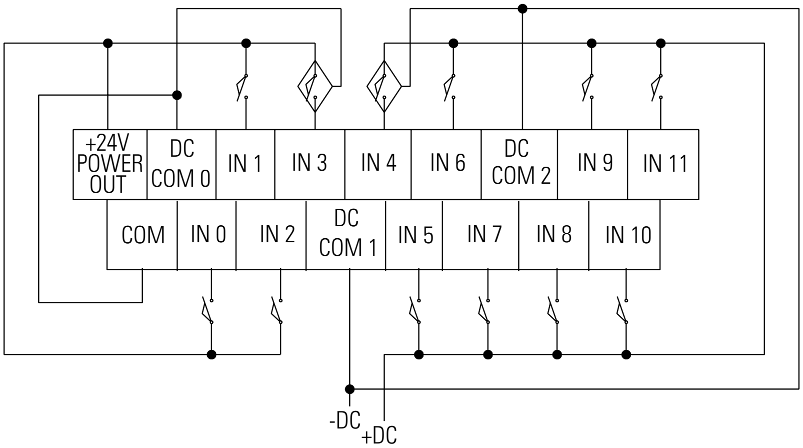
"NOT USED" terminals are not intended for use as connection points.

Output Terminals

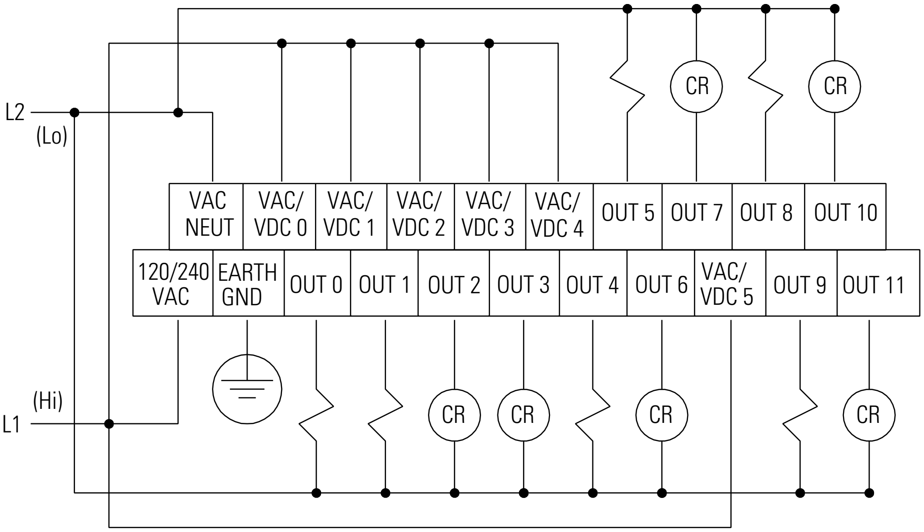


1764-24BWA Wiring Diagram with Sinking Inputs

Input Terminals

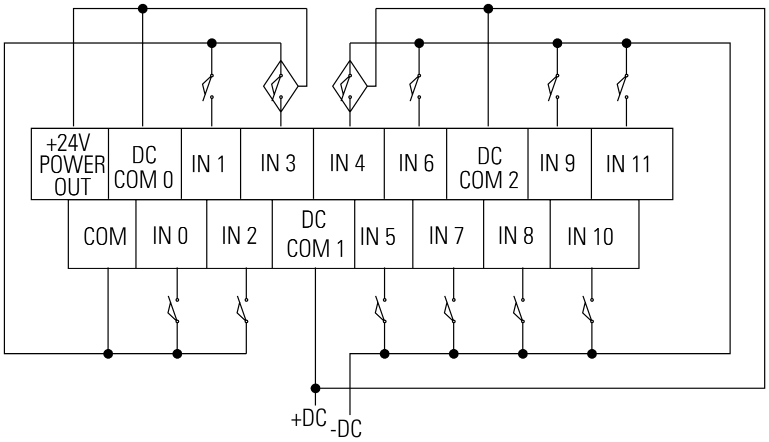


Output Terminals

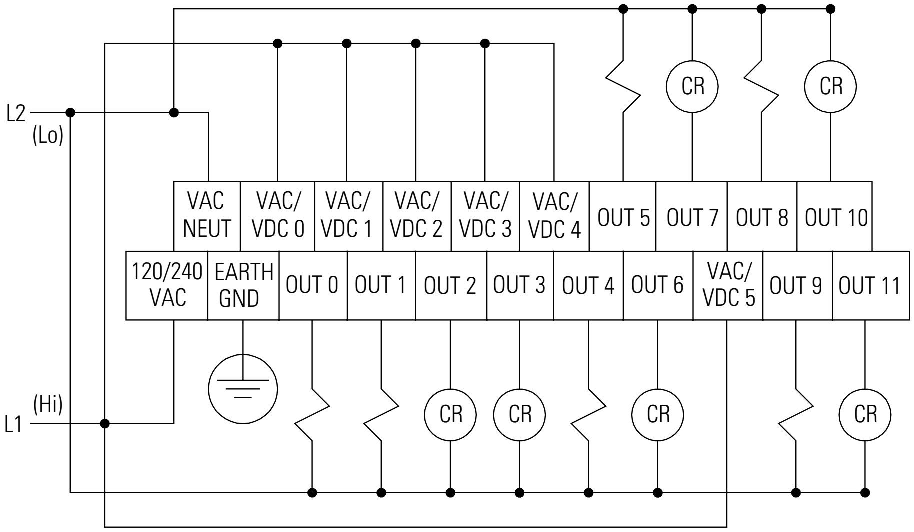


1764-24BWA Wiring Diagram with Sourcing Inputs

Input Terminals

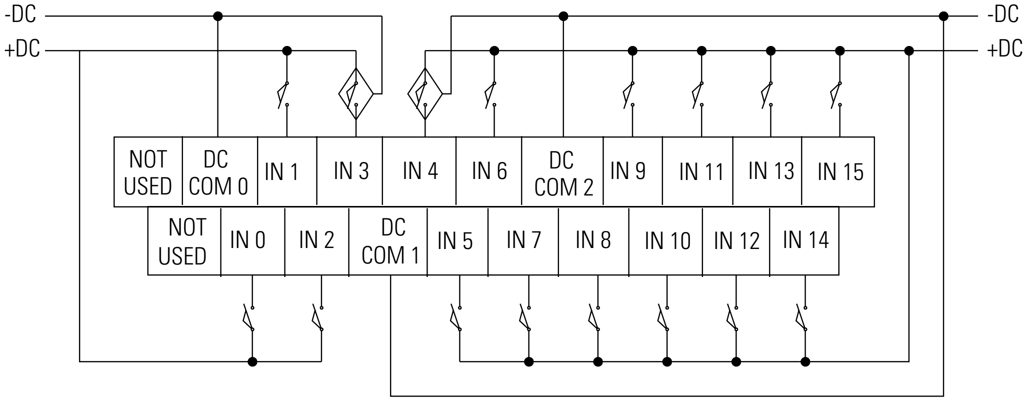


Output Terminals



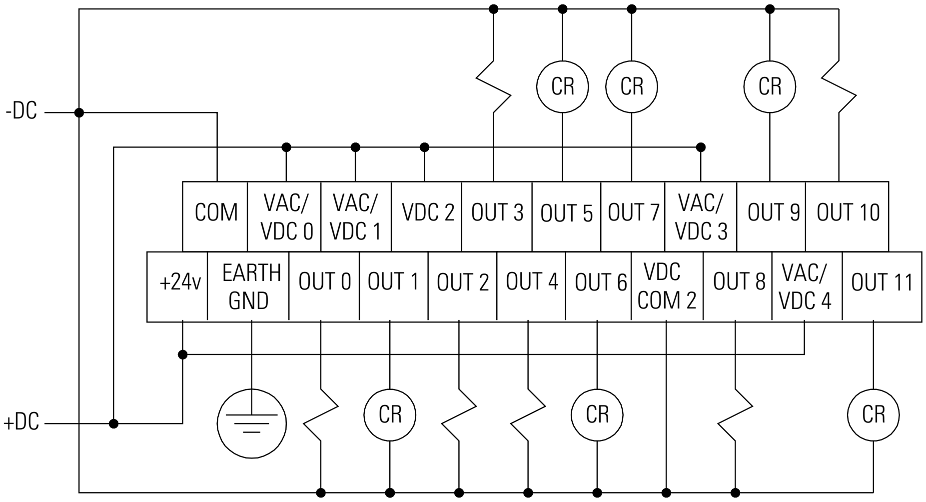
1764-28BXB Wiring Diagram with Sinking Inputs

Input Terminals



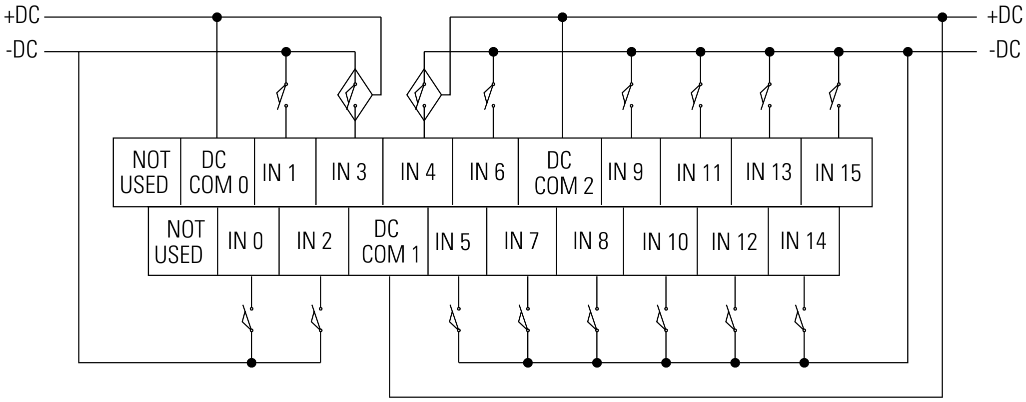
"NOT USED" terminals are not intended for use as connection points.

Output Terminals (FET Outputs Are Sourcing Only)



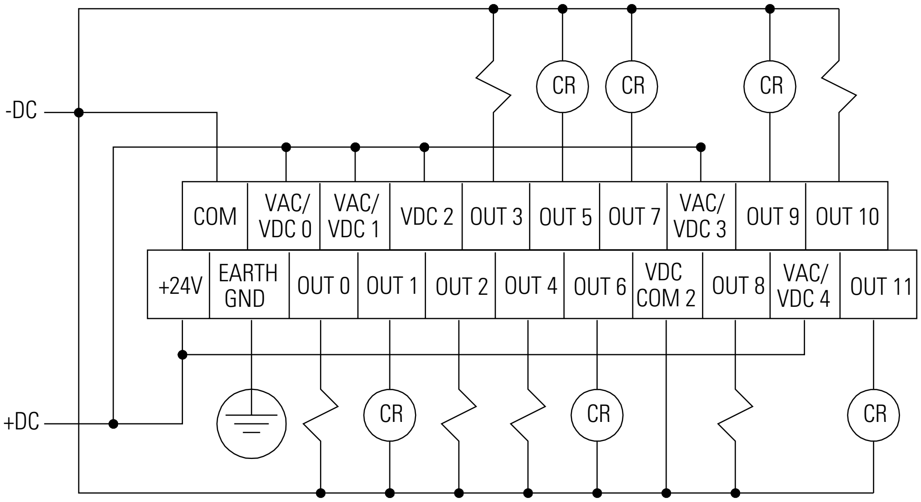
1764-28BXB Wiring Diagram with Sourcing Outputs

Input Terminals



“NOT USED” terminals are not intended for use as connection points.

Output Terminals (FET Outputs Are Sourcing Only)



Controller I/O Wiring

Minimizing Electrical Noise

Because of the variety of applications and environments where controllers are installed and operating, it is impossible to ensure that all environmental noise will be removed by input filters. To help reduce the effects of environmental noise, install the MicroLogix 1500 system in a properly rated (i.e. NEMA) enclosure. Make sure that the MicroLogix 1500 system is properly grounded.

A system may malfunction may occur due to a change in the operating environment after a period of time. We recommend periodically checking system operation, particularly when new machinery or other noise sources are installed near the Micrologix 1500 system.

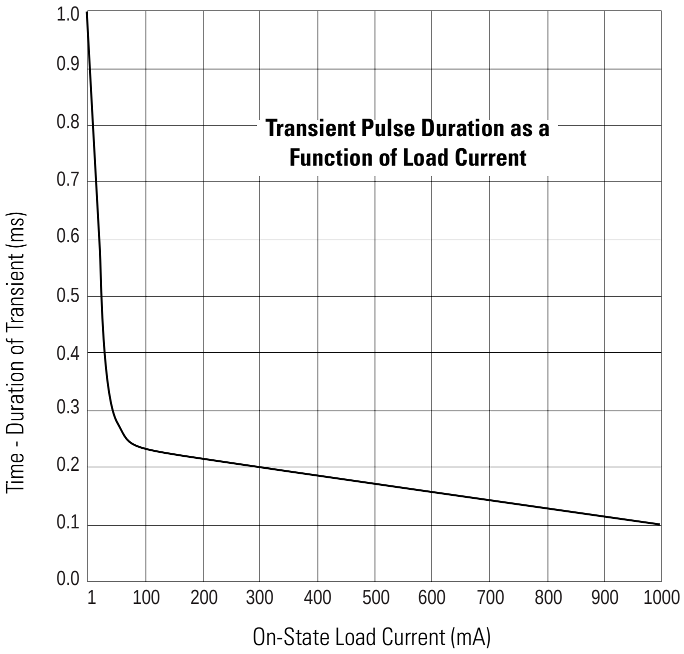
Transistor Output Transient Pulses

ATTENTION

A brief transient current pulse may flow through transistor outputs if the external supply voltage is suddenly applied at the V dc and V dc com terminals (e.g. via the master control relay). It is a fast rate-of-change of voltage at the terminals that causes the pulse. This condition is inherent in transistor outputs and is common to solid state devices. The transient pulses may occur regardless of whether the controller is powered or running.

The transient energy is dissipated in the load, and the pulse duration is longer for loads with high impedance. The graph below illustrates the relation between pulse duration and load current. Power-up transients will not exceed the times shown in the graph. For most applications the pulse energy is not sufficient to energize the load.

To reduce the possibility of inadvertent operation of devices connected to transistor outputs, consider adding an external resistor in parallel to the load to increase the on-state load current. The duration of the transient pulse is reduced when the on-state load current is increased or the load impedance is decreased.


Transient Pulse Duration as a Function of Load Current
Time - Duration of Transient (ms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
100
200
300
400
500
600
700
800
900
1000
On-State Load Current (mA)

Chapter 4

Communication Connections

This chapter describes how to set up communications for your control system. The method you use and cabling required depend on your application. This chapter also describes how the controller establishes communication with the appropriate network. Topics include:

- Default Communication Configuration
- Communications Toggle Push Button
- Connecting to the RS-232 Port
- Connecting to a DH-485 Network
- Connecting to DeviceNet
- Connecting to Ethernet

ATTENTION All devices communicating within a network, must use the same protocol.

Default Communication Configuration

The MicroLogix 1500 has the following default communication configuration.

Table 4.1 DF1 Full-Duplex Configuration Parameters

Parameter	Default
Baud Rate	19.2K
Parity	none
Source ID (Node Address)	1
Control Line	no handshaking
Error Detection	CRC
Embedded Responses	auto detect
Duplicate Packet (Message) Detect	enabled
ACK Timeout	50 counts
NAK retries	3 retries
ENQ retries	3 retries
Stop Bits	1

TIP

The default configuration is present when:

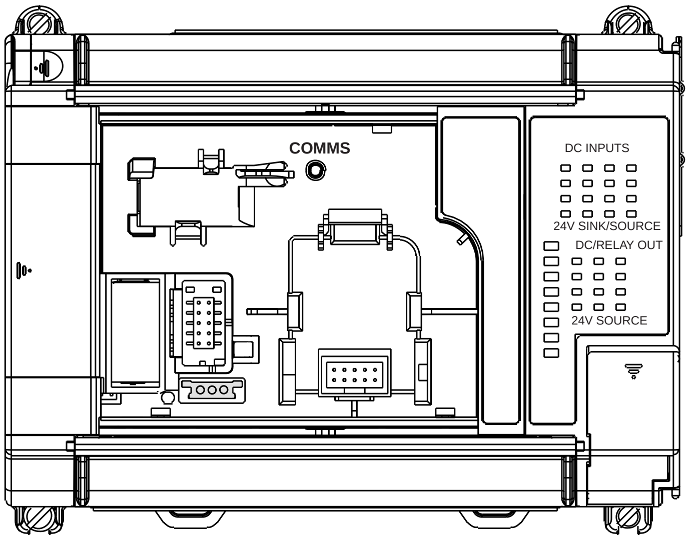
- The controller is powered-up for the first time.
- The communications toggle push button specifies default communications (the DCOMM LED is on).
- An OS upgrade is completed.

For more information about communications, see Understanding Communication Protocols on page E-1.

Communications Toggle Push Button

The Communications Toggle Push Button is located on the processor. You must remove processor door or DAT to access the Communications Toggle Push Button.

Use the Communications Toggle Push Button to change from the user-defined communication configuration to the default communications configuration and back. The Default Communications (DCOMM) LED operates to show when the controller is in the default communications mode (settings shown on page 4-1).



TIP

The Communication Toggle Push Button must be pressed and held for two seconds to activate.

The Communication Toggle Push Button only affects the communication configuration of Channel 0.

Connecting to the RS-232 Port

DF1 Full-Duplex Communication Parameters

When a communication channel is configured for DF1 Full-Duplex, the following parameters can be changed.

Table 4.2 DF1 Full-Duplex Configuration Parameters

Parameter	Options	Default
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K	19.2K
Parity	none, even	none
Source ID (Node Address)	0 to 254 decimal	1
Control Line	no handshaking, Full-Duplex modem handshaking	no handshaking
Error Detection	CRC, BCC	CRC
Embedded Responses	auto-detect, enabled	auto detect
Duplicate Packet (Message) Detect	enabled, disabled	enabled
ACK Timeout	1 to 65535 counts (20 ms increments)	50 counts
NAK retries	0 to 255	3 retries
ENQ retries	0 to 255	3 retries
Stop Bits	not a setting, always 1	1

Making a DF1 Full-Duplex Point-to-Point Connection

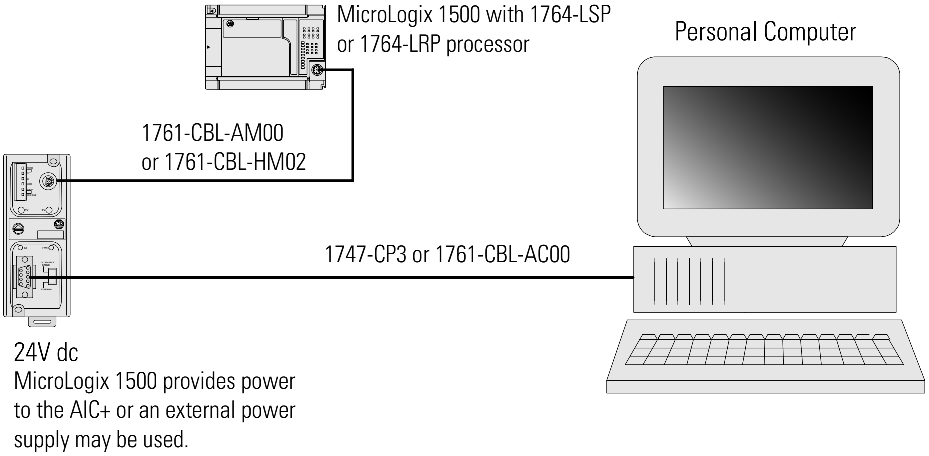
You can connect the MicroLogix 1500 programmable controller to your personal computer using a serial cable from your personal computer's serial port to the controller, as shown in the illustrations below.

ATTENTION

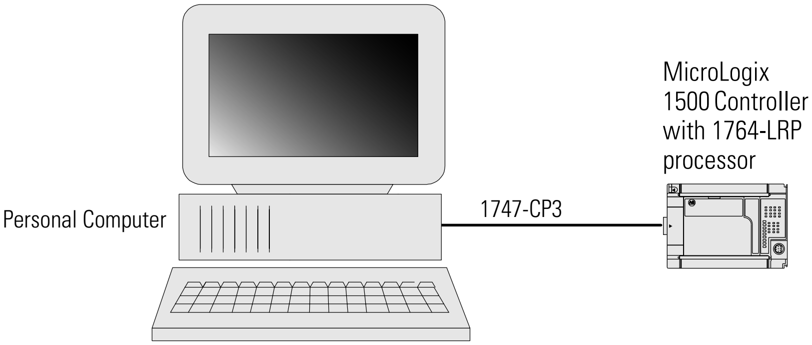
Chassis ground, internal 24V ground, user 24V dc ground, and RS-232 ground are internally connected. You must connect the chassis ground terminal screw to ground prior to connecting any devices. It is important that you understand your personal computer's grounding system before connecting to the controller. An optical isolator, such as the 1761-NET-AIC, is recommended between the controller and your personal computer when using Channel 0. An isolator is not required when using Channel 1 (1764-LRP).

Channel 0

We recommend using an Advanced Interface Converter (AIC+), catalog number 1761-NET-AIC, or similar optical isolator, as shown below. See page 4-16 for specific AIC+ cabling information.

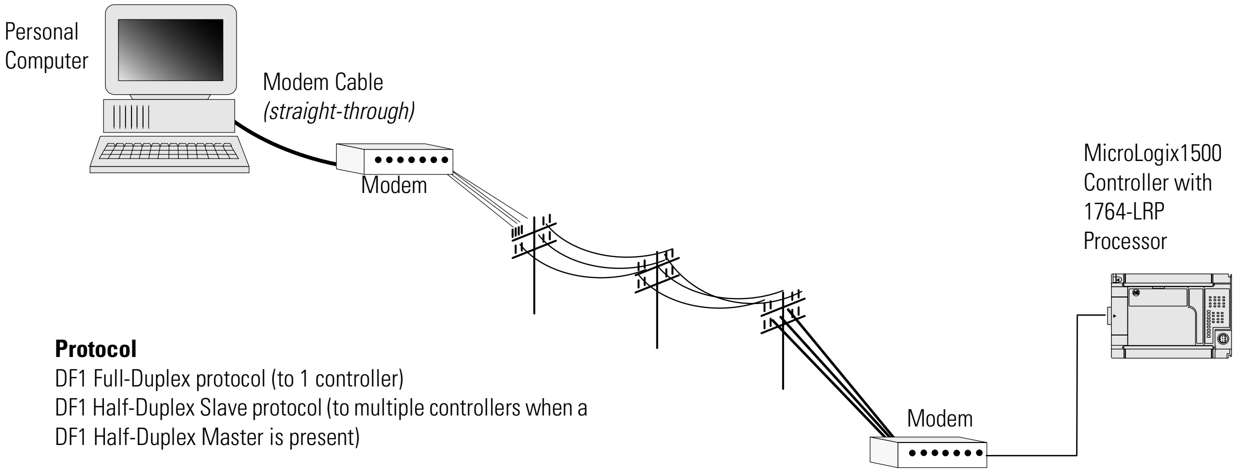


Channel 1



Using a Modem

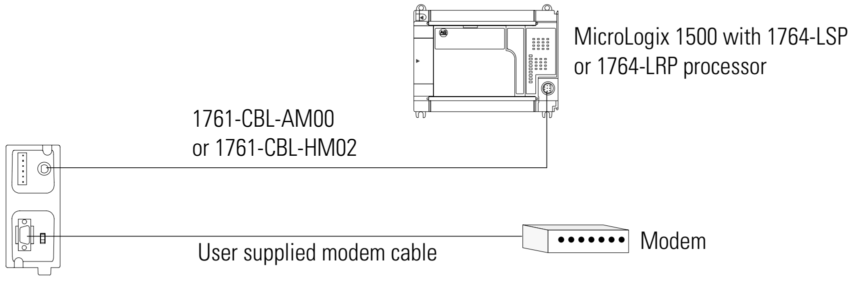
You can use modems to connect a personal computer to one MicroLogix 1500 controller (using DF1 Full-Duplex protocol), or to multiple controllers (using DF1 Half-Duplex protocol), or Modbus Slave RTU protocol, as shown in the following illustration. Do not use DH-485 protocol through modems under any circumstance. (See Using Modems with MicroLogix 1500 Programmable Controllers on page E-3 for information on types of modems you can use with the MicroLogix controllers.)



Protocol
DF1 Full-Duplex protocol (to 1 controller)
DF1 Half-Duplex Slave protocol (to multiple controllers when a DF1 Half-Duplex Master is present)

Isolated Modem Connection

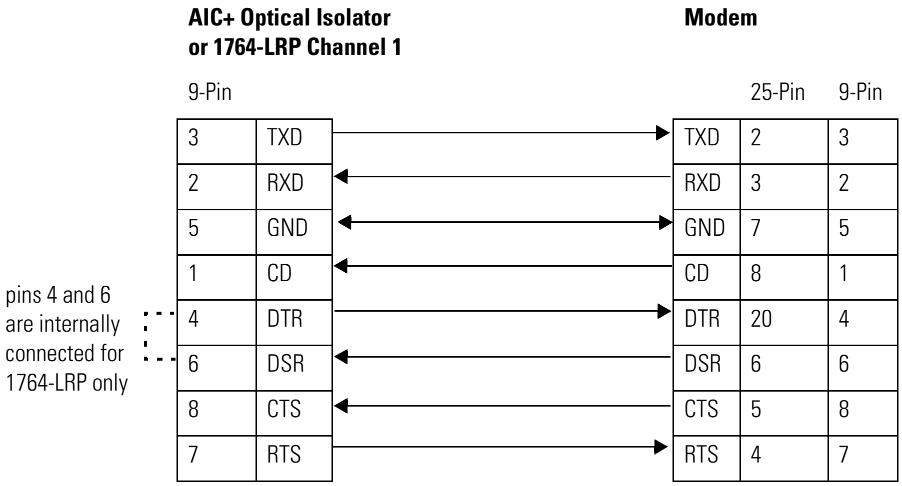
We recommend using an AIC+, catalog number 1761-NET-AIC, as your optical isolator for Channel 0. See page 4-16 for specific AIC+ cabling information. Using an AIC+ to isolate the modem is illustrated below:



24V dc
MicroLogix 1500 provides power to the AIC+ or an external power supply may be used.

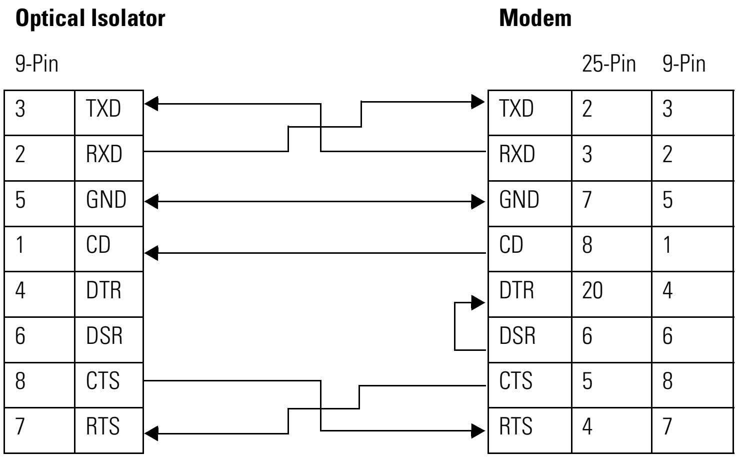
Constructing Your Own Modem Cable

If you construct your own modem cable, the maximum cable length is 15.24 m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout for constructing a *straight-through* cable:



Constructing Your Own Null Modem Cable

If you construct your own null modem cable, the maximum cable length is 15.24m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout:



Connecting to a DF1 Half-Duplex Network

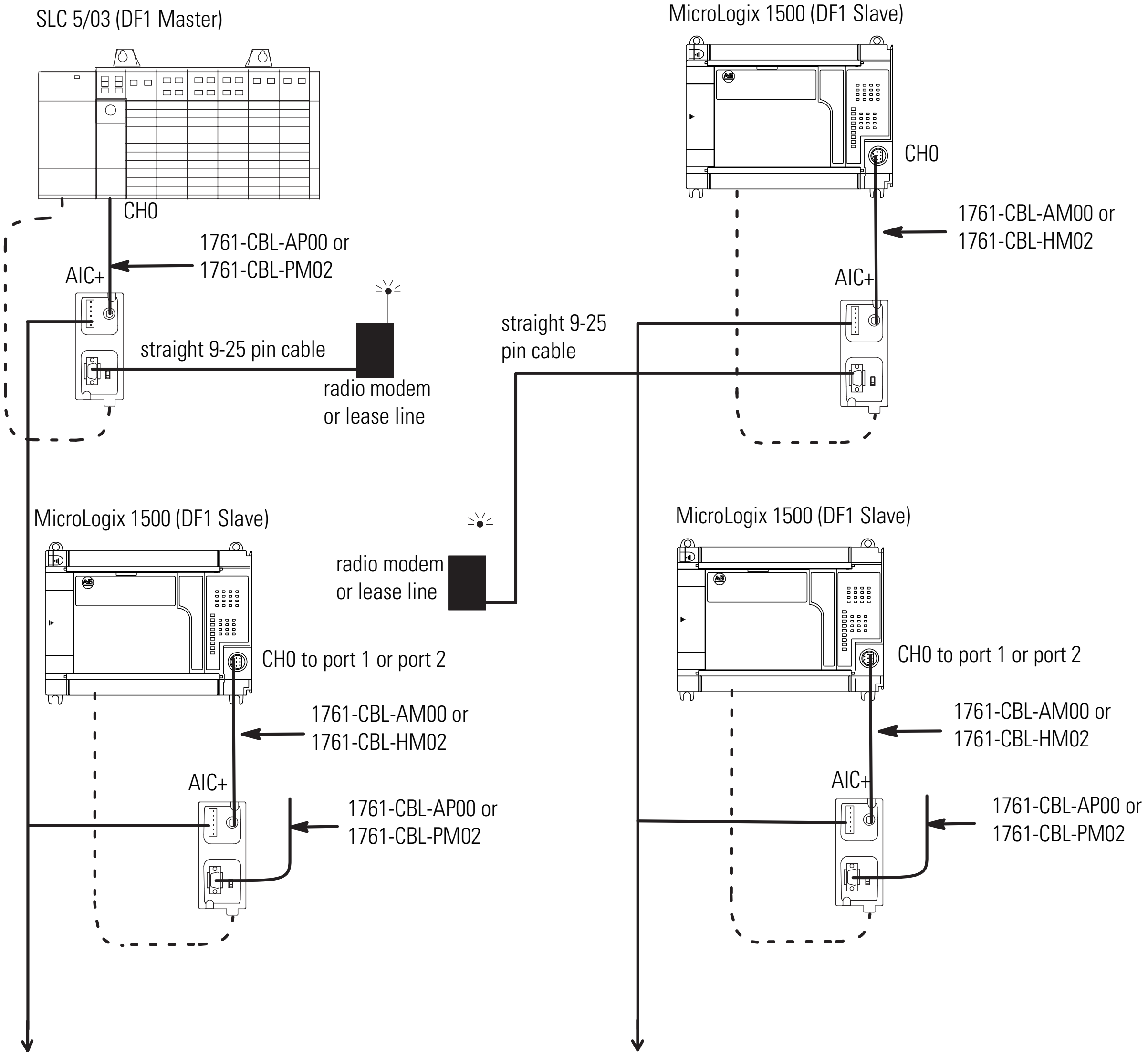
When a communication port is configured for DF1 Half-Duplex Slave, available parameters include:

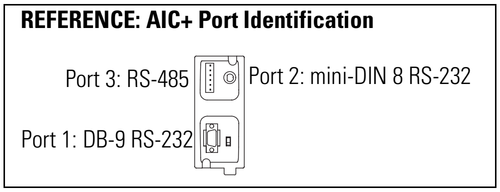
Table 4.3 DF1 Half-Duplex Configuration Parameters

Parameter	Options
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K
Parity	none, even
Source ID (Node Address)	0 to 254 decimal
Control Line	no handshaking, handshaking
Error Detection	CRC, BCC
EOT Suppression	enabled, disabled When EOT Suppression is enabled, the slave does not respond when polled if no message is queued. This saves modem transmission power and time when there is no message to transmit.
Duplicate Packet (Message) Detect	enabled, disabled Detects and eliminates duplicate responses to a message. Duplicate packets may be sent under noisy communication conditions if the sender's Message Retries are not set to 0.
Poll Timeout (x20 ms)	0 to 65535 (can be set in 20 ms increments) Poll Timeout only applies when a slave device initiates a MSG instruction. It is the amount of time that the slave device waits for a poll from the master device. If the slave device does not receive a poll within the Poll Timeout, a MSG instruction error is generated, and the ladder program needs to requeue the MSG instruction. If you are using a MSG instruction, it is recommended that a Poll Timeout value of zero not be used. Poll Timeout is disabled when set to zero.
RTS Off Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the delay time between when the last serial character is sent to the modem and when RTS is deactivated. Gives the modem extra time to transmit the last character of a packet.
RTS Send Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the time delay between setting RTS until checking for the CTS response. For use with modems that are not ready to respond with CTS immediately upon receipt of RTS.
Message Retries	0 to 255 Specifies the number of times a slave device attempts to resend a message packet when it does not receive an ACK from the master device. For use in noisy environments where message packets may become corrupted in transmission.
Pre Transmit Delay (x1 ms)	0 to 65535 (can be set in 1 ms increments) • When the Control Line is set to *no handshaking*, this is the delay time before transmission. Required for 1761-NET-AIC physical Half-Duplex networks. The 1761-NET-AIC needs delay time to change from transmit to receive mode. • When the Control Line is set to *DF1 Half-Duplex Modem*, this is the minimum time delay between receiving the last character of a packet and the RTS assertion.

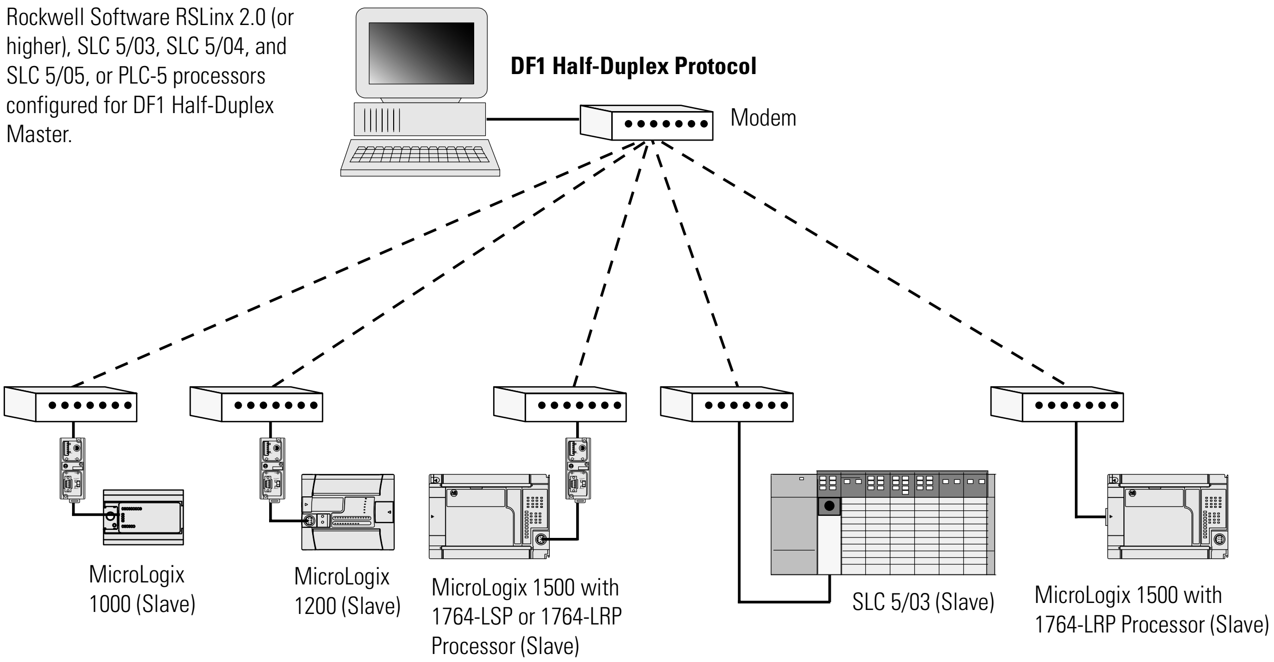
DF1 Half-Duplex Master-Slave Network

Use this diagram for DF1 Half-Duplex Master-Slave protocol without hardware handshaking.





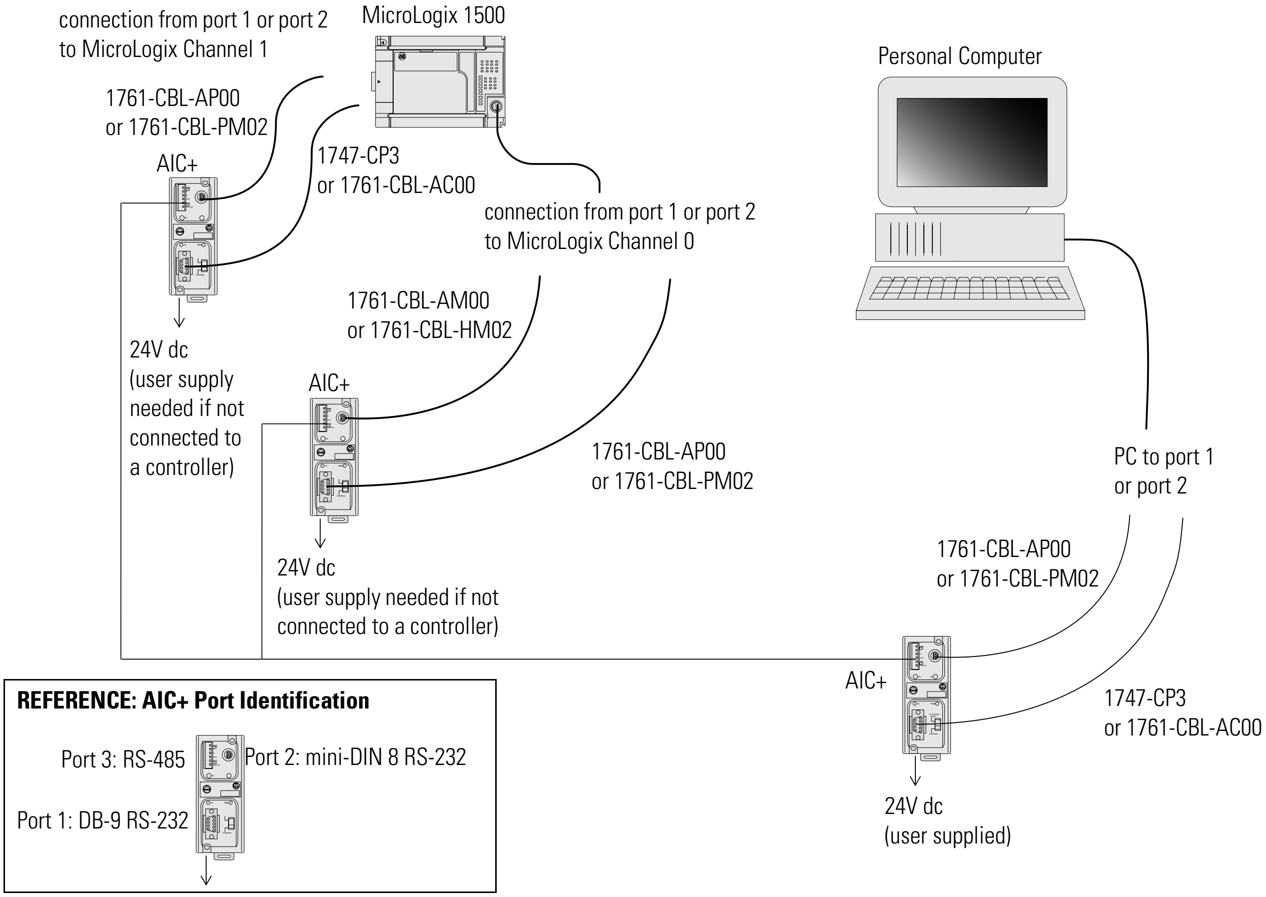
DF1 Half-Duplex Network (Using PC and Modems)



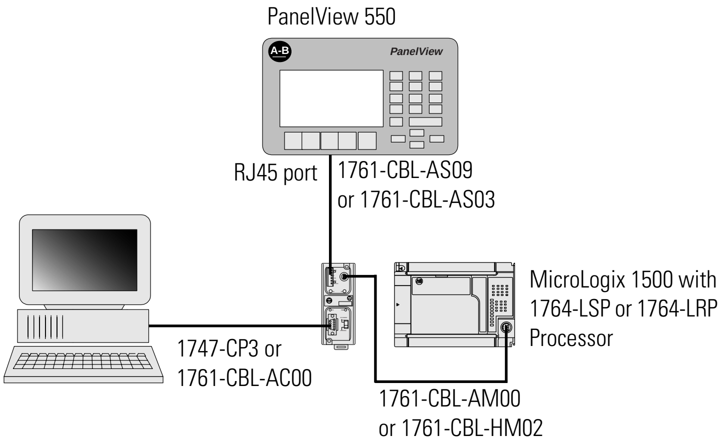
Connecting to a DH-485 Network

The following network diagrams provide examples of how to connect MicroLogix 1500 controllers to the DH-485 network using the Advanced Interface Converter (AIC+, catalog number 1761-NET-AIC). For more information on the AIC+, see the *Advanced Interface Converter and DeviceNet Interface Installation Instructions*, Publication 1761-5.11.

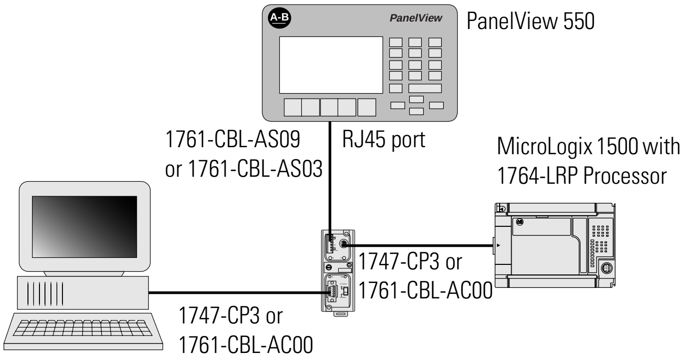
DH-485 Network with a MicroLogix 1500 Controller



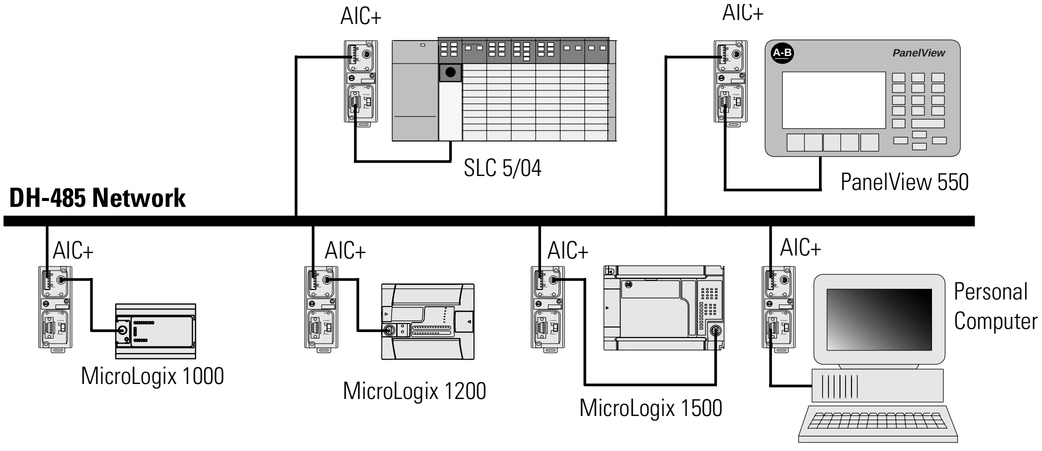
Typical 3-Node Network (Channel 0 Connection)



Typical 3-Node Network (Channel 1 Connection)



Networked Operator Interface Device and MicroLogix Controllers



DH-485 Configuration Parameters

When MicroLogix communications are configured for DH-485, the following parameters can be changed:

Table 4.4 DF1 Full-Duplex Configuration Parameters

Parameter	Options
Baud Rate	9600, 19.2K
Node Address	1 to 31 decimal
Token Hold Factor	1 to 4

See Software Considerations on page E-10 for tips on setting the parameters listed above.

Recommended Tools

To connect a DH-485 network, you need tools to strip and attach the shielded cable. We recommend the following equipment (or equivalent):

Table 4.5 Working with Cable for DH-485 Network

Description	Part Number	Manufacturer
Shielded Twisted Pair Cable	#3106A or #9842	Belden
Stripping Tool	45-164	Ideal Industries
1/8" Slotted Screwdriver	Not Applicable	Not Applicable

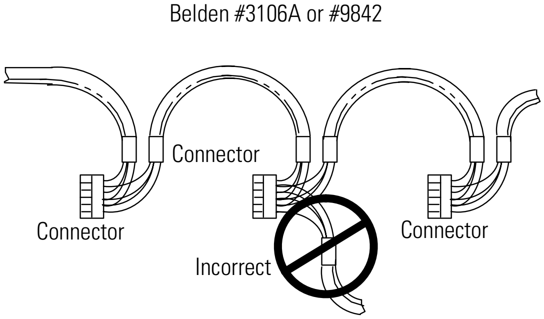
DH-485 Communication Cable

The communication cable consists of a number of cable segments daisy-chained together. The total length of the cable segments cannot exceed 1219 m (4000 ft). However, two segments can be used to extend the DH-485 network to 2438m (8000 ft). For additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual,* publication 1761-6.4.

Communication Cable Connection to the DH-485 Connector

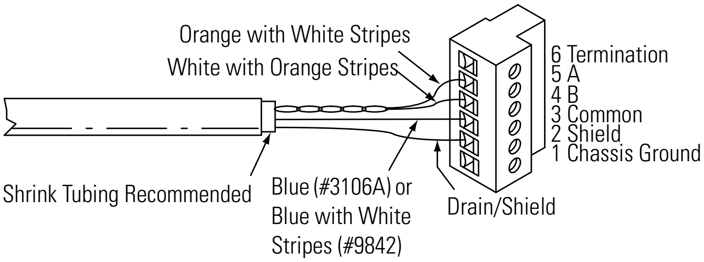
TIP

A daisy-chained network is recommended. We do *not* recommend the following:



Single Cable Connection

When connecting a single cable to the DH-485 connector, use the following diagram.



Multiple Cable Connection

When connecting multiple cables to the DH-485 connector, use the following diagram.

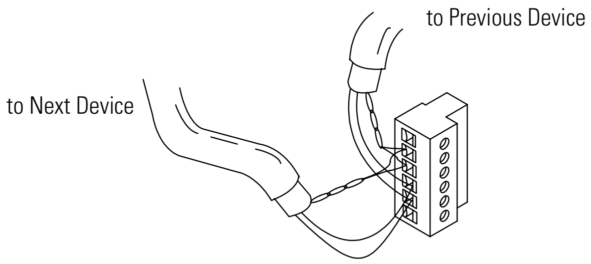


Table 4.6 Connections using Belden #3106A Cable

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue	Blue	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

Table 4.7 Connections using Belden #9842 Cable

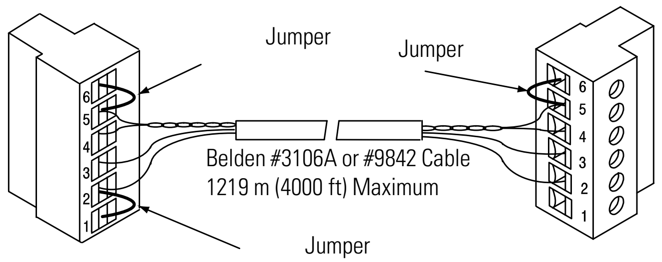
For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue/White	White with Blue Stripe	Cut back - no connection(1)
	Blue with White Stripe	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

(1) To prevent confusion when installing the communication cable, cut back the white with blue stripe wire immediately after the insulation jacket is removed. This wire is not used by DH-485.

Grounding and Terminating the DH-485 Network

Only one connector at the end of the link must have Terminals 1 and 2 jumpered together. This provides an earth ground connection for the shield of the communication cable. Both ends of the network must have Terminals 5 and 6 jumpered together, as shown below. This connects the termination impedance (of 120Ω) that is built into each AIC+ as required by the DH-485 specification.

End-of-Line Termination



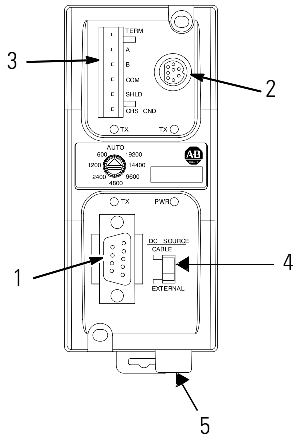
Connecting the AIC+

The AIC+, catalog number 1761-NET-AIC, enables MicroLogix controllers to connect to a DH-485 network when they are configured for DH-485 protocol. The AIC+ has two isolated RS-232 ports and one RS-485 port. When two MicroLogix controllers are closely positioned, you can connect a controller to each of the RS-232 ports on the AIC+.

The AIC+ can also be used as an RS-232 isolator, providing an isolation barrier between the controllers communications port and any equipment connected to it (i.e. personal computer, modem, etc.)

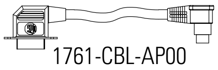
The following figure shows the connections and specifications of the AIC+.

Item	Description
1	Port 1 - DB-9 RS-232, DTE
2	Port 2 - mini-DIN 8 RS-232 DTE
3	Port 3 - RS-485 Phoenix plug
4	DC Power Source selector switch (cable = port 2 power source, external = external power source connected to item 5)
5	Terminals for external 24V dc power supply and chassis ground



For additional information on connecting the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual,* publication 1761-6.4.

Cable Selection Guide

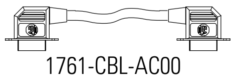


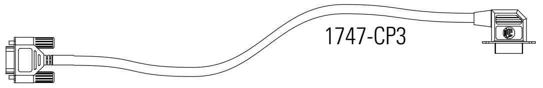
Cable	Length	Connections from	to AIC+	External Power Supply Required[1]	Power Selection Switch Setting[1]
1761-CBL-AP00 1761-CBL-PM02	45cm (17.7 in) 2m (6.5 ft)	1764-LRP processor, channel 1	port 2	yes	external
		SLC 5/03 or SLC 5/04 processors, channel 0	port 2	yes	external
		MicroLogix 1000 or 1500	port 1	yes	external
		PanelView 550 through NULL modem adapter	port 2	yes	external
		DTAM Plus / DTAM Micro	port 2	yes	external
		PC COM port	port 2	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

Cable	Length	Connections from	to AIC+	External Power Supply Required[1]	Power Selection Switch Setting[1]
1761-CBL-AM00 1761-CBL-HM02	45cm (17.7 in) 2m (6.5 ft)	MicroLogix 1000 or 1500	port 2	no	cable
		to port 2 on another AIC+	port 2	yes	external

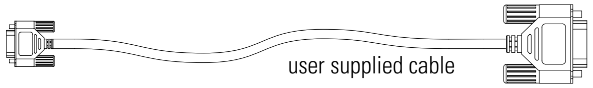
(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.





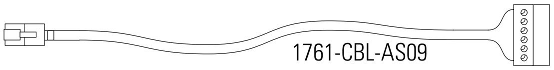
Cable	Length	Connections from	to AIC+	External Power Supply Required[1]	Power Selection Switch Setting[1]
1747-CP3 1761-CBL-AC00	3m (9.8 ft) 45cm (17.7 in)	1764-LRP processor, channel 1	port 1	yes	external
		SLC 5/03 or SLC 5/04 processor, channel 0	port 1	yes	external
		PC COM port	port 1	yes	external
		PanelView 550 through NULL modem adapter	port 1	yes	external
		DTAM Plus / DTAM Micro™	port 1	yes	external
		Port 1 on another AIC+	port 1	yes	external

[1] External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.



Cable	Length	Connections from	to AIC+	External Power Supply Required[1]	Power Selection Switch Setting[1]
straight 9-25 pin	—	modem or other communication device	port 1	yes	external

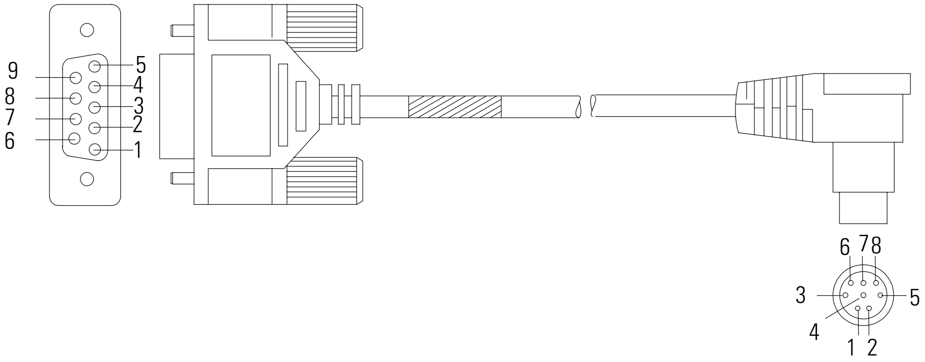
[1] External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.



Cable	Length	Connections from	to AIC+	External Power Supply Required[1]	Power Selection Switch Setting[1]
1761-CBL-AS03 1761-CBL-AS09	3m (9.8 ft) 9.5m (31.17 ft)	SLC 500 Fixed, SLC 5/01, SLC 5/02, and SLC 5/03 processors	port 3	yes	external
		PanelView 550 RJ45 port	port 3	yes	external

[1] External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

1761-CBL-PM02 (or equivalent) Cable Wiring Diagram

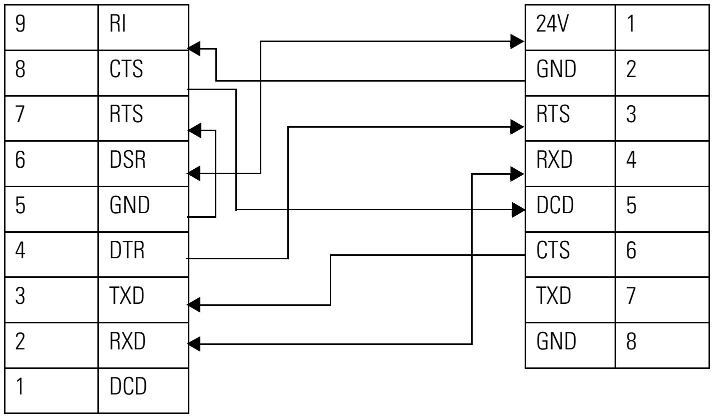


Programming Device

9-Pin D-Shell

Controller

8-Pin Mini Din



9	RI
8	CTS
7	RTS
6	DSR
5	GND
4	DTR
3	TXD
2	RXD
1	DCD

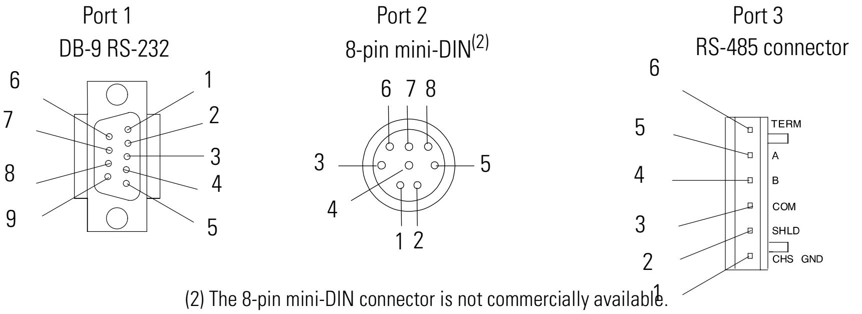
24V	1
GND	2
RTS	3
RXD	4
DCD	5
CTS	6
TXD	7
GND	8

Recommended User-Supplied Components

The components in Table 4.8 can be purchased from your local electronics supplier.

Table 4.8 User Supplied Components

Component	Recommended Model
external power supply and chassis ground	power supply rated for 20.4-28.8V dc
NULL modem adapter	standard AT
straight 9-25 pin RS-232 cable	see table below for port information if making own cables



(2) The 8-pin mini-DIN connector is not commercially available.

Table 4.9 AIC+ Terminals

Pin	Port 1: DB-9 RS-232	Port 2(2)	Port 3: RS-485 Connector
1	received line signal detector (DCD)	24V dc	chassis ground
2	received data (RxD)	ground (GND)	cable shield
3	transmitted data (TxD)	request to send (RTS)	signal ground
4	DTE ready (DTR)(1)	received data (RxD)	DH-485 data B
5	signal common (GND)	received line signal detector (DCD)	DH-485 data A
6	DCE ready (DSR)(2)	clear to send (CTS)	termination
7	request to send (RTS)	transmitted data (TxD)	not applicable
8	clear to send (CTS)	ground (GND)	not applicable
9	not applicable	not applicable	not applicable

(1) On port 1, pin 4 is electronically jumpered to pin 6. Whenever the AIC+ is powered on, pin 4 will match the state of pin 6.

(2) An 8-pin mini DIN connector is used for making connections to port 2. This connector is not commercially available.

Safety Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.

.

WARNING

EXPLOSION HAZARD

This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.

See Safety Considerations on page 2-3 for additional information.

Installing and Attaching the AIC+

1. Take care when installing the AIC+ in an enclosure so that the cable connecting the MicroLogix 1500 controller to the AIC+ does not interfere with the enclosure door.

2. Carefully plug the terminal block into the RS-485 port on the AIC+ you are putting on the network. Allow enough cable slack to prevent stress on the plug.

3. Provide strain relief for the Belden cable after it is wired to the terminal block. This guards against breakage of the Belden cable wires.

Powering the AIC+

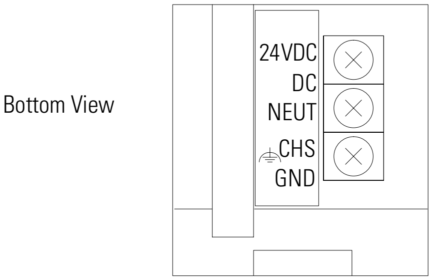
In normal operation with a MicroLogix programmable controller connected to port 2 of the AIC+, the controller powers the AIC+. Any AIC+ not connected to a MicroLogix controller requires a 24V dc power source. The AIC+ requires 120 mA at 24V dc.

If both the controller and external power are connected to the AIC+, the power selection switch determines what device powers the AIC+.

ATTENTION

If you use an external power supply, it must be 24V dc. Permanent damage results if higher voltage is used.

Set the DC Power Source selector switch to EXTERNAL before connecting the power supply to the AIC+. The following illustration shows where to connect external power for the AIC+.



ATTENTION

Always connect the CHS GND (chassis ground) terminal to the nearest earth ground. This connection must be made whether or not an external 24V dc supply is used.

Power Options

Below are two options for powering the AIC+:

- Use the 24V dc user power supply built into the MicroLogix 1500 controller. The AIC+ is powered through a hard-wired connection using a communication cable (1761-CBL-HM02, or equivalent) connected to port 2.
- Use an external DC power supply with the following specifications:
  - operating voltage: 24V dc +20% or -15%
  - output current: 150 mA minimum
  - rated NEC Class 2

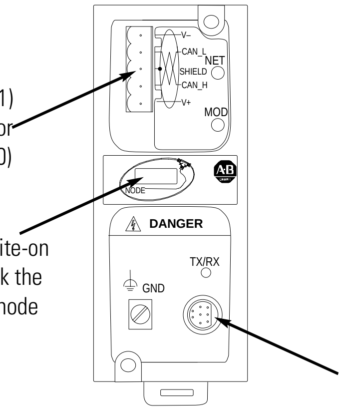
  Make a hard-wired connection from the external supply to the screw terminals on the bottom of the AIC+.

ATTENTION

If you use an external power supply, it must be 24V dc. Permanent damage results if miswired with the wrong power source.

Connecting to DeviceNet

You can connect a MicroLogix 1500 using DF1 Full-Duplex protocol to a DeviceNet network using the DeviceNet Interface (DNI), catalog number 1761-NET-DNI. For additional information on using the DNI, refer to the *DeviceNet Interface User Manual*, publication 1761-6.5. The following figure shows the external wiring connections of the DNI.



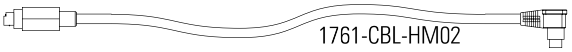
DeviceNet Node (Port 1)
(Replacement connector part no. 1761-RPL-0000)

Use this write-on area to mark the DeviceNet node address.

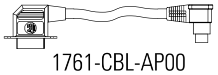
RS-232 (Port 2)

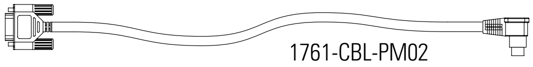
Cable Selection Guide


1761-CBL-AM00


1761-CBL-HM02

Cable	Length	Connections from	to DNI
1761-CBL-AM00 1761-CBL-HM02	45 cm (17.7 in) 2m (6.5 ft)	MicroLogix 1000	port 2
		MicroLogix 1500	port 2

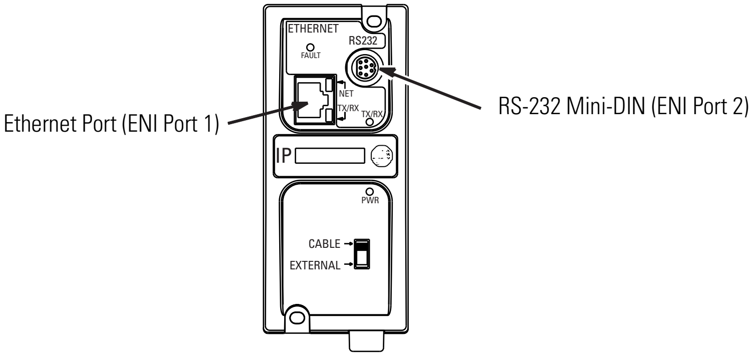

1761-CBL-AP00


1761-CBL-PM02

Cable	Length	Connections from	to DNI
1761-CBL-AP00 1761-CBL-PM02	45 cm (17.7 in) 2m (6.5 ft)	SLC 5/03 or SLC 5/04 processors, channel 0	port 2
		PC COM port	port 2
		1764-LRP processor, channel 1	port 2

Connecting to Ethernet

You can connect a MicroLogix 1500 to an Ethernet network using the Ethernet Interface (ENI), catalog number 1761-NET-ENI. For additional information on using the ENI, refer to the *Ethernet Interface User Manual*, publication 1761-UM006. The following figure shows the external wiring connections of the ENI.



Ethernet Connections

The Ethernet connector, port 1, is an RJ45, 10Base-T connector. The pin-out for the connector is shown below:

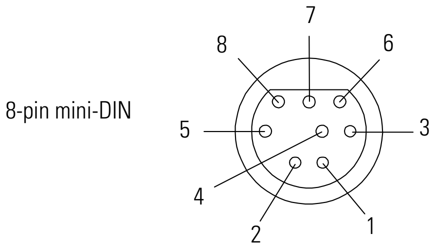
Pin	Pin Name
1	Tx+
2	Tx-
3	Rx+
4	not used by 10Base-T
5	not used by 10Base-T
6	Rx-
7	not used by 10Base-T
8	not used by 10Base-T

When to use straight-through and cross-over cable:

- ENI Ethernet port to 10Base-T Ethernet switch cables utilize a straight-through pin-out (1-1, 2-2, 3-3, 6-6).
- Direct point-to-point 10Base-T cables connecting the ENI Ethernet port directly to another ENI Ethernet port (or a computer 10Base-T port) require a cross-over pin-out (1-3, 2-6, 3-1, 6-2).

RS-232 Connections

Port 2 of the ENI is an 8-pin mini-DIN RS-232 port that provides connection to DF1 compatible RS-232 devices. The connector pin assignments are shown below.



Pin	Port 2
1	24V dc
2	ground (GND)
3	no connection
4	ENI input data, RxD
5	no connection
6	no connection
7	ENI output data, TxD
8	ground (GND)

The table below describes the RS-232 compatible cables.

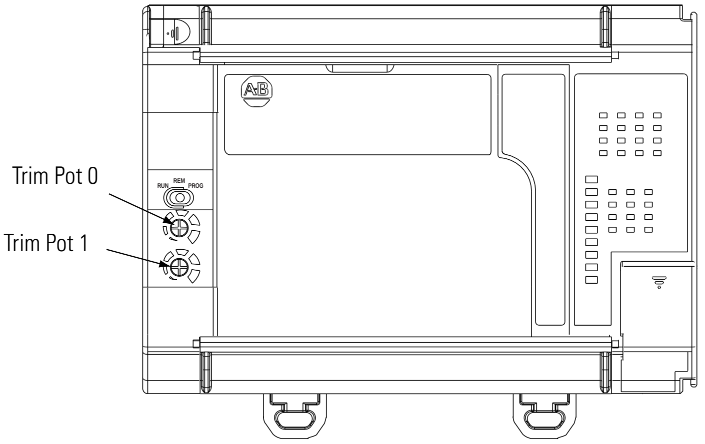
ENI Connected to:	Catalog Number	Use Cable
MicroLogix (all series)		Mini DIN to Mini DIN
	1761-CBL-AM00	45 cm (17.7 in)
	1761-CBL-HM02	2m (6.5 ft.)
SLC 5/03, SLC 5/04, or		Mini DIN to D-Shell
SLC 5/05 Channel 0	1761-CBL-AP00	45 cm (17.7 in)
	1761-CBL-PM02	2m (6.5 ft.)
PLC-5		Mini DIN to D-Shell
	1761-CBL-AP00	45 cm (17.7 in)
	1761-CBL-PM02	2m (6.5 ft.)

Using Trim Pots and the Data Access Tool (DAT)

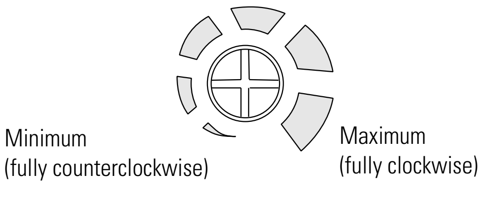
Trim Pot Operation

The processor has two trimming potentiometers (trim pots) which allow modification of data within the controller. Adjustments to the trim pots change the value in the corresponding Trim Pot Information (TPI) register. The data value of each trim pot can be used throughout the control program as timer, counter, or analog presets depending upon the requirements of the application.

The trim pots are located below the mode switch under the left access door of the processor.



Use a small flathead screwdriver to turn the trim pots. Adjusting their value causes data to change within a range of 0 to 250 (fully clockwise). The maximum rotation of each trim pot is three-quarters, as shown below. Trim pot stability over time and temperature is typically ±2 counts.



Trim pot data is updated continuously whenever the controller is powered-up.

Trim Pot Information Function File

The composition of the Trim Pot Information (TPI) Function File is described in the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001.

Error Conditions

If the controller detects a problem/error with either trim pot, the last values read remain in the data location, and an error code is put in the error code byte of the TPI file for whichever trim pot had the problem. Once the problem/error is corrected, the error code is cleared. The error codes are described in the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001.

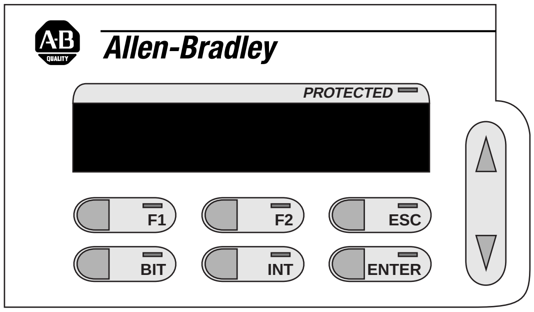
Data Access Tool (DAT)

The DAT is a convenient and simple tool that provides an interface for editing and monitoring data. The DAT has five primary features:

- provides direct access to 48 bit elements
- provides direct access to 48 integer elements
- provides two function keys
- displays controller faults
- allows removal/insertion under power

DAT Keypad and Indicator Light Functions

The DAT has a digital display, 6 keys, an up/down key, and 7 indicator lights. Their functions are described in the table on page 5-3.



Feature	Function
Digital Display	Displays address elements, data values, faults and errors.
Up/Down Key	Selects element numbers and change data values. The up/down key scrolls when held.
F1 Key and Indicator Light	Controls the F1 status bit. When the F1 key is pressed or latched, the F1 indicator LED is lit.
F2 Key and Indicator Light	Controls the F2 status bit. When the F2 key is pressed or latched, the F2 indicator LED is lit.
ESC Key	Cancels a current operation.
BIT Key and Indicator Light	Pressing the BIT key puts the DAT in bit mode. The bit indicator light is on when the DAT is in bit mode.
INT Key and Indicator Light	Pressing the INT key puts the DAT in integer mode. The integer indicator light is on when the DAT is in integer mode.
ENTER Key	Press to select the flashing element number or enter data value.
PROTECTED Indicator Light	Indicates element data cannot be changed using the DAT (element is read-only).

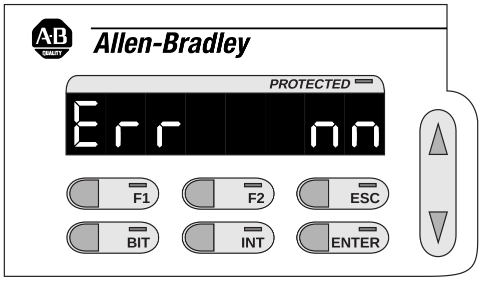
TIP

The F1, F2, ESC, BIT, INT, and ENTER keys do not repeat when held. Holding down any one of these keys results in only one key press. The Up/Down arrow key is the only key that repeats when held.

Power-Up Operation

The DAT receives power when it is plugged into the controller. Upon power-up, the DAT performs a self-test.

If the test fails, the DAT displays an error code, all indicator lights are deactivated, and the DAT does not respond to any key presses. See DAT Error Codes on page 5-10.

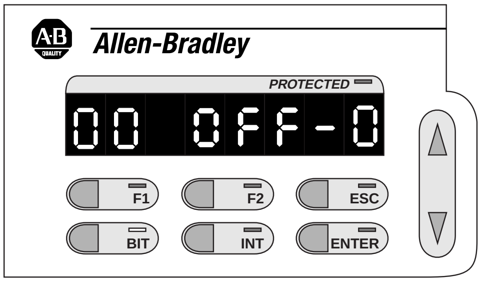


After a successful self-test, the DAT reads the DAT function file to determine its configuration.

DAT Function File

DAT configuration is stored in the processor in a specialized configuration file called the DAT Function File. The DAT Function File, which is part of the user's control program, is described in the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001.

Following a successful power-up sequence, the DAT enters the bit monitoring mode.



Power Save Timeout (PST) Parameter

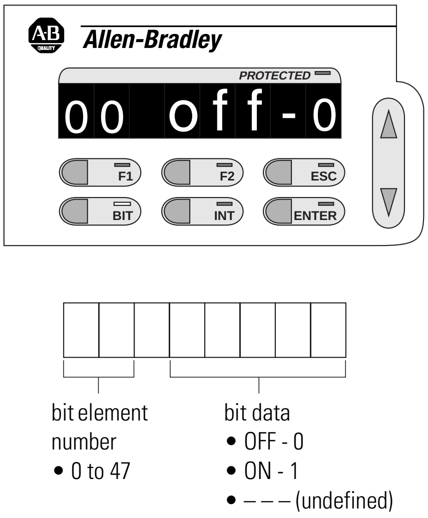
The power save timeout turns off the DAT display after keypad activity has stopped for a user-defined period of time. The power-save (DAT:0.PST) value is set in the DAT Function File. The valid range is 0 to 255 minutes. The power-save feature can be disabled by setting the PST value to 0, which keeps the display on continuously. The default value is 0.

In power-save mode, a dash flashes in the left-most segment of the display. Press any key (except F1 or F2) to return the DAT to its previous mode. If F1 or F2 is pressed, the DAT will change the value of the F1 or F2 status bits, but the display remains in power-save mode.

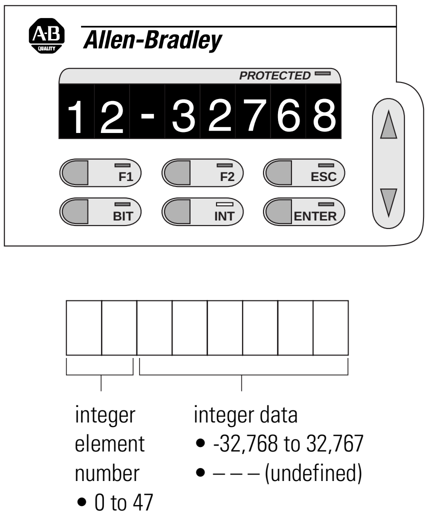
Understanding the DAT Display

When the DAT enters either the bit or integer mode, the element number and its data are displayed, as shown below. The element number is either the integer or bit location.

Bit Mode Display

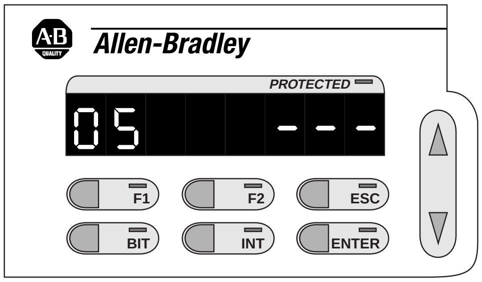


Integer Mode Display



If the displayed element is defined in the controller's data file, and is not protected, the element number flashes, indicating that it can be modified. If the displayed element is protected, the PROTECTED indicator light illuminates, and the element number does not flash, indicating that the element cannot be modified.

If the element is undefined, the data field displays three dashes. The element number does not flash because the element does not exist.



Entering Bit Mode

Bit mode allows you to view and modify up to 48 contiguous bit locations in the controller. The DAT enters the bit mode automatically following a successful power-up. The bit mode can also be selected by pressing the BIT key. If the bit mode was previously active, the DAT displays the last bit element monitored. If the integer mode was active, the DAT displays the first bit element in the data file. However, there may be a brief delay while the DAT requests information from the controller. During the delay, the working screen will display. See Working Screen Operation on page 5-7.

Entering Integer Mode

Integer mode allows you to view and modify up to 48 contiguous 16-bit integer data locations in the controller. To initiate integer mode, press the INT key. If the integer mode was previously active, the DAT displays the last integer element monitored. If the bit mode was active, the DAT displays the first integer element in the data file. However, there may be a brief delay while the DAT requests information from the controller. If there is a delay, the working screen is displayed. See Working Screen Operation on page 5-7.

Monitoring and Editing

1. Press the INT or BIT key to enter the desired mode. The element number flashes (if not protected).

2. Use the up/down key to scroll and select an element (to scroll rapidly, hold the up/down key).

3. Press ENTER to edit the element. The element number becomes steady and the data flashes if it is not protected.

4. Use the up/down key to change the data. Bit values toggle between “ON” and “OFF”. Integer values increment or decrement. Holding down the up/down key causes the integer value to increment or decrement quickly.

TIP If the data is protected or undefined, pressing the up/down key scrolls to the next element in the list.

5. Press ENTER to load the new data. Press ESC or INT/BIT to discard the new data.

F1 and F2 Functions

The function keys, F1 and F2, correspond to bits and can be used throughout the control program as desired. They have no effect on bit or integer monitoring.

Each key has two corresponding bits in the DAT function file. The bits within the DAT function file are shown in the table below.

Key	Bits	Address	Data Format	Type	User Program Access
F1 Key	Pressed	DAT:0/F1P	Binary	Status	Read/Write
	Latched	DAT:0/F1L	Binary	Status	Read/Write
F2 Key	Pressed	DAT:0/F2P	Binary	Status	Read/Write
	Latched	DAT:0/F2L	Binary	Status	Read/Write

F1 or F2 Key Pressed

The pressed bits (DAT:0/F1P and DAT:0/F2P) function as push-buttons and provide the current state of either the F1 or F2 key on the keypad. When the F1 or F2 key is pressed, the DAT sets (1) the corresponding pressed key bit. When the F1 or F2 key is not pressed, the DAT clears (0) the corresponding pressed key bit.

F1 or F2 Key Latched

The latched bits (DAT:0/F1L and DAT:0/F2L) function as latched push-buttons and provide latched/toggle key functionality. When the F1 or F2 key is pressed, the DAT sets (1) the corresponding latched key bit within the DAT Function File. When the F1 or F2 key is pressed a second time, the DAT clears (0) the corresponding latched key bit.

Working Screen Operation

Because the DAT is a communications device, its performance is affected by the scan time of the controller. Depending on the user program, if a long scan time is encountered and the DAT waits for information from the controller, a working screen is displayed. The working screen consists of three dashes that move across the display from left to right. While the working screen is displayed, key presses are not recognized. Once the DAT receives data from the controller, it returns to its normal mode of operation.

If you encounter excessive working screen conditions, you can minimize the effect by adding an SVC instruction to the control program. Refer to the *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001, for information on the SVC instruction.

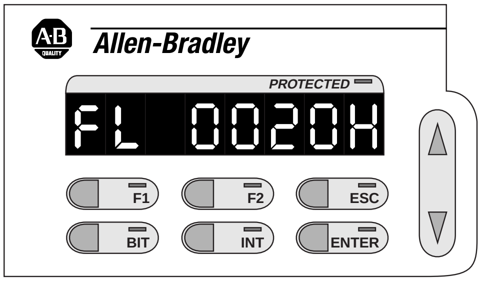
Non-Existent Elements

When the DAT determines that an element number does not exist in the controller, the element value displays as three dashes.

If the protection bit for an element is undefined, the DAT will assume that the element is unprotected.

Controller Faults

The DAT checks for controller faults every 10 seconds. When the DAT detects a controller fault, the display shows “FL” in the element number field and the value of the controller’s major fault word (S2:6) is displayed in the value field, as shown below.



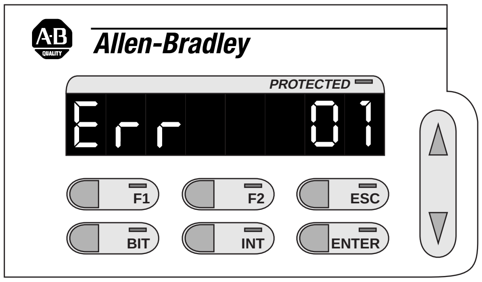
TIP

If an element value is being modified when the fault is detected, the fault is stored until the modification is accepted or discarded. Then, the fault will be displayed.

Pressing ESC while the fault is being displayed returns the DAT to its previous mode. The fault is not removed from the controller, just from the DAT display screen. The fault that was on screen will not display again and cannot be “recalled”. If a new fault is detected, it will be displayed. If the initial fault is cleared and returns at a later time, the DAT will display the fault at that time.

Error Conditions

When the DAT detects an error in its own operation, it displays the error screen. The error screen consists of “Err” and a two-digit error code, as shown below.



The DAT can experience two different types of errors, internal errors and communication errors.

Internal DAT Errors

Internal DAT errors are non-recoverable. When the DAT experiences an internal error, it displays the error screen, and does not respond to any key presses. Remove and re-install the DAT. If this does not clear the error, the DAT must be replaced.

Communication Errors

The DAT continually monitors the interface between the DAT and the controller to ensure a good communication path. If the DAT loses communication with the controller for more than three seconds, it generates an interface time-out error. The DAT automatically attempts to re-establish communications. The error screen displays until the DAT regains communications with the processor. All key presses are ignored until the display clears.

DAT Error Codes

Error Code	**Description**	**Caused by**	**Recommended Action**
00	Interface time-out	Communication traffic	Add SVC instructions to ladder program
01 to 02	Power-up test failure	Internal failure	Remove and re-insert the DAT. If failure persists, replace the unit.
03 to 07	internal error	Internal failure	Remove and re-insert the DAT. If failure persists, replace the unit.
08	processor owned(1)	Another device has ownership of the controller	Release ownership by the other device
09	access denied	Cannot access that file because another device has ownership	Release file ownership by the other device
31 to 34	internal error	Internal failure	Remove and re-insert the DAT. If failure persists, replace the unit.

(1) This error can occur after a download in which communications configurations are changed. This error can be cleared by removing and re-installing the DAT, or by cycling power to the controller.

Using Real-Time Clock and Memory Modules

Five modules with different levels of functionality are available for use with the MicroLogix 1500 controller.

Catalog Number	Function	Memory Size
1764-RTC	Real-Time Clock	not applicable
1764-MM1	Memory Module	8K
1764-MM1RTC	Memory Module and Real-Time Clock	8K
1764-MM2(1)	Memory Module	16K
1764-MM2RTC(1)	Memory Module and Real-Time Clock	16K

(1) For 1764-LRP programs greater than 8k, use the 1764-MM2 or 1764-MM2RTC.

Real-Time Clock Operation

Removal/Insertion Under Power

The real-time clock module can be installed or removed at any time without risk of damage to either the module or the controller. If a module is installed while the MicroLogix 1500 is in an executing mode (Run or Remote Run), the module is not recognized until either a power cycle occurs, or until the controller is placed in a non-executing mode (program mode or fault condition).

Removal of the memory module is detected within one program scan. Removal of the real-time clock under power causes the controller to write zeros to the (RTC) Function File.

Real-Time Clock Function File

The real-time clock provides year, month, day of month, day of week, hour, minute, and second information to the Real-Time Clock (RTC) Function File in the controller. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001 for information about the RTC function file.

Accuracy

The following table indicates the expected accuracy of the real-time clock at various temperatures.

Ambient Temperature	Accuracy(1)
0°C (+32°F)	+34 to -70 seconds/month
+25°C (+77°F)	+36 to -68 seconds/month
+40°C (+104°F)	+29 to -75 seconds/month
+55°C (+131°F)	-133 to -237 seconds/month

(1) These numbers are expected worst case values over a 31 day month.

Writing Data to the Real-Time Clock

When valid data is sent to the real-time clock from the programming device, the new values take effect immediately.

The real-time clock does not allow you to write invalid date or time data.

RTC Battery Operation

The real-time clock has an internal battery that is not replaceable. The RTC Function File features a battery low indicator bit (RTC:0/BL), which shows the status of the RTC battery. When the battery is low, the indicator bit is set (1). This means that the battery may fail within 14 days and the real-time clock module needs to be replaced. When the battery low indicator bit is clear (0), the battery level is acceptable or a real-time clock is not attached.

If the RTC battery is low and the controller is powered, the RTC operates normally. If the controller power is removed and the RTC battery is low, RTC data may be lost.

Use the *Disable Clock* button in your programming device to disable the real-time clock before storing a module. This decreases the drain on the battery during storage.

Table 6.1 RTC Battery Life Expectancy

Battery State	Temperature	Time Duration
Operating	0°C to +40°C (+32°F to +104°F)	5 years(1)
Storage	-40°C to +25°C (-40°F to +77°F)	5 years minimum
	+26°C to +60°C (+79°F to +140°F)	3 years minimum

(1) The operating life of the battery is based on 6 months of storage time before the real-time clock is used.

ATTENTION

Operating with a low battery indication for more than 14 days may result in invalid RTC data if controller power is lost.

Memory Module Operation

The memory module supports program back-up as well as the following features:

- User Program and Data Back-Up
- Program Compare
- Data File Download Protection
- Memory Module Write Protection
- Removal/Insertion Under Power

User Program and Data Back-Up

The memory module provides a simple and flexible program/data transport mechanism, allowing the user to transfer the program and data to the controller without the use of a personal computer and programming software.

The memory module can store one user program at a time.

During transfers from a memory module, the controller's RUN LED flashes.

Program Compare

The memory module can also provide application security, allowing you to specify that if the program stored in the memory module does not match the program in the controller, the controller will not enter an executing (run or remote run) mode. To enable this feature, set the S:2/9 bit in the system status file. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual,* publication 1762-RM001, for more information.

Data File Download Protection

The memory module allows the user to specify individual data files in the controller that are protected from the download procedure. This allows user data to be saved (not overwritten) during a download.

TIP

Data file download protection is only functional if the processor does not have a fault and if all protected data files in the memory module exactly match the protected data file structure within the controller. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual,* publication 1762-RM001, for information on protecting data files during download.

Memory Module Write Protection

The memory module supports write-once, read-many behavior. Write protection is enabled using your programming software.

IMPORTANT Once set, write protection cannot be removed. A change cannot be made to the control program or data stored in a write-protected memory module. If a change is required, you must use a different memory module.

Removal/Insertion Under Power

The memory module can be installed or removed at any time without risk of damage to either the memory module or the controller. If a memory module is installed while the MicroLogix 1500 is executing, the memory module will not be recognized until either a power cycle occurs, or until the controller is placed in a non-executing mode (program mode or fault condition).

Memory Module Information File

The controller has a Memory Module Information (MMI) File which provides status from the attached memory module. At power-up or on detection of a memory module being inserted, the catalog number, series, revision, and type (memory module and/or real-time clock) are identified and written to the MMI file. If a memory module and/or real-time clock is not attached, zeros are written to the MMI file. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001, for more information.

Specifications

Controller Specifications

Table A.1 General Specifications

Description	1764-24BWA	1764-24AWA	1764-28BXB
Number of I/O	12 inputs 12 outputs	12 inputs 12 outputs	16 inputs 12 outputs
Line Power	85 to 265V ac at 47 to 63 Hz	85 to 265V ac at 47 to 63 Hz	20.4 to 30V dc
Power Supply Usage	88 VA	70 VA	30W(2)
Power Supply Inrush	120V ac = 25A for 8 ms 240V ac = 40A for 4 ms	120V ac = 25A for 8 ms 240V ac = 40A for 4 ms	24V dc = 4A for 150 ms
User Power Output	24V dc at 400 mA, 400 µF max.	none	none
Input Circuit Type	24V dc, sink/source	120V ac	24V dc, sink/source
Output Circuit Type	relay	relay	6 relay, 6 FET transistor (24V dc source)
Typical CPU Hold-up Time	10 to 3000 ms		
Operating Temp.	+0°C to +55°C (+32°F to +131°F) ambient		
Storage Temp.	-40°C to +85°C (-40°F to +185°F) ambient (1)		
Operating Humidity	5% to 95% relative humidity (non-condensing)		
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. max. peak-to-peak Relay Operation: 2G		
Shock (without Data Access Tool installed)	Operating: 30G panel mounted (15G DIN Rail mounted) Relay operation: 7.5G panel mounted (5G DIN Rail mounted) Non-Operating: 40G panel mounted (30G DIN Rail mounted)		
Shock (with Data Access Tool installed)	Operating: 20G panel mounted (15G DIN Rail mounted) Relay operation: 7.5G panel mounted (5G DIN Rail mounted) Non-Operating: 30G panel mounted (20G DIN Rail mounted)		
Agency Certification	• UL 508 • C-UL under CSA C22.2 no. 142 • Class I, Div. 2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 no. 213) • CE compliant for all applicable directives • C-Tick marked for all applicable acts		

Table A.1 General Specifications

Description	1764-24BWA	1764-24AWA	1764-28BXB
Electrical/EMC	The module has passed testing at the following levels: • EN61000-4-2: 4 kV contact, 8 kV air, 4 kV indirect • EN61000-4-3: 10 V/m • EN61000-4-4: 2 kV, 5 kHz; communications cable: 1 kV, 5 kHz • EN61000-4-5: communications cable1 kv galvanic gun -I/O: 2 kV CM, 1 kV DM, -Power Supply (1764-24AWA/1764-24BWA): 4 kV CM, 2 kV DM -Power Supply (1764-28BXB): 0.5 kV CM, 0.5 kV DM • EN61000-4-6: 10V, communications cable 3V		
Terminal Screw Torque	1.13 Nm (10 in-Ib) rated; 1.3 Nm (12 in-Ib) maximum		
Programming Software	For 1764-LSP Series A Processors: RSLogix 500, Version 3.01.09 or higher For 1764-LSP and 1764-LRP Series B Processors: RSLogix 500, Version 4.00.00 or higher.		

(1) Recommended storage temperature for maximum battery life (5 years typical with normal operating/storage conditions) of the 1764-RTC, 1764-MM1RTC, and 1764-MM2RTC is -40°C to +40°C (-40°F to +104°F). Battery life is significantly shorter at elevated temperatures.

(2) See Choosing a Power Supply on page A-2.

Choosing a Power Supply

This section contains information for selecting a power supply for applications using a 1764-28BXB base unit. Use the tables in Appendix F to calculate the total power (Watts) consumed by the system. With that information, use the graphs below to chose a power supply. You can use either current or power, depending on how the power supply is rated.

Figure 1.1 Input Current Required

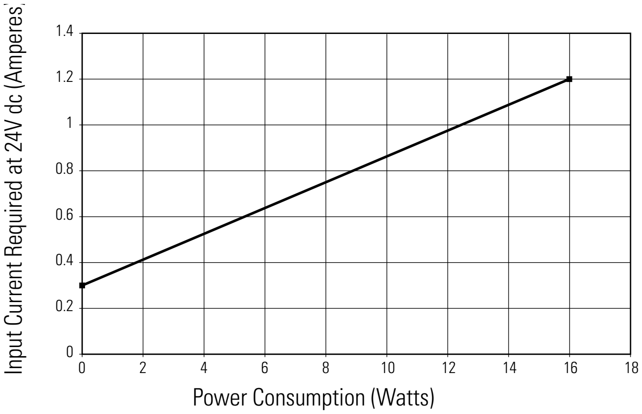


Figure 1.2 Input Power Required

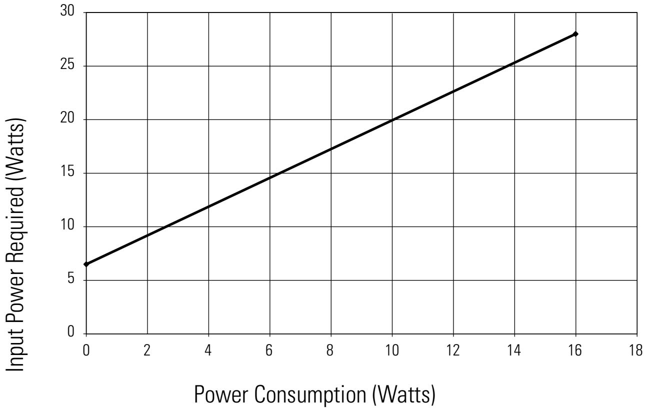


Table A.2 Input Specifications

Description	1764-24AWA	1764-24BWA and 1764-28BXB	
		Inputs 0 thru 7	Inputs 8 and Higher
On-State Voltage Range	79 to 132V ac	14 to 30.0V dc at 30°C (86°F) 14 to 26.4V dc at 55°C (131°F)	10 to 30.0V dc at 30°C (86°F) 10 to 26.4V dc at 55°C (131°F)
Off-State Voltage Range	0 to 20V ac	0 to 5V dc	
Operating Frequency	Not Applicable	1 kHz to 20 kHz	1 kHz to 500 Hz(1)
On-State Current: • minimum • nominal • maximum	 • 5.0 mA at 79V ac • 12.0 mA at 120V ac • 16.0 mA at 132V ac	 • 2.5 mA at 14V dc • 7.3 mA at 24V dc • 12.0 mA at 30V dc	 • 2.0 mA at 10V dc • 8.9 mA at 24V dc • 12.0 mA at 30V dc
Off-State Leakage Current	2.5 mA minimum	1.5 mA minimum	
Nominal Impedance	12k ohms at 50 Hz 10k ohms at 60 Hz	3.3k ohms	2.7k ohms
Inrush Current (max.)	250 mA at 120V ac	Not Applicable	Not Applicable

(1) Scan-time dependant.

TIP

The 1764-24AWA input circuits (inputs 0-11) do not support adjustable filter settings. They have maximum turn-on and maximum turn-off times of 20 milliseconds.

Table A.3 Response Times for High-Speed dc Inputs 0 Through 7 (applies to 1764-24BWA and 1764-28BXB)

Maximum High-Speed Counter Frequency at 50% Duty Cycle (KHz)	Filter Setting (ms)	Minimum ON Delay (ms)	Maximum ON Delay (ms)	Minimum OFF Delay (ms)	Maximum OFF Delay (ms)
20.000	0.025	0.005	0.025	0.005	0.025
6.700	0.075	0.040	0.075	0.045	0.075
5.000	0.100	0.050	0.100	0.060	0.100
2.000	0.250	0.170	0.250	0.210	0.250
1.000	0.500	0.370	0.500	0.330	0.500
0.500	1.000	0.700	1.000	0.800	1.000
0.250	2.000	1.700	2.000	1.600	2.000
0.125	4.000	3.400	4.000	3.600	4.000
0.063	8.000(1)	6.700	8.000	7.300	8.000
0.031	16.000	14.000	16.000	14.000	16.000

(1) This is the default setting.

Table A.4 Response Times for Normal dc Inputs 8 Through 11 (1764-24BWA) and 8 Through 15 (1764-28BXB)

Maximum Frequency at 50% Duty Cycle (kHz)	Filter Setting (ms)	Minimum ON Delay (ms)	Maximum ON Delay (ms)	Minimum OFF Delay (ms)	Maximum OFF Delay (ms)
1.000	0.500	0.090	0.500	0.020	0.500
0.500	1.000	0.500	1.000	0.400	1.000
0.250	2.000	1.100	2.000	1.300	2.000
0.125	4.000	2.800	4.000	2.700	4.000
0.063	8.000(1)	5.800	8.000	5.300	8.000
0.031	16.000	11.000	16.000	10.000	16.000

(1) This is the default setting.

IMPORTANT The relay current must stay within the limits defined in Tables A.5 and A.6.

Table A.5 Relay Contact Rating Table 1764-24AWA, -24BWA, -28BXB

Maximum Volts	Amperes		Amperes Continuous	Voltamperes	
	Make	Break		Make	Break
240V ac	7.5A	0.75A	2.5A	1800VA	180VA(2)
120V ac	15A	1.5A			
125V dc	0.22A(1)		1.0A	28VA	
24V dc	1.2A(1)		2.0A	28VA	

(1) For dc voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28 VA by the applied dc voltage. For example, 28 VA/48V dc = 0.58A. For dc voltage applications less than 14V, the make/break ratings for relay contacts cannot exceed 2A.

(2) The total load controlled by the 1764-24AWA and 1764-24BWA is limited to 1440VA (break).

Table A.6 Output Specifications - Maximum Continuous Relay Current

Specification		1764-24AWA, -24BWA	1764-28BXB
Current per Common		8A	8A
Current per Controller	at 150V Maximum	24A	18A
	at 240V Maximum	20A	18A

Table A.7 1764-28BXB FET Output Specifications

Specification		General Operation (Outputs 2 thru 7)	High Speed Operation(1) (Outputs 2 and 3 Only)
User Supply Voltage	minimum	20.4V dc	20.4V dc
	maximum	26.4V dc	26.4V dc
On-State Voltage Drop	at maximum load current	1V dc	Not Applicable
	at maximum surge current	2.5V dc	Not Applicable
Current Rating per Point	maximum load	1A at 55°C (131°F) 1.5A at 30°C (86°F)	100 mA
	minimum load	1.0 mA	10 mA
	maximum leakage	1.0 mA	1.0 mA

Table A.7 1764-28BXB FET Output Specifications

Specification		General Operation (Outputs 2 thru 7)	High Speed Operation[1] (Outputs 2 and 3 Only)
Surge Current per Point	peak current	4.0A	Not Applicable
	maximum surge duration	10 msec	Not Applicable
	maximum rate of repetition at 30°C (86°F)	once every second	Not Applicable
	maximum rate of repetition at 55°C (131°F)	once every 2 seconds	Not Applicable
Current per Common	maximum total	6A	Not Applicable
On-State Current	minimum	2.5 mA at 14V dc	2.0 mA at 10V dc
Off-State Leakage Current	maximum	1 mA	1 mA
Turn-On Time	maximum	0.1 msec	6 μsec
Turn-Off Time	maximum	1.0 msec	18 μsec
Repeatability	maximum	n/a	2 μsec
Drift	maximum	n/a	1 μsec per 5°C (1 μsec per 9°F)

(1) Outputs 2 and 3 are designed to provide increased functionality over the other FET outputs (4 through 7). They may be used like the other FET transistor outputs, but in addition, within a limited current range, they may be operated at a higher speed. Outputs 2 and 3 also provide a pulse train output (PTO) or pulse width modulation output (PWM) function.

Table A.8 Working Voltage (1764-24AWA)

Specification	1764-24AWA
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 151V ac for 1 second or 2145V dc for 1 second
	132V Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation).

Table A.9 Working Voltage (1764-24BWA)

Specification	1764-24BWA
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Power Supply User 24V Output to Backplane Isolation	Verified by one of the following dielectric tests: 600V ac for 1 second or 848V dc for 1 second
	50V Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation).
Output Group to Output Group Isolation.	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

Table A.10 Working Voltage (1764-28BXB)

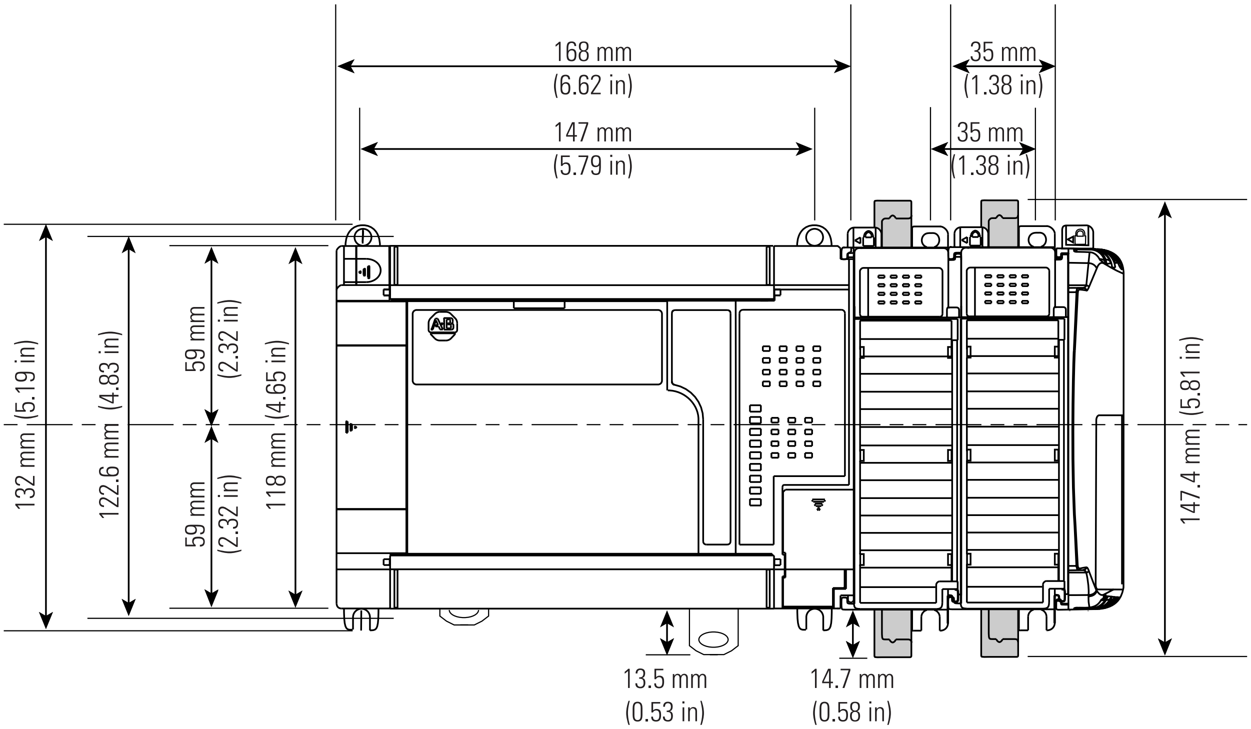
Specification	1764-28BXB
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
FET Output Group to Backplane Isolation and FET Outputs Group to Group	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Relay Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Relay Output Group to Relay and FET Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

Transistor Output Transient Pulses

Refer to page 3-16 for “Transistor Output Transient Pulses”.

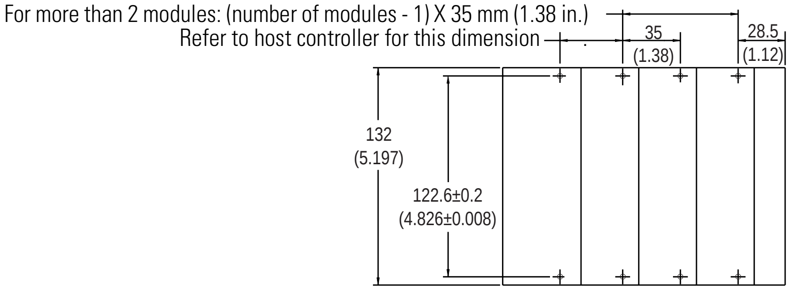
Controller Dimensions

See page 2-12 for Base Unit Mounting Dimensions.



Compact I/O Dimensions

Panel Mounting

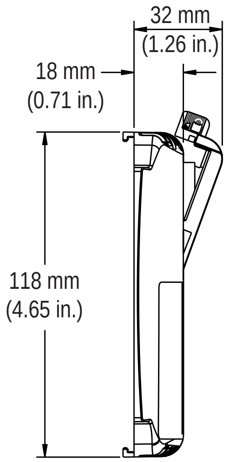

For more than 2 modules: (number of modules - 1) X 35 mm (1.38 in.)

Refer to host controller for this dimension

NOTE: All dimensions are in mm (inches). Hole spacing tolerance: ±0.4 mm (0.016 in.)

End Cap

This illustration shows the 1769-ECR right end cap. For the 1769-ECL left end cap, the drawing would be reversed.



Dimensions are in mm (inches).

Replacement Parts

This chapter contains the following information:

- a table of MicroLogix 1500 replacement parts
- procedure for replacing the lithium battery
- illustrations of the MicroLogix 1500 replacement doors and terminal blocks

MicroLogix 1500 Replacement Kits

The table below provides a list of replacement parts and their catalog number.

Description	Catalog Number
Lithium Battery (See page B-2.)	1747-BA
ESD Barrier	1764-RPL-TRM1
Base Terminal Doors (See page B-6.)	1764-RPL-TDR1
Processor Access Door (See page B-6.)	1764-RPL-CDR1
Door Combination Kit, includes ESD Barrier, Terminal Door, Access Door, Base Comms Door (See page B-6.), and Trim Pots/Mode Switch Cover Door (See page B-6.)	1764-RPL-DR
17-Point Terminal Block (for inputs on 1764-24AWA and -24BWA bases) (See page B-5.)	1764-RPL-TB1
21-Point Terminal Block (for inputs of 1764-28BXB and outputs for all base units)(See page B-5.)	1764-RPL-TB2

Lithium Battery (1747-BA)

IMPORTANT When the processor's Battery Low indicator is lit, install a backup battery immediately. After the indicator turns on, the battery lasts for at least:

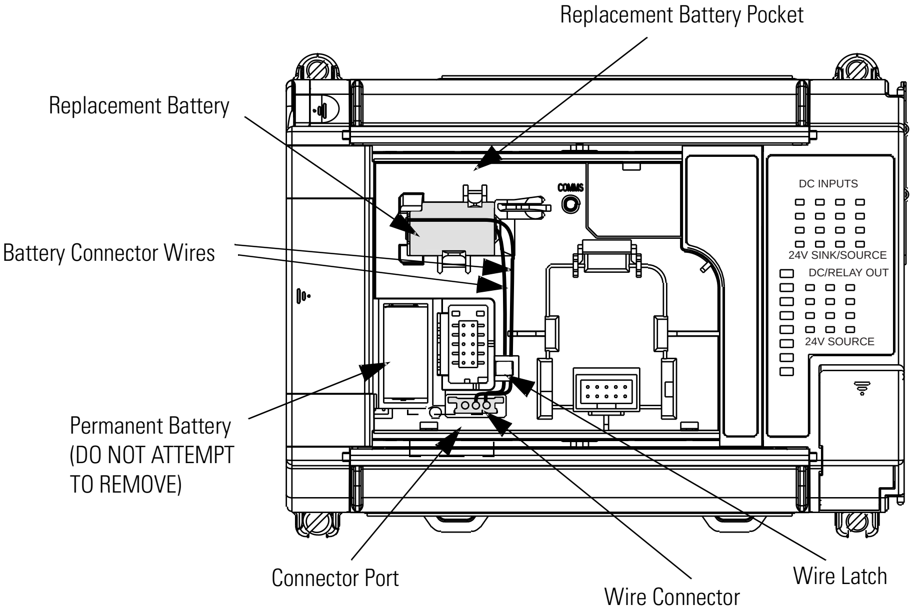
- 14 days for the 1764-LSP
- 7 days for the 1764-LRP

Installing

Follow the procedure below to ensure proper replacement battery installation.

IMPORTANT Do not remove the permanent battery when installing replacement battery.

1. Insert battery into replacement battery pocket with wires facing up.
2. Insert replacement battery wire connector into connector port.
3. Secure battery wires under wire latch (as shown below).



Battery Handling

Follow the procedure below to ensure proper battery operation and reduce personnel hazards.

- Use only for the intended operation.
- Do not ship or dispose of cells except according to recommended procedures.
- Do not ship on passenger aircraft.

ATTENTION

- Do not charge the batteries. An explosion could result or the cells could overheat causing burns.
- Do not open, puncture, crush, or otherwise mutilate the batteries. A possibility of an explosion exists and/or toxic, corrosive, and flammable liquids would be exposed.
- Do not incinerate or expose the batteries to high temperatures. Do not attempt to solder batteries. An explosion could result.
- Do not short positive and negative terminals together. Excessive heat can build up and cause severe burns.

Storing

Store lithium batteries in a cool, dry environment, typically +20°C to +25°C (+68°F to 77°F) and 40% to 60% humidity. Store the batteries and a copy of the battery instruction sheet in the original container, away from flammable materials.

Transporting

One or Two Batteries

Each battery contains 0.23 grams of lithium. Therefore, up to two batteries can be shipped together within the United States without restriction. Regulations governing shipment to or within other countries may differ.

Three or More Batteries

Procedures for the transportation of three or more batteries shipped together within the United States are specified by the Department of Transportation (DOT) in the Code of Federal Regulations, CFR49, “Transportation.” An exemption to these regulations, DOT - E7052, covers the transport of certain hazardous materials classified as flammable solids. This exemption authorizes transport of lithium batteries by motor vehicle, rail freight, cargo vessel, and cargo-only aircraft, providing certain conditions are met. Transport by passenger aircraft is not permitted.

A special provision of DOT-E7052 (11th Rev., October 21, 1982, par. 8-a) provides that:

> “Persons that receive cell and batteries covered by this exemption may reship them pursuant to the provisions of 49 CFR 173.22a in any of these packages authorized in this exemption including those in which they were received.”

The Code of Federal Regulations, 49 CFR 173.22a, relates to the use of packaging authorized under exemptions. In part, it requires that you must maintain a copy of the exemption at each facility where the packaging is being used in connection with shipment under the exemption.

Shipment of depleted batteries for disposal may be subject to specific regulation of the countries involved or to regulations endorsed by those countries, such as the IATA Articles Regulations of the International Air Transport Association, Geneva, Switzerland.

IMPORTANT Regulations for transportation of lithium batteries are periodically revised.

Disposing

ATTENTION Do not incinerate or dispose of lithium batteries in general trash collection. Explosion or violent rupture is possible. Batteries should be collected for disposal in a manner to prevent against short-circuiting, compacting, or destruction of case integrity and hermetic seal.

For disposal, batteries must be packaged and shipped in accordance with transportation regulations, to a proper disposal site. The U.S. Department of Transportation authorizes shipment of "Lithium batteries for disposal" by motor vehicle only in regulation 173.1015 of CFR 49 (effective January 5, 1983). For additional information contact:

U.S. Department of Transportation
Research and Special Programs Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

Although the Environmental Protection Agency at this time has no regulations specific to lithium batteries, the material contained may be considered toxic, reactive, or corrosive. The person disposing of the material is responsible for any hazard created in doing so. State and local regulations may exist regarding the disposal of these materials.

For a lithium battery product safety data sheet, contact the manufacturer:

Sanyo Energy Corporation
2001 Sanyo Avenue
San Diego, CA 92173
(619) 661-4801

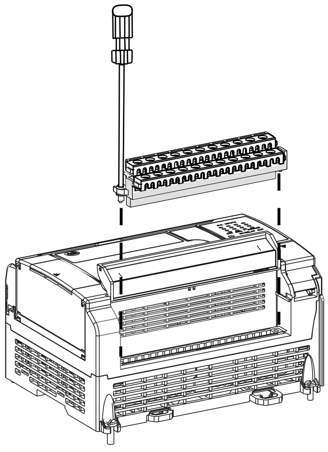
Tadarand Electronic Industries
2 Seaview Blvd.
Port Washington, NY 11050
(516) 621-4980

Replacement Terminal Blocks

This figure illustrates how to replace the MicroLogix 1500 terminal blocks.

Catalog Numbers:

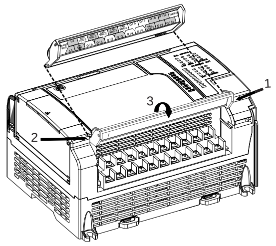
- 1764-RPL-TB1: 17-point terminal block
- 1764-RPL-TB2: 21-point terminal block



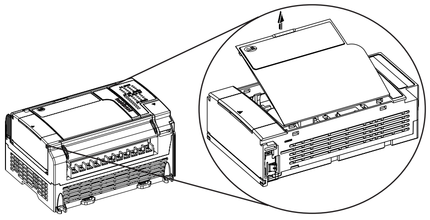
Replacement Doors

The following figures illustrate the procedure for installing the MicroLogix 1500 replacement doors.

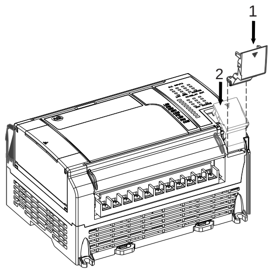
Base Terminal Door (1764-RPL-TDR1)



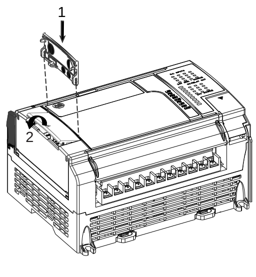
Processor Access Door (1764-RPL-CDR1)



Base Comms Door (included in 1764-RPL-DR)



Trim Pots/Mode Switch Cover Door (included in 1764-RPL-DR)



Appendix C

Troubleshooting Your System

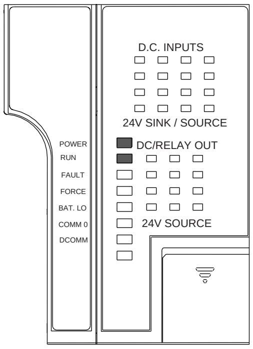
This chab

pter describes how to troubleshoot your controller. Topics include:

- understanding the controller LED status
- controller error recovery model
- identifying controller faults
- calling Rockwell Automation for assistance

Understanding Controller LEDs

The controller status LEDs provide a mechanism to determine the current status of the controller if a programming device is not present or available.



LED	Color	Indicates
POWER	off	no input power
	green	power on
RUN	off	controller is not in Run mode or REM Run
	green	controller is in Run mode or REM Run
	green flashing	system is not in Run mode; memory module transfer is in progress
FAULT	off	no fault detected
	red flashing	faulted user program
	red	processor hardware fault or critical fault
FORCE	off	no forces installed
	amber	forces installed
BATTERY LOW	off	battery OK
	red	battery needs replacement (See page B-2.)
COMM 0	off	flashes when communications are active
	green	
COMM 1 (1764-LRP only)	off	flashes when communications are active
	green	
DCOMM(1)	off	user configured communications mode is active
	green	default communications mode active

LED	Color	Indicates
INPUTS	off	input is not energized
	amber	input is energized (logic status)
OUTPUTS	off	output is not energized
	amber	output is energized (logic status)

(1) When using a 1764-LRP processor, the DCOMM LED applies only to Channel 0.

When Operating Normally

The POWER and RUN LEDs are on. If a force condition is active, the FORCE LED turns on and remains on until all forces are removed.

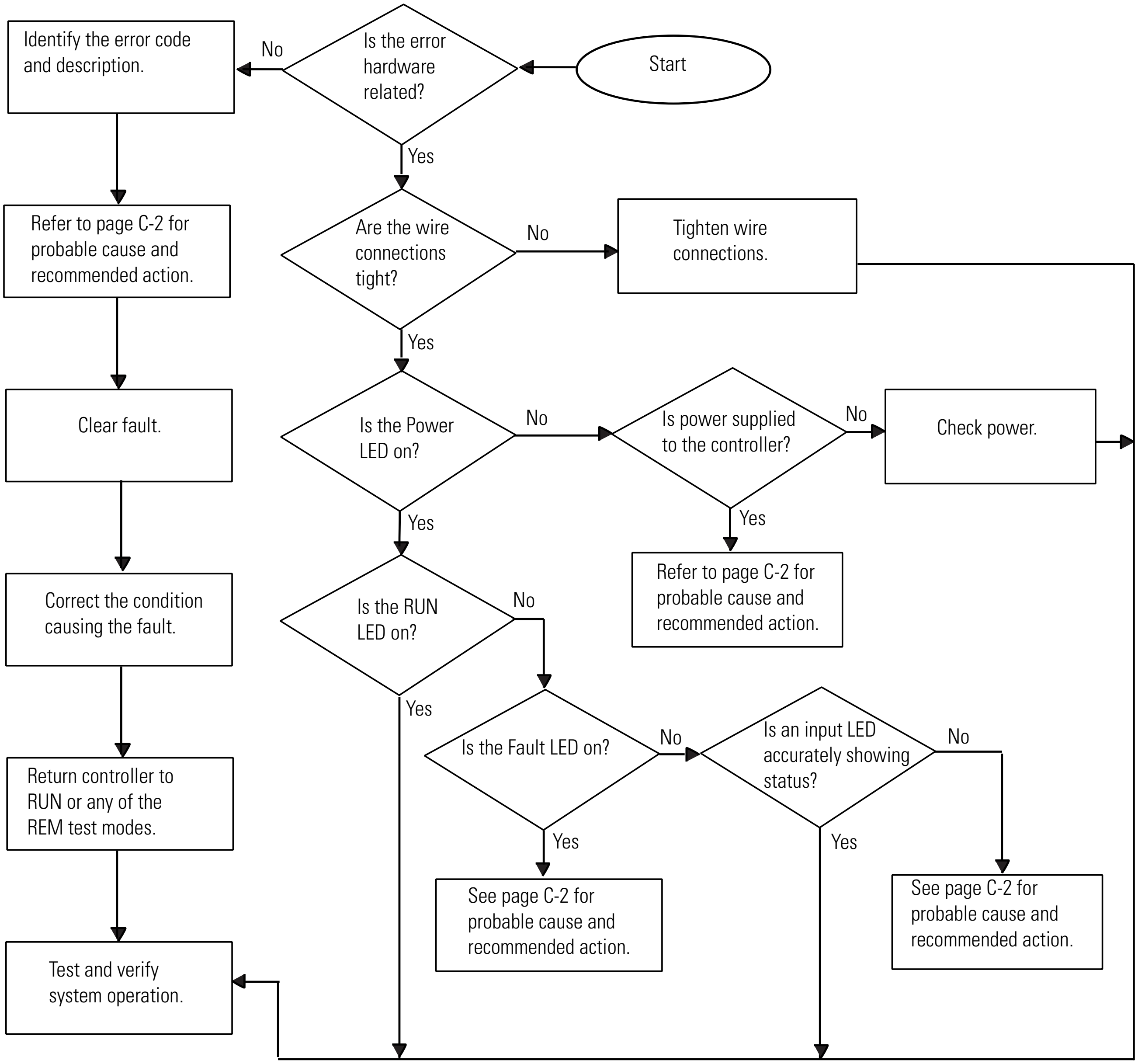
When an Error Exists

If an error exists within the controller, the controller LEDs operate as described in the following tables.

If the LEDS indicate:	The Following Error Exists	Probable Cause	Recommended Action
All LEDS off	No input power or power supply error	No Line Power	Verify proper line voltage and connections to the controller.
		Power Supply Overloaded	This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.
Power and FAULT LEDs on solid	Hardware faulted	Processor Hardware Error	Cycle power. Contact your local Rockwell Automation representative if the error persists.
		Loose Wiring	Verify connections to the controller.
Power LED on and FAULT LED flashing	Application fault	Hardware/Software Major Fault Detected	1. Monitor Status File Word S:6 for major error code. See page C-5 for more information. 2. Remove hardware/software condition causing fault. 3. Clear Major Error Halted flag, bit S2:1/13. 4. Attempt a controller Run mode entry. If unsuccessful, repeat recommended action steps above or contact your local Rockwell Automation distributor.

Controller Error Recovery Model

Use the following error recovery model to help you diagnose software and hardware problems in the micro controller. The model provides common questions you might ask to help troubleshoot your system. Refer to the recommended pages within the model for further help.



Identifying Controller Faults

While a program is executing, a fault may occur within the operating system or your program. When a fault occurs, you have various options to determine what the fault is and how to correct it. This section describes how to clear faults and provides a list of possible advisory messages with recommended corrective actions.

Automatically Clearing Faults

You can automatically clear a fault by cycling power to the controller when the Fault Override at Power-up bit (S:1/8) is set in the status file.

You can also configure the controller to clear faults and go to RUN every time the controller is power cycled. This is a feature that OEMs can build into their equipment to allow end users to reset the controller. If the controller faults, it can be reset by simply cycling power to the machine. To accomplish this, set the following bits in the status file:

- S2:1/8 - Fault Override at Power-up
- S2:1/12 - Mode Behavior

If the fault condition still exists after cycling power, the controller re-enters the fault mode. For more information on status bits, refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual,* publication 1762-RM001.

TIP

You can declare your own application-specific major fault by writing your own unique value to S:6 and then setting bit S:1/13 to prevent reusing system defined codes. The recommended values for user defined faults are FF00 to FF0F.

Manually Clearing Faults Using the Fault Routine

The occurrence of recoverable or non-recoverable user faults can cause the user fault subroutine to be executed. If the fault is recoverable, the subroutine can be used to correct the problem and clear the fault bit S:1/13. The controller then continues in the Run or test mode.

The subroutine does not execute for non-user faults. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference*

Manual, publication 1762-RM001, for information on creating a user fault subroutine.

Fault Messages

Refer to the *MicroLogix 1200 and 1500 Instruction Set Reference Manual,* publication 1762-RM001, for the controller fault messages that can occur during operation of the MicroLogix 1500 programmable controllers. Each fault message includes the error code description, the probable cause, and the recommended corrective action.

Calling Rockwell Automation for Assistance

If you need to contact Rockwell Automation or local distributor for assistance, it is helpful to obtain the following (prior to calling):

- controller type, series letter, and revision letter of the base unit
- series letter, revision letter, and firmware (FRN) number of the processor (on bottom side of processor unit)
- controller LED status
- controller error codes (found in S2:6 of status file).

Upgrading Your Operating System

The operating system (OS) can be upgraded through the communication port on the controller. In order to download a new operating system, you must have the following:

- ControlFLASH™ Upgrade Kit containing the new OS
- a Windows® 95, Windows® 98, Windows NT™, or Windows® 2000 based computer to run the download software.

The ControlFLASH™ Upgrade Kit includes:

- the operating system upgrade to be downloaded
- the ControlFLASH programming tool, along with its support drivers and on-line help
- a readme first file explaining how to upgrade the operating system

Preparing for Upgrade

Before upgrading the controller's operating system, you must:

- Obtain the operating system upgrade from *http://www.ab.com/micrologix* or from your local Allen-Bradley distributor

IMPORTANT Installing a new operating system deletes the controller's user program.

- Install the ControlFlash Software. Double click the processor catalog number/firmware revision number to install the operating system upgrade.
- The controller must be configured for default communications (use communications toggle push button; DCOMM LED on) and be in the Program mode to allow the download of a new operating system.

Performing the Upgrade

The following steps occur during the upgrade process.

1. Controller mode and communications parameters are checked.
2. Download begins.
3. During the download, the Force, Battery, and Comms LEDs perform a walking bit pattern.
4. When the download is complete, the integrity of the new OS is checked. If the new OS is corrupt, the controller sends an error message to the computer and flashes the Missing or Corrupt OS LED pattern. See Missing/Corrupt OS LED Pattern below.
5. Following a successful transfer, the Power, Force, and Battery LEDs flash on and remain on for five seconds. Then the controller resets.

Missing/Corrupt OS LED Pattern

When an operating system download is not successful or if the controller does not contain a valid operating system, the controller flashes the Run, Force, and Fault LEDS on and off.

Understanding Communication Protocols

Use the information in this appendix to understand the differences in communication protocols. The following protocols are supported from the RS-232 communication channel:

- DF1 Full-Duplex
- DF1 Half-Duplex Slave
- DH-485
- Modbus RTU Slave (1764-LSP and 1764-LRP Series B Processors only)
- ASCII (1764-LSP and 1764-LRP Series B Processors only)

See Chapter 4 for information about required network devices and accessories.

RS-232 Communication Interface

The communications port on the MicroLogix 1500 utilizes an RS-232 interface. RS-232 is an Electronics Industries Association (EIA) standard that specifies the electrical characteristics for serial binary communication. It provides you with a variety of system configuration possibilities. (RS-232 defines electrical characteristics; it is *not* a protocol.)

One of the biggest benefits of an RS-232 interface is that it lets you easily integrate telephone and radio modems into your control system.

DF1 Full-Duplex Protocol

DF1 Full-Duplex protocol is an open protocol developed by Allen-Bradley. It provides a point-to-point connection between two devices. DF1 Full-Duplex protocol combines data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1) and 2-way simultaneous transmission with embedded responses (subcategory F1). Refer to *DF1 Protocol and Command Set Reference Manual*, publication 1770-6.5.16, for more information.

DF1 Full-Duplex protocol (also referred to as DF1 point-to-point protocol) is useful where RS-232 point-to-point communication is required. DF1 protocol controls message flow, detects and signals errors, and retries if errors are detected.

MicroLogix 1500 controllers support the DF1 Full-Duplex protocol via RS-232 connection to external devices such as computers, controllers, and other interface devices that support DF1 Full-Duplex.

For information about required network connecting equipment and examples of DF1 Full-Duplex connections, see Chapter 4.

DF1 Half-Duplex Protocol

DF1 Half-Duplex protocol is a multi-drop single master/multiple slave network. DF1 Half-Duplex protocol supports data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1). In contrast to DF1 Full-Duplex, communication takes place in one direction at a time. With an active Half-Duplex Master, you can use the RS-232 port on the MicroLogix 1500 as a Half-Duplex programming port and a Half-Duplex peer-to-peer messaging port.

DF1 Half-Duplex Operation

A DF1 Half-Duplex master device initiates all communication by “polling” each slave device. The slave device may only transmit when it is polled by the master. It is the master’s responsibility to poll each slave on a regular and sequential basis to allow slave devices an opportunity to communicate.

An additional feature of the DF1 Half-Duplex protocol is that it is possible for a slave device to enable a MSG write or read to/from another slave. When the initiating slave is polled, the MSG is sent to the master. The master recognizes that the message is not intended for it, but for another slave, so the master immediately forwards the message to the intended slave. The master does this automatically; you do not need to program the master to move data between slave nodes. This slave-to-slave transfer can also be used by programming software to allow slave-to-slave upload and download of programs to processors (including the master) on the DF1 Half-Duplex link.

The MicroLogix 1500 can only act as a slave device. A device that can act as a master is required to “run” the network. Several Allen-Bradley products support DF1 Half-Duplex master protocol. They include the SLC 5/03™ and higher processors, enhanced PLC-5® processors, and Rockwell Software RSLinx (version 2.x and higher).

DF1 Half-Duplex supports up to 255 devices (address 0 to 254) with address 255 reserved for master broadcasts. The MicroLogix 1500 supports broadcast reception.

Considerations When Communicating as a DF1 Slave on a Multi-drop Link

When communication is between either your programming software and a MicroLogix Programmable Controller or between two MicroLogix 1500 Programmable Controllers via slave-to-slave communication on a larger multi-drop link, the devices depend on a DF1 Half-Duplex Master to give each of them access in a timely manner. As the number of slave devices increase, the time between when slave devices are polled also increases. This increase in time may also be large if you are using low baud rates. As these time periods grow, you may need to increase the poll timeout and reply timeout values for slave devices.

IMPORTANT If a program download is started when using DF1 Half-Duplex, but then is interrupted due to electromagnetic interference or other events, discontinue communications to the controller for the *ownership timeout* period and then restart the program download. The *ownership timeout* period is 60 seconds. After the timeout, you can re-establish communications with the processor and try the program download again. The only other way to remove program ownership is to cycle power on the processor.

Using Modems with MicroLogix 1500 Programmable Controllers

The types of modems that you can use with MicroLogix 1500 controllers include dial-up phone modems, leased-line modems, radio modems and line drivers.

For point-to-point Full-Duplex modem connections that do not require any modem handshaking signals to operate, use DF1 Full-Duplex protocol with no handshaking. For point-to-point Full-Duplex modem connections that require RTS/CTS handshaking, use DF1 Full-Duplex protocol with handshaking.

For multi-drop modem connections, or for point-to-point modem connections that require RTS/CTS handshaking, use DF1 Half-Duplex slave protocol.

IMPORTANT Never attempt to use DH-485 protocol through modems under any circumstance.

TIP All MicroLogix controllers support RTS/CTS modem handshaking when configured for DF1 Full-Duplex protocol with the control line parameter set to Full-Duplex Modem Handshaking or DF1 Half-Duplex slave protocol with the control line parameter set to “Half-Duplex Modem”. No other modem handshaking lines (i.e. Data Set Ready, Carrier Detect and Data Terminal Ready) are supported by any MicroLogix 1500 controllers. MicroLogix 1500 1764-LRP processors also support DCD (Data Carrier Detect)

Dial-Up Phone Modems

Some dial-up phone line modems support point-to-point Full-Duplex communications. A MicroLogix 1500 controller, on the receiving end of the dial-up connection, can be configured for DF1 Full-Duplex protocol with or without handshaking. The modem connected to the MicroLogix controller should support auto-answer. The MicroLogix 1500 Series B processors (1764-LSP and 1764-LRP) support ASCII out communications. There fore, they can cause the modem to initiate or disconnect a phone call.

Leased-Line Modems

Leased-line modems are used with dedicated phone lines that are typically leased from the local phone company. The dedicated lines may be in a point-to-point topology supporting Full-Duplex communications between two modems or in a multi-drop topology supporting Half-Duplex communications between three or more modems.

Radio Modems

Radio modems may be implemented in a point-to-point topology supporting either Half-Duplex or Full-Duplex communications, or in a multi-drop topology supporting Half-Duplex communications between three or more modems.

Line Drivers

Line drivers, also called short-haul “modems”, do not actually modulate the serial data, but rather condition the electrical signals to operate reliably over long transmission distances (up to several miles). Line drivers are available in Full- and Half-Duplex models. Allen-Bradley’s AIC+ Advanced Interface Converter is a Half-Duplex line driver that converts an RS-232 electrical signal into an RS-485 electrical signal, increasing the signal transmission distance from 50 to 4000 feet (8000 feet when bridged).

DH-485 Communication Protocol

The information in this section describes DH-485 network functions, network architecture, and performance characteristics. It will also help you plan and operate the MicroLogix controllers on a DH-485 network.

DH-485 Network Description

The DH-485 protocol defines the communication between multiple devices that coexist on a single pair of wires. DH-485 protocol uses RS-485 Half-Duplex as its physical interface. (RS-485 is a definition of electrical characteristics; it is *not* a protocol.) RS-485 uses devices that are capable of co-existing on a common data circuit, thus allowing data to be easily shared between devices.

The DH-485 network offers:

- interconnection of 32 devices
- multi-master (peer-to-peer) capability
- token passing access control
- the ability to add or remove nodes without disrupting the network
- maximum network segment of 1219 m (4000 ft)

The DH-485 protocol supports two classes of devices: initiators and responders. All initiators on the network get a chance to initiate message transfers. To determine which initiator has the right to transmit, a token passing algorithm is used.

The following section describes the protocol used to control message transfers on the DH-485 network.

DH-485 Token Rotation

A node holding the token can send a message onto the network. Each node is allowed a fixed number of transmissions (based on the Token Hold Factor) each time it receives the token. After a node sends a message, it passes the token to the next device.

The allowable range of node addresses is 1 to 31. There must be at least one initiator on the network (such as a MicroLogix controller, or an SLC 5/02™ or higher processor).

DH-485 Configuration Parameters

When MicroLogix communications are configured for DH-485, the following parameters can be changed:

Table E.1 DF1 Full-Duplex Configuration Parameters

Parameter	Options
Baud Rate	9600, 19.2K
Node Address	1 to 31 decimal
Token Hold Factor	1 to 4

See Software Considerations on page E-10 for tips on setting the parameters listed above.

Devices that Use the DH-485 Network

In addition to the MicroLogix 1500 controllers, the devices shown in the following table also support the DH-485 network.

Table E.2 Allen-Bradley Devices that Support DH-485 Communication

Catalog Number	Description	Installation	Function	Publication
Bulletin 1761 Controllers	MicroLogix 1000	Series C or higher	These controllers support DH-485 communications.	1761-6.3
Bulletin 1762	MicroLogix 1200	Series A or higher	These controllers support DH-485 communications.	1762-UM001
Bulletin 1747 Processors	SLC 500 Processors	SLC Chassis	These processors support a variety of I/O requirements and functionality.	1747-6.2
1746-BAS	BASIC Module	SLC Chassis	Provides an interface for SLC 500 devices to foreign devices. Program in BASIC to interface the 3 channels (2 RS232 and 1 DH-485) to printers, modems, or the DH-485 network for data collection.	1746-6.1 1746-6.2 1746-6.3
1785-KA5	DH+™/ DH-485 Gateway	(1771) PLC Chassis	Provides communication between stations on the PLC-5® (DH+) and SLC 500 (DH-485) networks. Enables communication and data transfer from PLC® to SLC 500 on DH-485 network. Also enables programming software programming or data acquisition across DH+ to DH-485.	1785-6.5.5 1785-1.21
2760-RB	Flexible Interface Module	(1771) PLC Chassis	Provides an interface for SLC 500 (using protocol cartridge 2760-SFC3) to other A-B PLCs and devices. Three configurable channels are available to interface with Bar Code, Vision, RF, Dataliner™, and PLC systems.	1747-KE 2760-ND001
1784-KTX, -KTXD	PC DH-485 IM	IBM XT/AT Computer Bus	Provides DH-485 using RSLinx.	1784-6.5.22
1784-PCMK	PCMCIA IM	PCMCIA slot in computer and Interchange	Provides DH-485 using RSLinx.	1784-6.5.19

Table E.2 Allen-Bradley Devices that Support DH-485 Communication

Catalog Number	Description	Installation	Function	Publication
1747-PT1	Hand-Held Terminal	NA	Provides hand-held programming, monitoring, configuring, and troubleshooting capabilities for SLC 500 processors.	1747-NP002
1747-DTAM, 2707-L8P1, -L8P2, -L40P1, -L40P2, -V40P1, -V40P2, -V40P2N, -M232P3, and -M485P3	DTAM, DTAM Plus, and DTAM Micro Operator Interfaces	Panel Mount	Provides electronic operator interface for SLC 500 processors.	1747-ND013 2707-800, 2707-803
2711-K5A2, -B5A2, -K5A5, -B5A5, -K5A1, -B5A1, -K9A2, -T9A2, -K9A5, -T9A5, -K9A1, and -T9A1	PanelView 550 and PanelView 900 Operator Terminals	Panel Mount	Provides electronic operator interface for SLC 500 processors.	2711-802, 2711-816

NA = Not Applicable

Important DH-485 Network Planning Considerations

Carefully plan your network configuration before installing any hardware. Listed below are some of the factors that can affect system performance:

- amount of electrical noise, temperature, and humidity in the network environment
- number of devices on the network
- connection and grounding quality in installation
- amount of communication traffic on the network
- type of process being controlled
- network configuration

The major hardware and software issues you need to resolve before installing a network are discussed in the following sections.

Hardware Considerations

You need to decide the length of the communication cable, where you route it, and how to protect it from the environment where it will be installed.

When the communication cable is installed, you need to know how many devices are to be connected during installation and how many devices will be added in the future. The following sections will help you understand and plan the network.

Number of Devices and Length of Communication Cable

The maximum length of the communication cable is 1219m (4000 ft). This is the total cable distance from the first node to the last node in a segment. However, two segments can be used to extend the DH-485 network to 2438m (8000 ft). for additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual*, publication 1761-6.4.

Planning Cable Routes

Follow these guidelines to help protect the communication cable from electrical interference:

- Keep the communication cable at least 1.52m (5 ft) from any electric motors, transformers, rectifiers, generators, arc welders, induction furnaces, or sources of microwave radiation.
- If you must run the cable across power feed lines, run the cable at right angles to the lines.
- If you do not run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.15m (6 in.) from ac power lines of less than 20A, 0.30m (1 ft) from lines greater than 20A, but only up to 100 kVA, and 0.60m (2 ft) from lines of 100 kVA or more.
- If you run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.08m (3 in.) from ac power lines of less than 20A, 0.15m (6 in.) from lines greater than 20A, but only up to 100 kVA, and 0.30m (1 ft) from lines of 100 kVA or more.

  Running the communication cable through conduit provides extra protection from physical damage and electrical interference. If you route the cable through conduit, follow these additional recommendations:

- Use ferromagnetic conduit near critical sources of electrical interference. You can use aluminum conduit in non-critical areas.
- Use plastic connectors to couple between aluminum and ferromagnetic conduit. Make an electrical connection around the plastic connector (use pipe clamps and the heavy gauge wire or wire braid) to hold both sections at the same potential.
- Ground the entire length of conduit by attaching it to the building earth ground.
- Do not let the conduit touch the plug on the cable.
- Arrange the cables loosely within the conduit. The conduit should contain only serial communication cables.
- Install the conduit so that it meets all applicable codes and environmental specifications.

For more information on planning cable routes, see *Industrial Automation Wiring and Grounding Guidelines*, publication 1770-4.1.

Software Considerations

Software considerations include the configuration of the network and the parameters that can be set to the specific requirements of the network. The following are major configuration factors that have a significant effect on network performance:

- number of nodes on the network
- addresses of those nodes
- baud rate

The following sections explain network considerations and describe ways to select parameters for optimum network performance (speed). See your programming software's user manual for more information.

Number of Nodes

The number of nodes on the network directly affects the data transfer time between nodes. Unnecessary nodes (such as a second programming terminal that is not being used) slow the data transfer rate. The maximum number of nodes on the network is 32.

Setting Node Addresses

The best network performance occurs when node addresses are assigned in sequential order. Initiators, such as personal computers, should be assigned the lowest numbered addresses to minimize the time required to initialize the network. The valid range for the MicroLogix 1500 controllers is 1-31 (controllers cannot be node 0). The default setting is 1. The node address is stored in the controller Communications Status file (CS0:5/0 to CS0:5/7).

Setting Controller Baud Rate

The best network performance occurs at the highest baud rate, which is 19200. This is the default baud rate for a MicroLogix 1500 device on the DH-485 network. All devices must be at the same baud rate. This rate is stored in the controller Communications Status file (CS0:5/8 to CS0:5/15).

Setting Maximum Node Address

Once you have an established network set up and are confident that you will not be adding more devices, you may enhance performance by adjusting the maximum node address of your controllers. It should be set to the highest node address being used.

IMPORTANT All devices should be set to the same maximum node address.

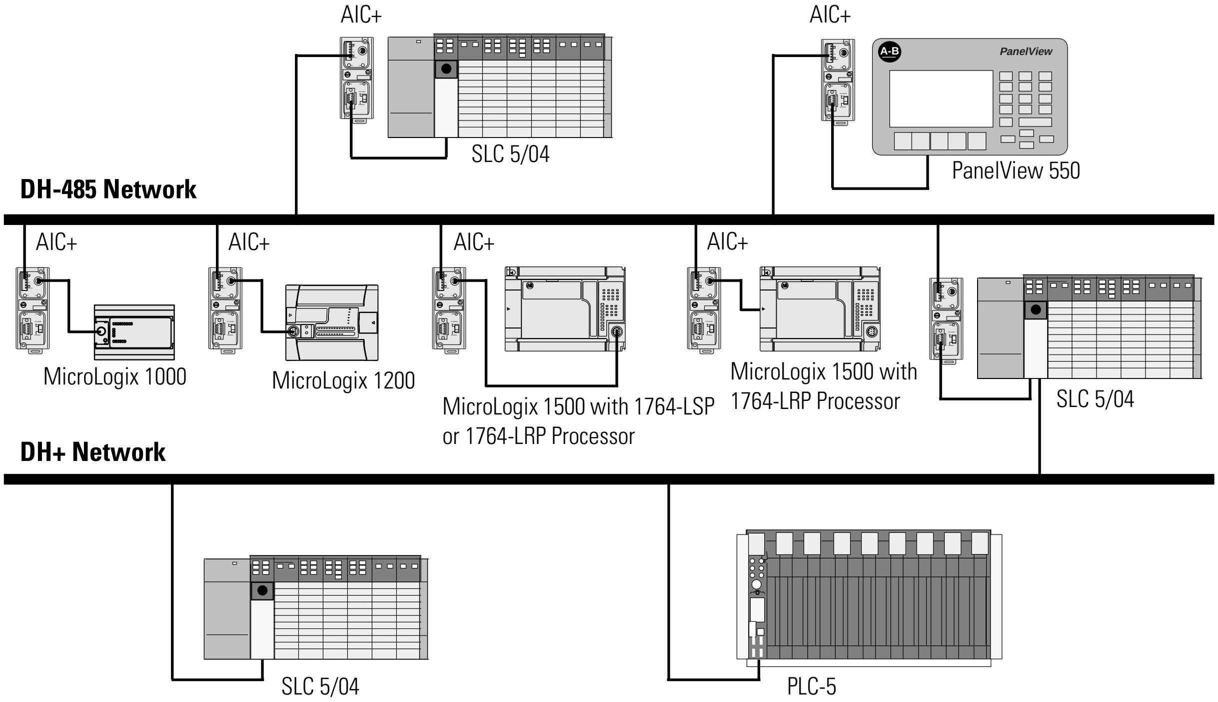
MicroLogix Remote Packet Support

MicroLogix 1500 controllers can respond and initiate with device's communications (or commands) that do not originate on the local DH-485 network. This is useful in installations where communication is needed between the DH-485 and DH+ networks.

The example below shows how to send messages from a PLC device or a PC on the DH+ network to a MicroLogix controller on the DH-485 network. This method uses an SLC 5/04 processor bridge connection.

When using this method (as shown in the following illustration):

- PLC-5 devices can send read and write commands to MicroLogix 1500 controllers.
- MicroLogix 1500 controllers can respond to MSG instructions received.
- The MicroLogix 1500 controllers can initiate MSG instructions to devices on the DH+ network.
- PC can send read and write commands to MicroLogix 1500 controllers.
- PC can do remote programming of MicroLogix 1500 controllers.



Modbus RTU Slave Communication Protocol (MicroLogix 1764-LSP and 1764-LRP Series B and later processors only)

Modbus RTU Slave is a Half-Duplex, master-slave communications protocol. The Modbus network master initiates and controls all communications on the network. Modbus protocol allows a single master to communicate with a maximum of 255 slave devices.

When a MicroLogix 1200 or 1500 Communications port is configured for Modbus RTU Slave operation, the user must define where Modbus data (coils, contacts, and registers) is mapped into the MicroLogix data space.

The Modbus address space is comprised of seven distinct memory ranges. Four of these ranges can be mapped into MicroLogix data files. Three Modbus ranges are fixed to MicroLogix file 2, the Status file. The table below illustrates Modbus to MicroLogix mappings.

Table E.3 Modbus to MicroLogix Memory Map

Modbus Addressing	Description	Valid MicroLogix Addressing		
		File Type	Data File Number	Address
0001 to 4096	Read/Write Modbus Coil Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
10001 to 14096	Read-Only Modbus Contact Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
30001 to 30256	Read-Only Modbus Input Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
30501 to 30532	Modbus Communication Parameters	Communication Status Files	2	words 0 to 31
31501 to 31566	Read-Only System Status File space	Status (S)	2	words 32 to 65
40001 to 40256	Read/Write Modbus Holding Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
41501 to 41566	Read/Write System Status File space	Status (S)	2	words 0 to 65

For more information on the MicroLogix 1500 configuration parameters for Modbus Slave RTU (Remote Terminal Unit transmission mode) protocol, refer to the MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual, publication 1762-RM001. For more information about the Modbus Slave protocol, see the Modbus Protocol Specifications (available from http://www.modicon.com/techpubs/).

ASCII Protocol (MicroLogix 1500 1764-LSP and 1764-LRP Series B and later Processors only)

ASCII protocol provides connection to other ASCII devices, such as bar code readers, weigh scales, serial printers, and other intelligent devices.

You can use ASCII protocol by configuring the RS-232 port, channel 0 for ASCII driver (*For the 1764-LRP only, you can select either Channel 0 or Channel 1*).

Refer to the *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001 for detailed configuration information.

When the driver is set to ASCII, the following parameters can be changed:

Table E.4 ASCII Channel Configuration Parameters

Parameter	Description	Programming Software Default
Baud Rate	Toggles between the communication rate of 300, 600, 1200, 2400, 4800, 9600, 19.2K, and 38.4K.	1200
Parity	Toggles between None, Odd, and Even.	None
Termination 1	Specifies the first termination character. The termination character defines the one or two character sequence used to specify the end of an ASCII line received. Setting the first ASCII termination character to undefined (\ff) indicates no ASCII receiver line termination is used.	\d
Termination 2	Specifies the second termination character. The termination character defines the one or two character sequence used to specify the end of an ASCII line received. Setting the second ASCII Termination character to undefined (\ff) and the first ASCII Termination character to a defined value (\d) indicates a single character termination sequence.	\ff
Control Line	Toggles between No Handshaking, Half-Duplex Modem, and Full-Duplex Modem	No Handshaking
Delete Mode	The Delete Mode allows you to select the mode of the “delete” character. Toggles between Ignore, CRT, and Printer. Delete Mode affects the characters echoed back to the remote device. When Delete Mode is enabled, the previous character is removed from the receive buffer. • In CRT mode, when a delete character is encountered, the controller echos three characters to the device: backspace, space, and backspace. This erases the previous character on the terminal. • In Printer Mode, when a delete character is encountered, the controller echos the slash character, then the deleted character. Enable the Echo parameter to use Delete Mode.	Ignore
Echo	When Echo Mode is enabled, all of the characters received are echoed back to the remote device. This allows you to view characters on a terminal connected to the controller. Toggles between Enabled and Disabled.	Disabled
XON/XOFF	Allows you to Enable or Disable XON/ XOFF software handshaking. XON/XOFF software handshaking involves the XON and XOFF control characters in the ASCII character set. When the receiver receives the XOFF character, the transmitter stops transmitting until the receiver receives the XON character. If the receiver does not receive an XON character after 60 seconds, the transmitter automatically resumes sending characters. Also, when the receive buffer is more than 80% full, an XOFF character is sent to the remote device to pause the transmission. Then, when the receive buffer drops to less than 80% full, an XON character is sent to the remote device to resume the transmission.	Disabled
RTS Off Delay (x20 ms)	Allows you to select the delay between when a transmission is ended and when RTS is dropped. Specify the RTS Off Delay value in increments of 20 ms. Valid range is 0 to 65535.	0
RTS Send Delay (x20 ms)	Allows you to select the delay between when RTS is raised and the transmission is initiated. Specify the RTS Send Delay value in increments of 20 ms. Valid range is 0 to 65535.	0

System Loading and Heat Dissipation

System Loading Limitations

When you connect MicroLogix accessories and expansion I/O, an electrical load is placed on the base unit power supply. This section shows how to calculate the load and validate that the system will not exceed the capacity of the base unit power supply or expansion power supply.

The following example is provided to illustrate system loading validation. The system validation procedure accounts for the amount of 5V dc and 24V dc current consumed by controller, expansion I/O, and user supplied equipment.

Current consumed by the Base Units, Memory Modules, Real Time Clock Modules, and the End Cap Terminators (for systems utilizing Compact I/O expansion) has already been factored into the calculations. A system is valid if the current and power requirements are satisfied.

TIP An End Cap Terminator (catalog number 1769-ECR or -ECL) is needed for any system using Compact expansion I/O.

IMPORTANT In a MicroLogix 1500 system, a maximum of one 1769 expansion cable can be used, allowing for two banks of I/O modules. One bank is connected directly to the controller and the other is connected via the expansion cable. The bank connected to the controller uses the controller's embedded power supply. The bank connected via the cable requires its own power supply.

System Expansion Calculations

A download is also available for system validation. On the Internet, go to http://www.ab.com/micrologix and navigate to MicroLogix 1500.

The procedure in this publication consists of:

- Selecting System Devices
- Verifying the System Loading

Selecting System Devices

1. Use Table F.1 to select the processor and optional communications or display devices. Enter a 1 in the “Select Devices” column.

2. Enter the current draw values in the “Calculated Current for System” columns. If an external power supply will be used to power communication devices, do not include their current draw values in this calculation. Add up the current draw values to determine the “SUBTOTAL1” values.

Table F.1 Selecting Hardware: Base Unit and Communications/Display Devices

Catalog Number	Select Device(s)	Bus Current Draw Specification		Calculated Current for System	
		at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
Choose a Processor, LSP or LRP:					
1764-LSP		300	0		
1764-LRP		380	0		
1764-DAT(1) optional		350	0		
Communications/Display Devices, optional, one only maximum:					
1761-NET-AIC(1)		0	120(2)		
1761-NET-ENI(1)		0	100(2)		
2707-MVH232 or 2707-MVP232(1)		0	80(2)		
			SUBTOTAL1	**(A1)**	**(B1)**

(1) These are optional accessories. Current is consumed only if the accessory is installed.

(2) Current for the AIC+ and ENI may be supplied by controller communications port or from an external 24V dc source. No current is consumed from the controller when a user-supplied, external source is used. If an external source is to be used, do not select the device here. The current for a 2707-MVH232 or 2707-MVP232 MicroView Operator Interface is supplied from the controller communication port, when directly connected.

3. Use Table F.2 to select the I/O modules. Enter the number of modules in either the “Base Unit Expansion” or the “Bank 1” column.

IMPORTANT When planning the system layout, keep in mind that each module has a “Power Supply Distance Rating”. This is the maximum distance an I/O module may be located from the power supply. For most modules, the rating is 8. For the 1769-HSC and 1769-SDN, the rating is 4.

Depending on its configuration, the 1769-SDN may transfer large amounts of data into and out of the controller I/O image tables. Care should be taken when using more than three of these modules to verify that they are optimally configured. This will ensure that the maximum available 4K data table size will not be exceeded. Refer to the 1769-SDN User Manual for more details.

4. Enter the current draw values in the "Calculated Current" columns. Add up the current draw values to determine the "SUBTOTAL2" values.

5. Verify that the total number of modules does not exceed the system limits using the maximum values for the base unit and Table F.5 for the expansion power supply, if used.

Table F.2 Selecting Hardware: Expansion I/O

Select I/O Modules for Each Bank:			**Bus Current Draw Specification (mA)**		*Calculate Current Draw:*			
Expansion I/O Modules	**Base Unit Expansion** (1)	**Bank 1**(2)			**Calculated Current for Base Unit Expansion (mA)**		**Calculated Current for Bank 1 Power Supply (mA)**(3)	
					2250 mA max	**400 mA max**		
Catalog Number	**n1**	**n2**	**X**	**Y**	**n1 x X**	**n1 x Y**	**n2 x X**	**n2 x Y**
	Number of Modules(4)		**at 5V dc**	**at 24V dc**	**at 5V dc**	**at 24V dc**	**at 5V dc**	**at 24V dc**
1769-HSC(5)			425	0				
1769-IA16			115	0				
1769-IA8I			90	0				
1769-IF4 (Series A)			120	150				
1769-IF4 (Series B)			120	60				
1769-IF4XOF2			120	160				
1769-IM12			100	0				
1769-IQ16			115	0				
1769-IQ6XOW4			105	50				
1769-IR6			100	45				
1769-IT6			100	40				
1769-OA8			145	0				
1769-OA16			225	0				
1769-OB16			200	0				
1769-OB16P			160	0				
1769-OF2 (Series A)			120	200				
1769-OF2 (Series B)			120	120				
1769-OV16			200	0				
1769-OW8			125	100				
1769-OW8I			125	100				
1769-OW16			205	180				
1769-SDN			440	0				
TOTAL MODULES:				**SUBTOTAL2:**	**(A2)**	**(B2)**	**(C)**	**(D)**

(1) May not exceed 8 I/O modules.

(2) No more than 8 I/O modules on either side of the power supply.

(3) Maximum value depends on the power supply chosen.

(4) Up to 16 modules may be used in a MicroLogix 1500 system when using a Series B Base Unit and Series C processor (up to 8 for Series A Base Units).
A maximum of 8 modules can be connected directly to the Base Unit.
A maximum of 8 modules can be connected to each side of the Expansion Power Supply.

(5) No more than 4 I/O modules may be connected to the base unit or to either side of the expansion power supply when the 1769-HSC or 1769-SDN are used in the system.

Verifying the System Loading

To have a valid system, both current and power requirements must be satisfied.

Verifying the Base Unit Loading

1. Enter the SUBTOTAL values from Tables F.1 and F.2. Add the total current draw for the Base Unit. Verify the values are within the maximum limits.

Table F.3 Base Unit Power Supply Loading - Verify the Current Limits

Current from:	**Calculated Current for System**	
	at 5V dc (mA)	**at 24V dc (mA)**
For 1764-24BWA only, enter sum of any User 24V dc Sensor Current		(E)
MAXIMUM LIMIT	**n/a**	**400 mA User 24V dc**
Values from SUBTOTAL1 (Table F.1)	(A1)	(B1)
Values from SUBTOTAL2 (Table F.2)	(A2)	(B2)
TOTAL BASE UNIT CURRENT LOADING	**(F)**	**(G)**
MAXIMUM LIMIT	**2250 mA at 5V dc**	**400 mA at 24V dc**

2. Using the table below, verify that the MAXIMUM POWER LIMIT is not exceeded.

Table F.4 Base Unit Power Supply Loading - Verify the Required Power

Catalog Number:	**1764-24AWA, 1764-28BXB Base Units**			**1764-24BWA Base Unit**		
5V Power Calculation	(F)	x 5V	= W	(F)	x 5V	= W
24V Power Calculation	(G)	x 24V	= W	(G)	x 24V	= W
				(E)	x 24V	= W
Add up Total Watts	**W**			**W**		
MAXIMUM POWER LIMIT	**16W**			**22W**		

Verifying the Expansion Power Supply Loading

Using the values from SUBTOTAL2, verify that the system loading and I/O distribution are within the limits shown in Table F.5. Consider future expansion when selecting a power supply.

Table F.5 Bank 1 Power Supply Loading - Verify the Current Limits

Specification	Catalog Number	Calculated Current for System		24V dc User Output Capacity
		at 5V dc (mA)	at 24V dc (mA)	
Values from SUBTOTAL2 (Table F.2):		(C)	(D)	
MAXIMUM CURRENT LIMIT	**1769-PA2**	**2000**	**800**	**250 mA**
	1769-PA4	**4000**	**2000**	n/a
	1769-PB2	**2000**	**800**	
	1769-PB4	**4000**	**2000**	
I/O Distribution - Distribute I/O modules such that the current consumed from either the left side or the right side of the power supply never exceeds the following values:	1769-PA2	2000	800	**250 mA**
	1769-PA4	2000	1000	n/a
	1769-PB2	2000	800	
	1769-PB4	2000	1000	

System Using a 1769-PA2

To validate your system, the total 5V dc current and 24V dc current consumed must be considered. The I/O modules must be distributed, such that the current consumed from the left *or* right side of the power supply never exceeds 2A at 5V dc and 1.0A at 24V dc. Use the current graphs below to determine if the power supply loading in your system is within the allowable range.

Figure F.1 1769-PA2 Current with +24V dc User Load = 0A

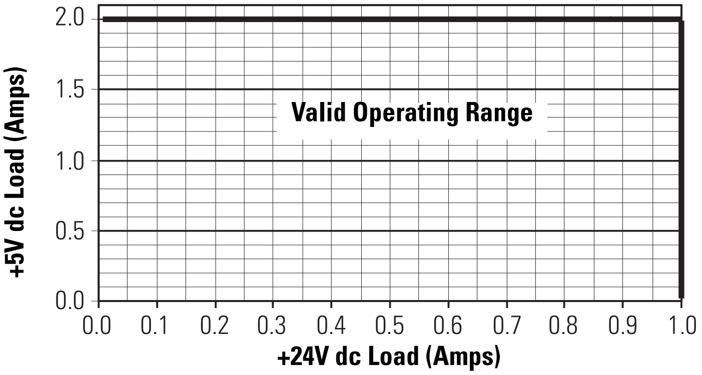


Figure F.2 1769-PA2 Current with +24V dc User Load = 0.2A

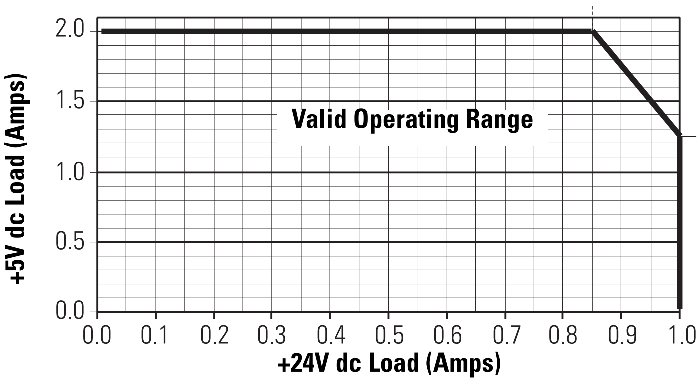
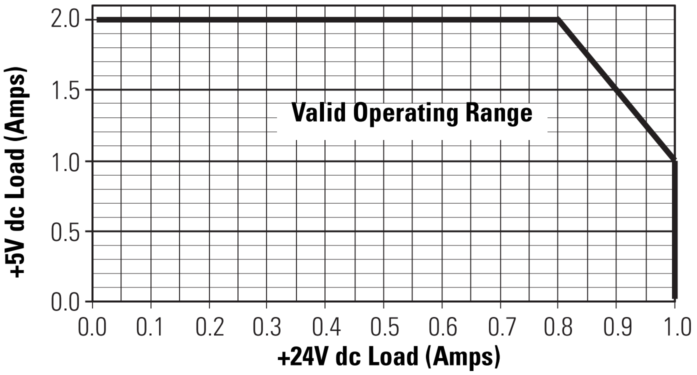


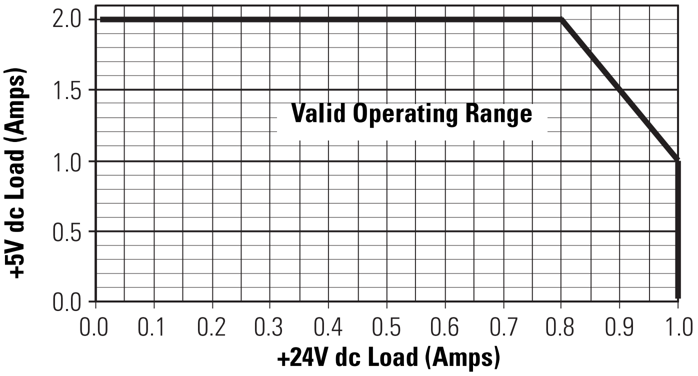
Figure F.3 1769-PA2 Current with +24V dc User Load = 0.25A



System Using a 1769-PB2

To validate your system, the total 5V dc current and 24V dc current consumed must be considered. The I/O modules must be distributed, such that the current consumed from the left *or* right side of the power supply never exceeds 2A at 5V dc and 1.0A at 24V dc. Use the current graph below to determine if the power supply loading in your system is within the allowable range.

Figure F.4 1769-PB2 Current

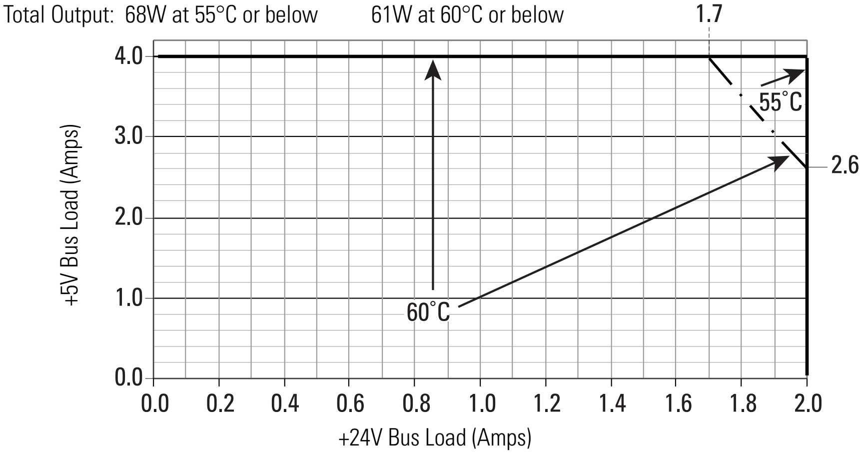


System Using a 1769-PA4

To validate your system, the total 5V dc current and 24V dc current consumed must be considered. The I/O modules connected to the PB2 should be distributed, such that the current consumed from the left and right side of the power supply never exceeds 2A at 5V and 0.8A at 24V dc with an ambient temperature of 0 to 55°C. Use the current graph below to determine if the power supply loading in your system is:

- within the allowable range for special load conditions
- above 55° to 60°C.

Figure 7 1769-PA4 5V and 24V dc Current

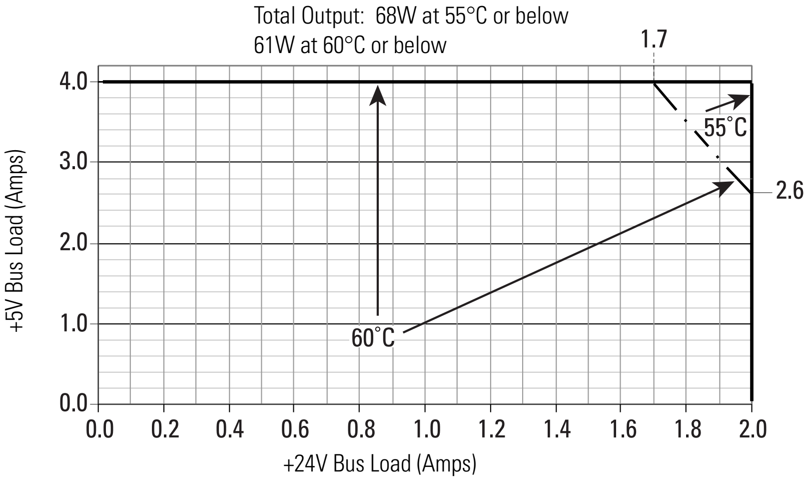


System Using a 1769-PB4

To validate your system, the total 5V dc current and 24V dc current consumed must be considered. The I/O modules connected to the PB2 should be distributed, such that the current consumed from the left and right side of the power supply never exceeds 2A at 5V and 0.8A at 24V dc with an ambient temperature of 0 to 55°C. Use the current graph below to determine if the power supply loading in your system is:

- within the allowable range for special load conditions
- above 55° to 60°C.

Figure 8 1769-PB4 5V and 24V dc Current



Calculating Heat Dissipation

Use this procedure when you need to determine the heat dissipation for installation in an enclosure. Use the following table.

Catalog Number	Heat Dissipation		
	Equation or Constant	Calculation	Subtotal
1764-24AWA	18W + (0.3 x System Loading)	18W + (0.3 x _______ W)	
1764-24BWA	20W + (0.3 x System Loading)	20W + (0.3 x _______ W)	
1764-28BXB	20W + (0.3 x System Loading)	20W + (0.3 x _______ W)	
1764-DAT	1.75W		
1769-HSC	6.21W x number of modules	6.21W x ___________	
1769-IA16	3.30W x number of modules	3.30W x ___________	
1769-IA8I	1.81W x number of modules	1.81W x ___________	
1769-IF4 (Series A)	3.99W x number of modules	3.99W x ___________	
1769-IF4 (Series B)	2.63W x number of modules	2.63W x ___________	
1769-IF4XOF2	3.03W x number of modules	3.03W x ___________	
1769-IM12	3.65W x number of modules	3.65W x ___________	
1769-IQ16	3.55W x number of modules	3.55W x ___________	
1769-IQ6XOW4	2.75W x number of modules	2.75W x ___________	
1769-IR6	1.50W x number of modules	1.50W x ___________	
1769-IT6	1.50W x number of modules	1.50W x ___________	
1764-LSP	1.5W		
1764-LRP	1.9W		
1764-MM1, -RTC, -MM1/RTC	0		
1769-OA8	2.12W x number of modules	2.12W x ___________	
1769-OA16	4.9W x number of modules	4.9W x ___________	
1769-OB16	2.11W x number of modules	2.11W x ___________	
1769-OB16P	2.69W x number of modules	2.69W x ___________	
1769-OF2 (Series A)	4.77W x number of modules	4.77W x ___________	
1769-OF2 (Series B)	2.52W x number of modules	2.52W x ___________	
1769-OV16	2.06W x number of modules	2.06W x ___________	
1769-OW8	2.83W x number of modules	2.83W x ___________	
1769-OW8I	2.83W x number of modules	2.83W x ___________	
1769-OW16	4.75W x number of modules	4.75W x ___________	
1769-SDN	3.8W x number of modules	3.8W x ___________	
		Add Subtotals to determine Heat Dissipation	

Glossary

The following terms are used throughout this manual. Refer to the *Allen-Bradley Industrial Automation Glossary*, Publication Number AG-7.1, for a complete guide to Allen-Bradley technical terms.

address

A character string that uniquely identifies a memory location. For example, I:1/0 is the memory address for data located in Input file word 1, bit 0.

AIC+ Advanced Interface Converter

A device that provides RS-232 isolation to an RS-485 Half-Duplex communication link. (Catalog Number 1761-NET-AIC.)

application

1) A machine or process monitored and controlled by a controller.
2) The use of computer- or processor-based routines for specific purposes.

baud rate

The speed of communication between devices. Baud rate is typically displayed in *K baud*. For example, 19.2K baud = 19,200 bits per second.

bit

The smallest unit of memory used in discrete or binary logic, where the value 1 represents ON and 0 represents OFF.

block diagrams

A method used to illustrate logic components or a sequence of events.

Boolean operators

Logical operators such as AND, OR, NAND, NOR, NOT, and Exclusive-OR that can be used singularly or in combination to form logic statements or circuits. Can have an output response of T or F.

branch

A parallel logic path within a rung of a ladder program. Its primary use is to build OR logic.

communication scan

A part of the controller's operating cycle. Communication with devices (such as other controllers and operator interface devices) takes place during this period.

control program

User logic (the application) that defines the controller's operation.

controller

A device, such as a programmable controller, used to control output devices.

controller overhead

A portion of the operating cycle used for housekeeping purposes (memory checks, tests, communications, etc.).

counter

A device that counts the occurrence of an event.

CPU (Central Processing Unit)

The decision-making and data storage section of a programmable controller.

data table

The part of processor memory that contains I/O status and files where user data (such as bit, integer, timers, and counters) is monitored, manipulated, and changed for control purposes.

DIN rail

Manufactured according to Deutsche Industrie Normenausshus (DIN) standards, a metal railing designed to ease installation and mounting of your devices.

download

The transfer of program or data files to a device.

DCD

Data Carrier Detect. A signal generated by a modem that represents traffic (activity) on a communications network.

DTE

Data Terminal Equipment

EMI

Electromagnetic interference.

embedded I/O

Embedded I/O is the controller's on-board I/O. For MicroLogix controllers, embedded I/O is all I/O residing at slot 0.

expansion I/O

Expansion I/O is I/O that is connected to the controller via a bus or cable. MicroLogix 1200 controllers use Bulletin 1762 expansion I/O. MicroLogix 1500 controllers use Bulletin 1769 expansion I/O. For MicroLogix controllers, expansion I/O is all I/O residing at slot 1 and higher.

encoder

A device that detects position, and transmits a signal representing that position.

executing mode

Any run, remote run, or test mode.

false

The status of an instruction that does not provide a continuous logical path on a ladder rung.

FIFO (First-In-First-Out)

The order that data is stored and retrieved from a file.

file

A collection of data or logic organized into groups.

full-duplex

A mode of communication where data may be transmitted and received simultaneously (contrast with half-duplex).

half-duplex

A mode of communication where data transmission is limited to one direction at a time.

hard disk

A storage device in a personal computer.

high byte

Bits 8 to 15 of a word.

housekeeping

The portion of the scan when the controller performs internal checks and services communications.

input device

A device, such as a push button or a switch, that supplies an electrical signal to the controller.

input scan

The controller reads all input devices connected to the input terminals.

inrush current

The temporary surge of current produced when a device or circuit is initially energized.

instruction

A mnemonic defining an operation to be performed by the processor. A rung in a program consists of a set of input and output instructions. The input instructions are evaluated by the controller as being true or false. In turn, the controller sets the output instructions to true or false.

instruction set

The set of instructions available within a controller.

I/O

Input and Output

jump

Changes the normal sequence of program execution. In ladder programs a JUMP (JMP) instruction causes execution to jump to a specific rung in the user program.

ladder logic

A graphical programming format resembling a ladder-like diagram. The ladder logic programing language is the most common programmable controller language.

least significant bit (LSB)

The element (or bit) in a binary word that carries the smallest value of weight.

LED (Light Emitting Diode)

Used as status indicator for processor functions and inputs and outputs.

LIFO (Last-In-First-Out)

The order that data is stored and retrieved from a file.

low byte

Bits 0 to 7 of a word.

logic

A general term for digital circuits or programmed instructions to perform required decision making and computational functions.

Master Control Relay (MCR)

A hard-wired relay that can be de-energized by any series-connected emergency stop switch.

mnemonic

A simple and easy to remember term that is used to represent a complex or lengthy set of information.

Modbus™ RTU Slave

A serial communication protocol.

modem

Modulator/demodulator. Equipment that connects data terminal equipment to a communication line.

modes

Selected methods of operation. Example: run, test, or program.

negative logic

The use of binary logic in such a way that “0” represents the desired voltage level.

network

A series of stations (nodes) connected by some type of communication medium. A network may be made up of a single link or multiple links.

nominal input current

The typical amount of current seen at nominal input voltage.

normally closed

Contacts on a relay or switch that are closed when the relay is de-energized or deactivated. They are open when the relay is energized or the switch is activated.

normally open

Contacts on a relay or switch that are open when the relay is de-energized or the switch is deactivated. They are closed when the relay is energized or the switch is activated.

off-delay time

The OFF delay time is a measure of the time required for the controller logic to recognize that a signal has been removed from the input terminal of the controller. The time is determined by circuit component delays and by any applied filter.

offline

When a device is not scanning/controlling or when a programming device is not communicating with the controller.

offset

A continuous deviation of a controlled variable from a fixed point.

off-state leakage current

When a mechanical switch is opened (off-state), no current flows through the switch. Semiconductor switches and transient suppression components which are sometimes used to protect switches, have a small current flow when they are in the off state. This current is referred to as the off-state leakage current. To ensure reliable operation, the off-state leakage current rating must be less than the minimum operating current rating of the device that is connected.

on-delay time

The ON delay time is a measure of the time required for the controller logic to recognize that a signal has been presented at the input terminal of the controller.

one shot

A programming technique that sets a bit ON or OFF for one program scan.

online

When a device is scanning/controlling or when a programming device is communicating with the controller.

operating voltage

For inputs, the voltage range needed for the input to be in the On state. For outputs, the allowable range of user-supplied voltage.

output device

A device, such as a pilot light or a motor starter coil, that receives a signal or command from the controller.

output scan

The controller turns on, off, or modifies the devices connected to the output terminals.

PCCC

Programmable Controller Communications Commands

processor

A Central Processing Unit. (See CPU.)

processor files

The set of program and data files resident in the controller.

program file

Areas within a processor that contain the logic programs. MicroLogix controllers support multiple program files.

program mode

When the controller is not scanning the control program.

program scan

A part of the controller’s operating cycle. During the program scan, the logic program is processed and the Output Image is updated.

programming device

Programming package used to develop ladder logic diagrams.

protocol

The rules of data exchange via communications.

read

To acquire data. For example, the processor reads information from other devices via a read message.

relay

An electrically operated device that mechanically switches electrical circuits.

relay logic

A representation of binary or discrete logic.

restore

To transfer a program from a device to a controller.

reserved bit

A location reserved for internal use.

retentive data

Information (data) that is preserved through power cycles.

RS-232

An EIA standard that specifies electrical, mechanical, and functional characteristics for serial binary communication circuits.

run mode

An executing mode during which the controller scans or executes the logic program.

rung

A rung contains input and output instructions. During Run mode, the inputs on a rung are evaluated to be true or false. If a path of true logic exists, the outputs are made true (energized). If all paths are false, the outputs are made false (de-energized).

RTU

Remote Terminal Unit

save

To save a program to a computer hard disk.

scan

The scan is made up of four elements: input scan, program scan, output scan, and housekeeping.

scan time

The time required for the controller to complete one scan.

sinking

A term used to describe current flow between two devices. A sinking device provides a direct path to ground.

sourcing

A term used to describe current flow between two devices. A sourcing device or circuit provides a power.

status

The condition of a circuit or system.

terminal

A point on an I/O module that external devices, such as a push button or pilot light, are wired to.

throughput

The time between when an input turns on and a corresponding output turns on or off. Throughput consists of input delays, program scan, output delays, and overhead.

true

The status of an instruction that provides a continuous logical path on a ladder rung.

upload

Data is transferred from the controller to a programming or storage device.

watchdog timer

A timer that monitors a cyclical process and is cleared at the conclusion of each cycle. If the watchdog runs past its programmed time period, it causes a fault.

write

To send data to another device. For example, the processor writes data to another device with a message write instruction.

www.rockwellautomation.com

Corporate Headquarters
Rockwell Automation, 777 East Wisconsin Avenue, Suite 1400, Milwaukee, WI, 53202-5302 USA, Tel: (1) 414.212.5200, Fax: (1) 414.212.5201

Headquarters for Allen-Bradley Products, Rockwell Software Products and Global Manufacturing Solutions
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe: Rockwell Automation SA/NV, Vorstlaan/Boulevard du Souverain 36-BP 3A/B, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Headquarters for Dodge and Reliance Electric Products
Americas: Rockwell Automation, 6040 Ponders Court, Greenville, SC 29615-4617 USA, Tel: (1) 864.297.4800, Fax: (1) 864.281.2433
Europe: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 17741
Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 351 6723, Fax: (65) 355 1733

Publication 1764-UM001B-EN-P - April 2002
PN 40072-091-01(2)
Supersedes Publication 1764-UM001A-US-P - April 2000

1764-28BXB

ITEM # 33

Installation Instructions

MicroLogix™ 1500 Programmable Controller Base Units

(Catalog Numbers 1764-24AWA, 1764-24BWA, and 1764-28BXB)

Inside...

Publication 1764-IN001A-ML-P

Installation Instructions

English Section

MicroLogix™ 1500 Programmable Controller Base Units

(Catalog Numbers 1764-24AWA, 1764-24BWA, and 1764-28BXB)

Inside...

For More Information

Table 1 Related Publications

For	Refer to this Document	Pub. No.
A more detailed description of how to install and use your MicroLogix 1500 programmable controller.	MicroLogix 1500 Programmable Controllers User Manual	1764-UM001A-US-P
A reference manual that contains data and functin files, instruction set, and troubleshooting information for MicroLogix 1200 and MicroLogix 1500.	MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual	1762-RM001B-US-P
More information on proper wiring and grounding techniques.	Industrial Automation Wiring and Grounding Guidelines	1770-4.1

If you would like a manual, you can:

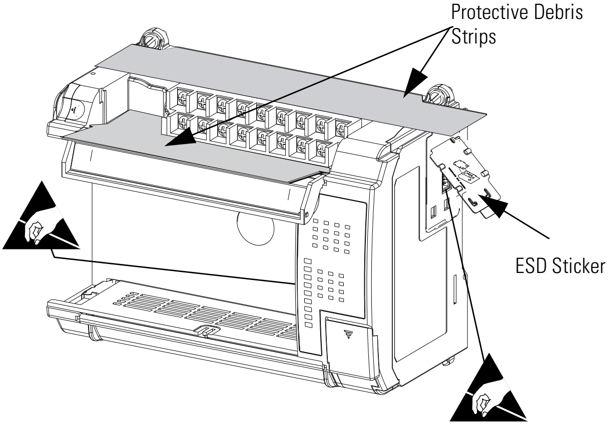
- download a free electronic version from the internet: **`www.ab.com/micrologix`** or **`www.theautomationbookstore.com`**
- purchase a printed manual by:
  - contacting your local distributor or Rockwell Automation representative
  - visiting **`www.theautomationbookstore.com`** and placing your order
  - calling **`1.800.963.9548`** (USA/Canada) or **`001.330.725.1574`** (Outside USA/Canada)

Overview

Install your controller using these installation instructions.

ATTENTION

Do not remove protective debris strips until after the base and all other equipment in the panel near the base is mounted and wiring is complete. Once wiring is complete, remove protective debris strips and install processor unit. Failure to remove strips before operating can cause overheating.



ATTENTION

Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the controller could cause damage. Do not drill holes above a mounted controller if the protective debris strips have been removed.

ATTENTION

Electrostatic discharge can damage semiconductor devices inside the base unit. Do not touch the connector pins or other sensitive areas.

Base Unit Description

Table 2 Standard Base Units

Catalog Number	Base Unit I/O and Power Supply
1764-24AWA	120V ac inputs/ relay outputs/ 120/240V ac power supply
1764-24BWA	24V dc inputs/ relay outputs/ 120/240V ac power supply
1764-28BXB	24V dc inputs/ FET and relay outputs/ 24V dc power supply

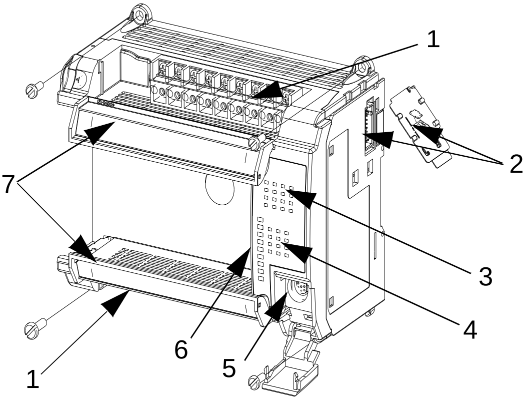


Table 3 Base Unit Description

Feature	Description
1	Removable Terminal Blocks
2	Interface to Expansion I/O, Removable ESD Sticker
3	Input LEDs
4	Output LEDs
5	RS-232 Communication Port (CH0)
6	Status LEDs
7	Terminal Doors and Label

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.
- This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.
- All wiring must comply with N.E.C. article 501-4(b).

Use only the following communication cables in Class I, Division 2 hazardous locations.

Table 4 Cable Listing

Environment Classification	Communication Cables
Class I, Division 2 Hazardous Environment	1761-CBL-PM02 Series C or later
	1761-CBL-HM02 Series C or later
	1761-CBL-AM00 Series C or later
	1761-CBL-AP00 Series C or later
	2707-NC8 Series B or later
	2707-NC10 Series B or later
	2707-NC11 Series B or later

Mounting the Controller

General Considerations

Most applications require installation in an industrial enclosure (Pollution Degree 2) to reduce the effects of electrical interference (Over Voltage Category II) and environmental exposure. Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the *Industrial Automation Wiring and Grounding Guidelines* publication 1770-4.1.

ATTENTION ⚠

Vertical mounting is not recommended due to heat build-up considerations.

ATTENTION ⚠

Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the base or processor unit could cause damage. Do not drill holes above a mounted controller if the protective debris strips have been removed or the processor has been installed.

NOTE

Remove the ESD sticker to install expansion I/O modules. An end cap terminator (catalog numbers 1769-ECR or -ECL) or an extension cable (catalog numbers 1769-CRR1, -CRR3, -CLL1, -CLL3, -CRL1, -CRL3) must be used at the end of the group of I/O modules attached to the MicroLogix 1500 Controller. The end cap terminator is not provided with the base unit. A maximum of eight I/O modules may be connected to the base.

Mounting Dimensions

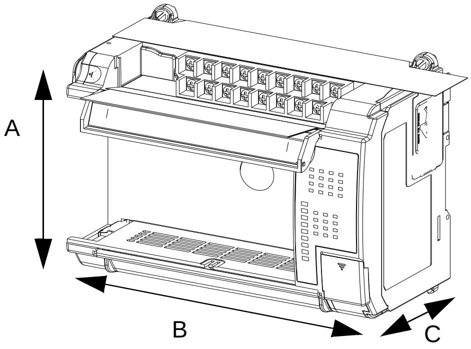
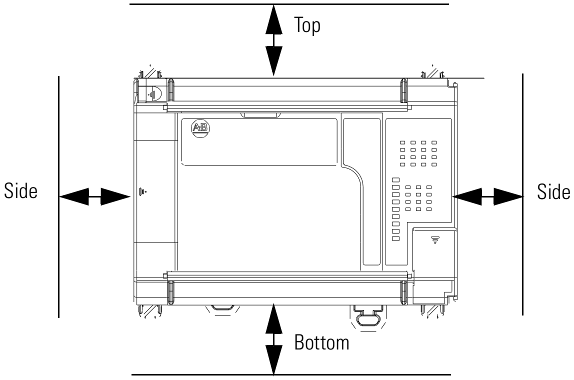


Table 5 Dimensions

Dimension	1764-24AWA	1764-24BWA	1764-28BXB
Height (A)	138 mm (5.43 in.)		
Width (B)	168 mm (6.62 in.)		
Depth (C)	87 mm (3.43 in.)		

Controller Spacing

The base unit is designed to be mounted horizontally, with the Compact™ expansion I/O extending to the right of the base unit. Allow 50 mm (2 in.) of space on all sides for adequate ventilation, as shown below.



Using a DIN Rail

The base unit and expansion I/O DIN rail latches lock in the open position so that an entire system can be easily attached to or removed from the DIN rail. The maximum extension of the latch is 15 mm (0.67 in.) in the open position. A flat-blade screw driver is required for removal of the base unit. The base can be mounted to EN50022-35x7.5 or EN50022-35x15 DIN rails. DIN rail mounting dimensions are shown below.

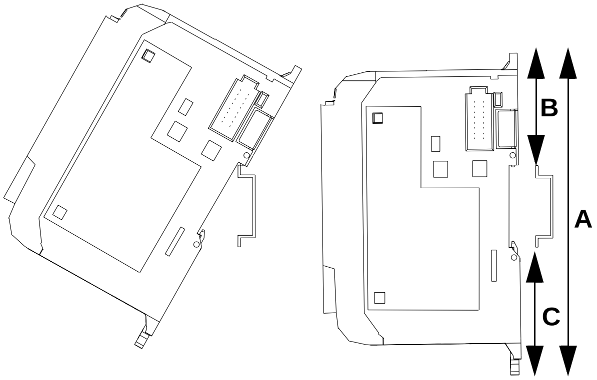


Table 6 DIN Rail Mounting Dimensions

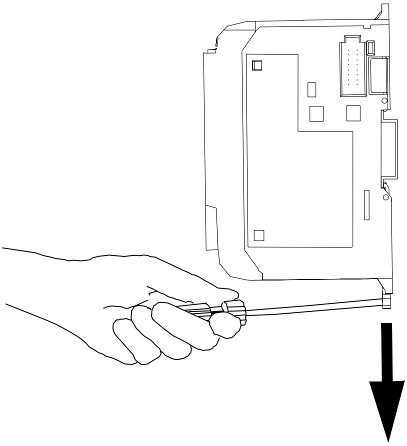
Dimension	Height
A	138 mm (5.43 in.)
B	47.6 mm (1.875 in.)
C	47.6 mm (1.875 in) DIN latch closed 54.7 mm (2.16 in.) DIN latch open

To install your base unit on the DIN rail:

1. Mount your DIN rail. (Make sure that the placement of the base unit on the DIN rail meets the recommended spacing requirements, see “Controller Spacing” on page 9. Refer to the mounting template from the inside back cover of this document.)
2. Hook the top slot over the DIN rail.
3. While pressing the base unit down against the top of the rail, snap the bottom of the base unit into position.
4. Leave the protective debris strip attached until you are finished wiring the base unit and any other devices.

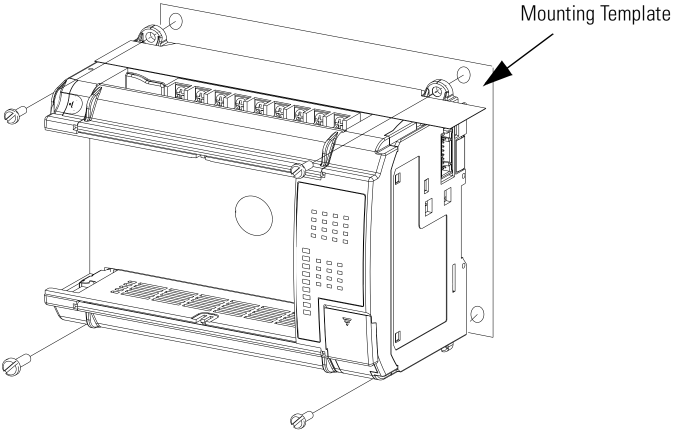
To remove your base unit from the DIN rail:

1. Place a flat-blade screwdriver in the DIN rail latch at the bottom of the base unit.
2. Holding the base unit, pry downward on the latch until the latch locks in the open position. This releases the base unit from the DIN rail.



Using Mounting Screws

Mount to panel using #8 or M4 screws.



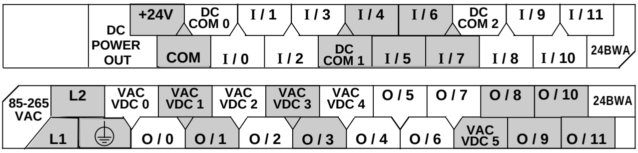
To install your base unit using mounting screws:

1. Remove the mounting template from the inside back cover of this document.
2. Secure the template to the mounting surface. (Make sure your base unit is spaced properly, see “Controller Spacing” on page 9).
3. Drill holes through the template.
4. Remove the mounting template.
5. Mount the base unit.
6. Leave the protective debris strips attached until you are finished wiring the base unit and any other devices.

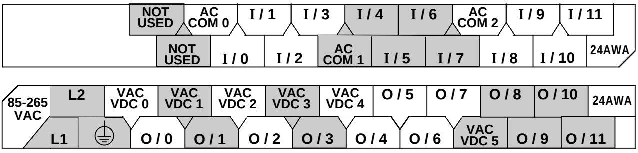
Wiring the Controller

Terminal Block Layout

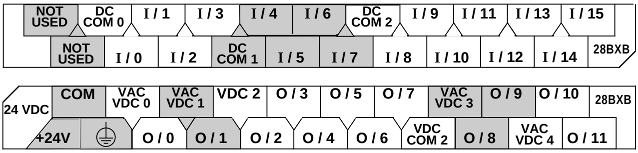
1764-24BWA



1764-24AWA



1764-28BXB



Wire Requirements

Table 7 Wire Type Recommendation

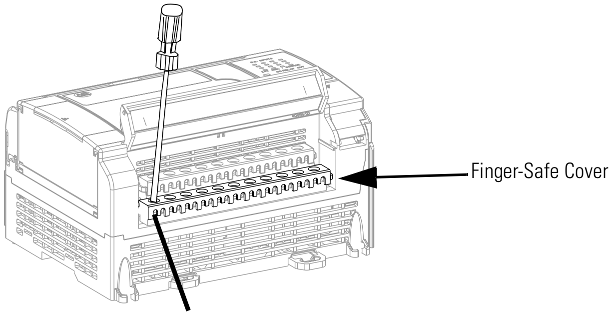
Wire Type		Wire Size (2 wire maximum per terminal screw)
Solid	Cu-90°C (194°F)	#14 to #22 AWG
Stranded	Cu-90°C (194°F)	#14 to #22 AWG

Wiring torque = 1.13 Nm (10 in-lb) rated; 1.3 Nm (12 in-lb) maximum

ATTENTION ⚠ Be careful when stripping wires. Wire fragments that fall into the controller could cause damage. Once wiring is complete, be sure the base unit is free of all metal fragments before removing protective debris strips and installing the processor unit. Failure to remove strips before operating can cause overheating.

Wiring Recommendation

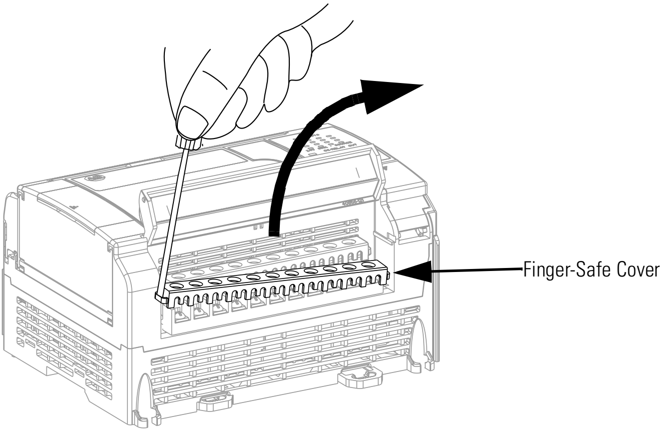
When wiring without spade lugs, keep the finger-safe covers in place. Loosen the terminal screw and route the wires through the opening in the finger-safe cover. Tighten the terminal screw making sure the pressure plate secures the wire.



Spade Lug Recommendation

The diameter of the terminal screw head is 5.5 mm (0.220 in.). The input and output terminals of the MicroLogix 1500 base unit are designed for the following spade lugs. The terminals will accept a 6.35mm (0.25 in.) wide spade (standard for #6 screw for up to 14AWG) or a 4 mm (metric #4) fork terminal.

When using spade lugs, use a small, flat-blade screwdriver to pry the finger-safe cover from the terminal blocks, then loosen the terminal screw.



Surge Suppression

ATTENTION

Inductive load devices such as motor starters and solenoids require the use of some type of surge suppression to protect the controller output. Switching inductive loads without surge suppression can significantly reduce the lifetime of relay contacts or damage transistor outputs. By using suppression, you also reduce the effects of voltage transients caused by interrupting the current to that inductive device, and prevent electrical noise from radiating into system wiring.

Grounding the Controller

ATTENTION

All devices connected to the RS-232 channel must be referenced to base unit ground or floating. Failure to follow this procedure may result in property damage or personal injury.

In solid-state control systems, grounding and wire routing helps limit the effects of noise due to electromagnetic interference (EMI). Run the ground connection from the ground screw of the base unit to the ground bus prior to connecting any devices. Use AWG #14 wire. This connection must be made for safety purposes.

You must also provide an acceptable grounding path for each device in your application. For more information on proper grounding guidelines, see the *Industrial Automation Wiring and Grounding Guidelines* publication 1770-4.1.

Specifications

Table 8 General Specifications

Description	1764-24BWA	1764-24AWA	1764-28BXB
Number of I/O	12 inputs 12 outputs	12 inputs 12 outputs	16 inputs 12 outputs
Line Power	85/265V ac	85/265V ac	20.4 to 30V dc
Power Supply Inrush	120V ac = 25A for 8 ms 240V ac = 40A for 4 ms	120V ac = 25A for 8 ms 240V ac = 40A for 4 ms	24V dc = 4A for 150 ms
User Power Output	24V dc at 400 mA, 400 µf max.	none	none
Input Circuit Type	24V dc, sink/source	120V ac	24V dc, sink/source
Output Circuit Type	relay	relay	6 relay, 6 FET transistor
Operating Temp.	+0°C to +55°C (+32°F to +131°F) ambient		
Storage Temp.	-40°C to +85°C (-40°F to +185°F) ambient		
Operating Humidity	5% to 95% relative humidity (non-condensing)		
Vibration	Operating: 10 to 500 Hz, 5G, 0.015 in. peak-to-peak Relay Operation: 2G		
Shock (without Data Access Tool installed)	Operating: 30G panel mounted (15G DIN Rail mounted) Relay Operation: 7.5G panel mounted (5G DIN Rail mounted) Non-Operating: 40G panel mounted (30G DIN Rail mounted)		
Shock (with Data Access Tool installed)	Operating: 20G panel mounted (15g DIN Rail mounted) Relay Operation: 7.5G panel mounted (5G DIN Rail mounted) Non-Operating: 30G panel mounted (20G DIN Rail mounted)		
Agency Certification	• UL 508 • C-UL under CSA C22.2 no. 142 • Class I, Div. 2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 no. 213) • CE compliant for all applicable directives		
Terminal Screw Torque	1.13 Nm (10 in-lb) rated; 1.3 Nm (12 in-lb) maximum		
Power Supply Isolation	2596V dc	2596V dc	1697V dc
Relay Outputs Isolation	2596V dc	2596V dc	2596V dc
Transistor Output Isolation	none	none	1697V dc
Inputs Isolation	2145V dc	2145V dc	1697V dc
User 24V Isolation	848V dc	none	none

Table 9 Input Specifications

Description	**1764-24AWA**	**1764-24BWA and 1764-28BXB**	
		Inputs 0 thru 7	**Inputs 8 and Higher**
On State Voltage Range	79 to 132V ac	14 to 30.0 V dc at 30°C (86°F) 14 to 26.4 V dc at 55°C (131°F)	10 to 30.0 V dc at 30°C (86°F) 10 to 26.4 V dc at 55°C (131°F)
Off State Voltage Range	0 to 20V ac	0 to 5V dc	
Operating Frequency	47 Hz to 63 Hz	0 Hz to 20 KHz (1764-24BWA)	0 Hz to 1 KHz(1) (1764-24BWA)
On State Current: - minimum - nominal - maximum	 - 5.0 mA at 79V ac - 12.0 mA at 120V ac - 16.0 mA at 132V ac	 - 2.5 mA at 14V dc - 7.3 mA at 24V dc - 12.0 mA at 30V dc	 - 2.0 mA at 10V dc - 8.9 mA at 24V dc - 12.0 mA at 30V dc
Off State Leakage Current	2.5 mA minimum	1.5 mA minimum	
Nominal Impedance	12k ohms at 50 Hz 10k ohms at 60 Hz	3.3k ohms	2.7k ohms
Inrush Current (max.) at 120V ac	250 mA	Not Applicable	Not Applicable

(1) Scan-time dependant.

Table 10 Output Specifications

Specification		**1764-24AWA/BWA**	**1764-28BXB**
Current per Common		8A	8A
Current per Controller	at 150V Maximum	24A	18A
	at 240V Maximum	20A	18A

Table 11 Relay Contact Rating Table 1764-24AWA, -24BWA, -28BXB

Maximum Volts	**Amperes**		**Amperes Continuous**	**Voltamperes**	
	Make	**Break**		**Make**	**Break**
240V ac	7.5A	0.75A	2.5A	1800 VA	180 VA
120V ac	15A	1.5A			
125V dc	0.22A (1)		1.0A	28 VA	
24V dc	1.2A (1)		2.0A	28 VA	

(1) For dc voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28 VA by the applied dc voltage. For example, 28 VA/48V dc = 0.58A. For dc voltage applications less than 48V, the make/break ratings for relay contacts cannot exceed 2A

Table 12 1764-28BXB FET Output Specifications

Specification		General Operation (Outputs 2 thru 7)	High Speed Operation[1] (Outputs 2 and 3 Only)
User Supply Voltage	minimum	20.4V dc	20.4V dc
	maximum	26.4V dc	26.4V dc
On-State Voltage Drop	at maximum load current	1V dc	Not Applicable
	at maximum surge current	2.5V dc	Not Applicable
Current Rating per Point	maximum load	1A at 55°C (131°F) 1.5A at 30°C (86°F)	100 mA
	minimum load	1.0 mA	10 mA
	maximum leakage	1.0 mA	1.0 mA
Surge Current per Point	peak current	4.0A	Not Applicable
	maximum surge duration	10 msec	Not Applicable
	maximum rate of repetition at 30°C (86°F)	once every second	Not Applicable
	maximum rate of repetition at 55°C (131°F)	once every 2 seconds	Not Applicable
Current per Common	maximum total	6A	6A
Turn-On Time	maximum	0.1 msec	6 µsec
Turn-Off Time	maximum	1.0 msec	18 µsec
Repeatability	maximum	n/a	2 µsec
Drift	maximum	n/a	1 µsec per 5°C (1 µsec per 9°F)

(1) Outputs 2 and 3 are designed to provide increased functionality over the other FET outputs (4 through 7). They may be used like the other FET transistor outputs, but in addition, within a limited current range, they may be operated at a higher speed. Outputs 2 and 3 also provide a pulse train output (PTO) or pulse width modulation output (PWM) function.

Table 13 Working Voltage

Specification	**1764-L24AWA**
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 151V ac for 1 second or 2145V dc for 1 second
	132V Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation).
Specification	**1764-24BWA**
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Power Supply User 24V Output to Backplane Isolation	Verified by one of the following dielectric tests: 600V ac for 1 second or 848V dc for 1 second
	50V Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation).
Output Group to Output Group Isolation.	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

Table 13 Working Voltage

Specification	**1764-28BXB**
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
FET Output Group to Backplane Isolation and FET Outputs Group to Group	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Relay Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Relay Output Group to Relay and FET Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

2711-NC21 ITEM # 40

Cat. No.	Protective Antiglare Overlays
2711P-RGK4	PanelView Plus 400 Keypad Antiglare Overlay
2711P-RGK6	PanelView Plus 600 Keypad or Keypad/Touch Antiglare Overlay
2711P-RGT6	PanelView Plus 600 Touch Antiglare Overlay
2711P-RGK7	PanelView Plus 700 & VersaView CE 700H Keypad or Keypad/Touch Antiglare Overlay
2711P-RGT7	PanelView Plus 700 & VersaView CE 700H Touch Antiglare Overlay
2711P-RGK10	PanelView Plus 1000 & VersaView CE 1000H Keypad or Keypad/Touch Antiglare Overlay
2711P-RGT10	PanelView Plus 1000 & VersaView CE 1000H Touch Antiglare Overlay
2711P-RGK12	PanelView Plus 1250 & VersaView CE 1250H Keypad or Keypad/Touch Antiglare Overlay
2711P-RGT12	PanelView Plus 1250 & VersaView CE 1250H Touch Antiglare Overlay
2711P-RGK15	PanelView Plus & VersaView CE 1500/1500H Keypad or Keypad/Touch Antiglare Overlay
2711P-RGT15	PanelView Plus 1500 & VersaView CE 1500H Touch Antiglare Overlay

Cat. No.	Cutout Adapter Plates
2711P-RAK4	Adapts PanelView Plus 400 Keypad or 600 Touch to PanelView Standard 550 Keypad
2711P-RAK6	Adapts PanelView Plus 600 Keypad to PanelView Standard 600 Keypad
2711P-RAK7	Adapts PanelView Plus 700 & VersaView CE 700H Keypad or Keypad/Touch to PanelView Standard 900 Keypad
2711P-RAT7	Adapts PanelView Plus 700 & VersaView CE 700H Touch to PanelView Standard 900 Touch
2711P-RAK10	Adapts PanelView Plus 1000 & VersaView CE 1000H Keypad or Keypad/Touch to PanelView 1000/1000E Keypad
2711P-RAT10	Adapts PanelView Plus 1000 & VersaView CE 1000H Touch to PanelView 1000/1000E Touch
2711P-RAK15	Adapts PanelView Plus 1500 & VersaView CE 1500H Keypad or Keypad/Touch to PanelView 1200E/1400E Keypad
2711P-RAT15	Adapts PanelView Plus 1500 & VersaView CE 1500H Touch to PanelView 1200E/1400E Touch
2711P-RAK12E	Adapts a PanelView Plus 1250 & VersaView CE 1250H (or PV1000/1000E) Keypad or Keypad/Touch to PanelView 1200/1400E Keypad
2711P-RAT12E2	Adapts PanelView Plus 1250 & VersaView CE 1250H (or PV1000/1000E) Touch to PanelView 1200 Touch
2711P-RAT12E	Adapts PanelView Plus 1250 & VersaView CE 1250H (or PV1000/1000E) Touch to a PanelView 1200E/1400E Touch
2711P-RAK12S	Adapts PanelView Plus 1250 & VersaView CE 1250H (or PV1000/1000E) Keypad or Keypad/Touch to PanelView Standard 1400 Keypad
2711P-RAT12S	Adapts PanelView Plus 1250 & VersaView CE 1250H (or PV1000/1000E) Touch to PanelView Standard 1400 Touch

See Step 3, Determining Cable Requirements, on page 62 for cable configuration details.

Cat. No.	Cables/Interface Modules
2711-NC13	RS-232 Operating/Programming Cable, 9-Pin D Shell to 9-Pin D Shell, 5 m (16.4 ft)
2711-NC14	RS-232 Operating/Programming Cable, 9-Pin D Shell to 9-Pin D Shell, 10 m (32.7 ft)
2711-NC17	Remote RS-232 Serial Cable
2711-NC21	RS-232 Operating Cable, 9-Pin D Shell to 8-Pin Mini DIN, 5 m (16.4 ft)
2711-NC22	RS-232 Operating Cable, 9-Pin D Shell to 8-Pin Mini DIN, 15 m (49 ft)
2711P-CBL-EX04	Ethernet CAT5 Crossover Industrial Cable, 4.3 m (14 ft)
2711P-CBL-US02	USB to Serial Network Interface Module (2m)
2711P-CBL-UU02	USB Host-to-Host Data Transfer Cable (2m)
1746-C10, -C11, -C20	DH-485 Network Interface Cable (SDL AMP to RJ45)
1761-CBL-AS03, -AS09	DH-485 Network Interface Cable (6-Pin Phoenix to RJ45)

Cat. No.	Miscellaneous
2711P-RTFC	Mounting Levers for PanelView Plus 400 and 600 (Qty 8)
2711P-RVAC	AC Power Terminal Block for PanelView Plus 400 and 600 (Qty 10)
2711-TBDC	DC Power Terminal Block for PanelView Plus 400/600 Terminals and PanelView Micro 300 (Quantity 10)
2711P-RCH	Compact Flash to PCMCIA Adapter
2711P-CBL-UP02	USB to PS/2 Adapter
2711P-RY2032	Replacement Battery for PanelView Plus 700-1500 & VersaView CE 700H-1500H
2711P-RTMC	Mounting Clips for PanelView Plus 700-1500 & VersaView CE 700H-1500H
6189-2CONN	AC/DC Connectors for PanelView Plus 700-1500 and VersaView CE 700-1500

2711P-B10C4D1

ITEM # 41

Installation Instructions

PanelView Plus/VersaView CE Terminals and Display Modules

(Catalog Numbers 2711P-xxxxxx, 6182H-xxxxxx)

Inside...

Publication 2711P-IN001B-MU-P - March 2003

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of these products must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards. In no event will Rockwell Automation be responsible or liable for indirect or consequential damage resulting from the use or application of these products.

Any illustrations, charts, sample programs, and layout examples shown in this publication are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Rockwell Automation office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Reproduction of the contents of this copyrighted publication, in whole or part, without written permission of Rockwell Automation, is prohibited.

Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard, avoid a potential hazard, and recognize the consequences of a potential hazard:

WARNING ⚠	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
ATTENTION ⚠	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Installation Instructions

PanelView Plus/VersaView CE Terminals and Display Modules

(Catalog Numbers 2711P-xxxxxx, 6182H-xxxxxx)

English

Inside:

Publication 2711P-IN001B-MU-P

Overview

This document provides instructions on how to install the following devices in a panel or enclosure.

- factory assembled PanelView Plus or VersaView CE terminal
- PanelView Plus or VersaView CE Display Module

Refer to the installation instructions shipped with the Logic Module and Communication Module for field installation of these components.

For More Information

To obtain electronic versions of the PanelView Plus or VersaView CE User Manual, visit the following web sites:

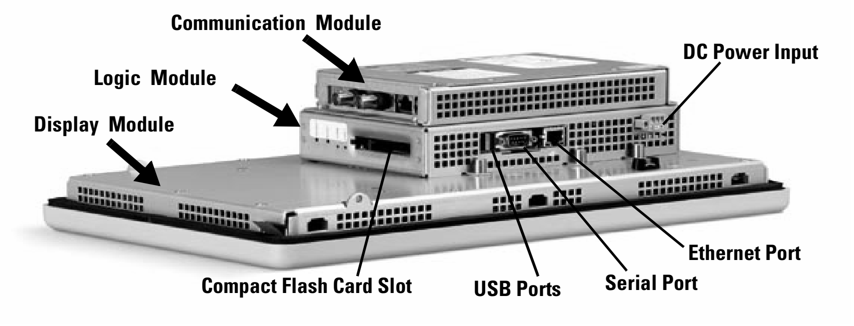
- www.theautomationbookstore.com
- www.ab.com/manuals

Modular Components

The PanelView Plus and VersaView CE terminals have the following modular components:

- Display Module (700/700H, 1000/1000H, 1250/1250H, 1500/1500H)
- Logic Module (DC Power, CF Card Slot, Ethernet Port, Serial Port, USB Ports)
- Internal Compact Flash card with firmware or operating system, RAM Memory (SO-DIMM)
- Communication Module (for specific communication protocols)

These items can be ordered as separate components for field installation or factory assembled per your configuration. The base configured unit includes the Display Module and the Logic Module (with Internal Compact Flash and RAM).



If the modules are ordered separately, attach the Logic Module and Communication Module) to the Display Module before panel installation. See instructions shipped with each module.

The VersaView CE terminal is shipped with RAM and Compact Flash pre-installed in Logic Module. The RAM and Compact Flash are not pre-installed in the Logic Module of the PanelView Plus. You must install the memory before attaching the Logic Module to Display Module. See instructions shipped with Logic Module.

Wiring and Safety Guidelines

Use publication NFPA 70E, Electrical Safety Requirements for Employee Workplaces when wiring the terminals. In addition to the NFPA guidelines:

- connect the terminal and other similar electronic equipment to its own branch circuit
- protect the input power by a fuse or circuit breaker rated at no more than 15 Amps.
- route incoming power to the terminal by a separate path from the communication lines.
- where power and communication lines must cross, they should cross at right angles. Communication lines can be installed in the same conduit as low level DC I/O lines (less than 10 volts).
- grounding minimizes noise from Electromagnetic Interference (EMI) and is a safety measure in electrical installations. To avoid EMI, shield and ground cables appropriately.

A source for grounding recommendations is the National Electrical Code published by the National Fire Protection Association of Boston.

Hazardous Locations

This equipment is suitable for:

- Class I, Division 2 Groups A, B, C, D
- Class II, Division 2 Groups F, G
- Class III Division 1
- or non-hazardous locations only

The following statement applies to use in hazardous locations.

WARNING

- Substitution of components may impair suitability for hazardous locations.
- Do not disconnect equipment unless power has been switched off and area is known to be non-hazardous.
- Do not connect or disconnect components unless power has been switched off.
- All wiring must comply with N.E.C. articles 501-4(b), 502-4(b), 503-3(b) as appropriate.
- Peripheral equipment must be suitable for the location it is used in.

The PanelView Plus and VersaView CE terminals have an operating temperature code of T4 (maximum operating temperature of 55 °C or 131 °F). Do not install the terminals in environments where atmospheric gases have ignition temperatures less than 135 °C or 275 °F.

Environmental Considerations

The terminals are suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution Degree 2(1) and with circuits not exceeding Over Voltage Category II (2) (IEC 60664-1).(3)

---

(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product’s insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

Enclosures

The terminals must be mounted in a panel or enclosure to protect the internal circuitry. The terminals meet NEMA Type 12/13 and 4X ratings only when mounted in a panel or enclosure with the equivalent rating.

When the terminal is not mounted in a panel, it is not secure or safe for operation. You must comply with the NEMA Type 4 requirements for environmental specifications.

Clearances

Allow adequate clearances around the terminal, inside the enclosure, for adequate ventilation. Consider heat produced by other devices in the enclosure. The ambient temperature around the terminals must be between 0…55 °C (32…131 °F).

Minimum clearances for ventilation are:

- top and bottom clearance: 51 mm (2 in)
- side clearances: 25 mm (1 in)

Maximum side clearance for insertion of memory card is 102 mm (4 in).

Required Tools

Besides the tools required for the panel or enclosure cutouts, you will need the following for installation:

- small slotted screw driver
- torque wrench (in-lb)

Mounting Dimensions

This section provides mounting dimensions for the PanelView Plus and VersaView CE terminals. The depth dimensions are shown for the:

- base configured unit (Display Module and Logic Module)
- base configured unit with Communication Module

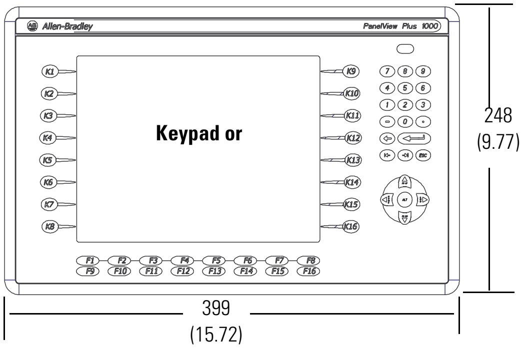
All measurements are in mm (inches).

The illustration following the table shows dimensions for the 1000/1000H terminals.

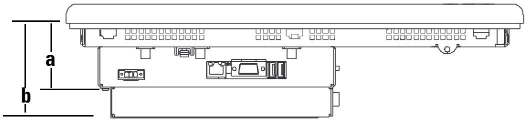
Terminal Type	**Height**	**Width**	**Depth**
PanelView Plus 700/VersaView CE 700H Keypad or Keypad & Touch	193 (7.58)	290 (11.40)	55 (2.18) Display to Logic Module 83 (3.27) Display to Comm Module
PanelView Plus 700/VersaView CE 700H Touch Screen	179 (7.04)	246 (9.68)	
PanelView Plus 1000/VersaView CE 1000H Keypad or Keypad & Touch	248 (9.77)	399 (15.72)	
PanelView Plus 1000/VersaView CE 1000H Touch Screen	248 (9.77)	329 (12.97)	
PanelView Plus 1250/VersaView CE 1250H Keypad or Keypad & Touch	282 (11.12)	416 (16.36)	
PanelView Plus 1250/VersaView CE 1250H Touch Screen	282 (11.12)	363 (14.30)	
PanelView Plus 1500/VersaView CE 1500H Keypad or Keypad & Touch	330 (12.97)	469 (18.46)	65 (2.55) Display to Logic Module 93 (3.65) Display to Comm Module
PanelView Plus 1500/VersaView CE 1500H Touch Screen	330 (12.97)	416 (16.36)	

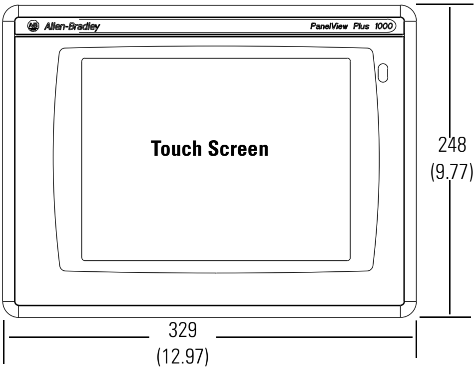
PanelView Plus 1000 and VersaView CE 1000H

All measurements are in mm (inches).

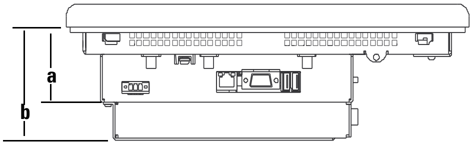


a 55 (2.18) Display to Logic Module
b 83 (3.27) Display to Comm Module





a 55 (2.18) Display to Logic Module
b 83 (3.27) Display to Comm Module



Cutout Dimensions

The table below shows the overall cutout dimensions for each PanelView Plus and VersaView CE terminal. Dimensions are in mm (inches).

Use the full size template shipped with your terminal to mark the cutout dimensions.

PanelView Plus /VersaView CE Terminal	Height	Width
700/700H Keypad or Keypad & Touch	167 (6.57)	264 (10.39)
700/700H Touch	154 (6.08)	220 (8.67)
1000/1000H Keypad or Keypad & Touch	224 (8.8)	375 (14.75)
1000/1000H Touch	224 (8.8)	305 (12.00)
1250/1250H Keypad or Keypad & Touch	257 (10.11)	390 (15.35)
1250/1250H Touch	257 (10.11)	338 (13.29)
1500/1500H Keypad or Keypad & Touch	305 (12.00)	419 (16.50)
1500/1500H Touch	305 (12.00)	391 (15.40)

Installing Terminal in a Panel

All of the PanelView Plus and VersaView CE terminals are installed in the same manner using clips for mounting. The number of clips used (4, 6 or 8) varies by terminal type. The mounting clips are shipped with each terminal.

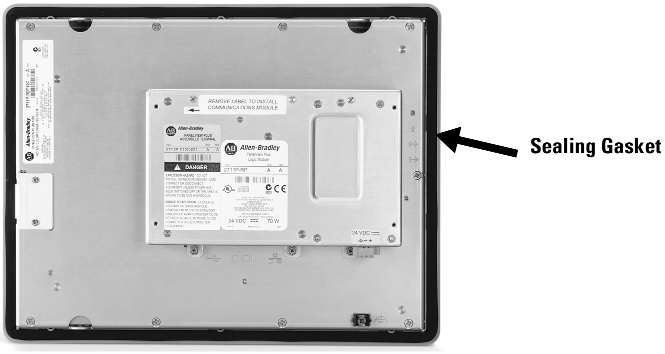
ATTENTION

- Disconnect all electrical power from the panel before making the panel cutout.
- Make sure the area around the panel cutout is clear.
- Do not allow metal cuttings to enter any components already installed in the panel.
- Failure to follow these instructions may result in personal injury or damage to panel components.

To install terminal in a panel:

1. Cut an opening in the panel using the panel cutout provided with the terminal. Remove any sharp edges or burrs.

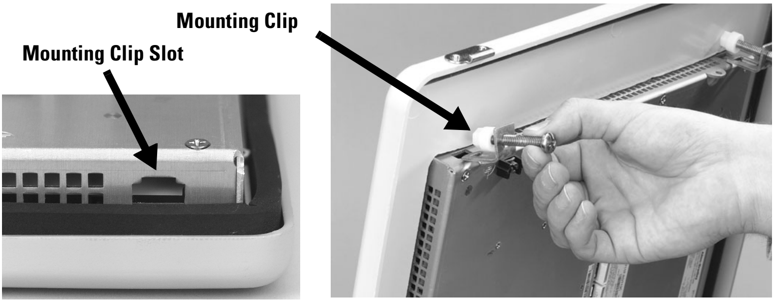
2. Make sure the terminal sealing gasket is properly positioned on the terminal as shown. This gasket forms a compression type seal. Do not use sealing compounds.



3. If using keypad legend strips on keypad terminals, we recommend that you install the strips before installing the terminal. Be careful not to pinch legend strip during installation.

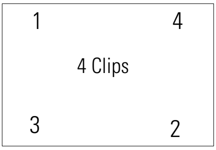
4. Place the terminal in the panel cutout.

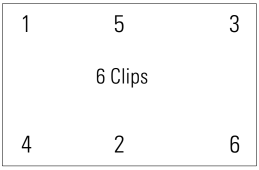
5. Install the mounting clips. The ends of the clips slide into the slots on the terminal.

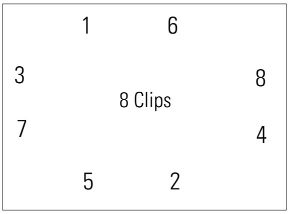


6. Tighten the mounting clip screws by hand until the gasket seal contacts the mounting surface uniformly.

7. Alternately tighten the mounting clips screws to a torque of .90 - 1.1 N•m (8 - 10 in-lb). Do not over-tighten. Below are recommended torque sequences.







ATTENTION

Tighten the mounting clip screws to a torque of .90 - 1.1 N•m (8 - 10 in-lb) to provide a proper seal and to prevent potential damage to the terminal. Allen-Bradley assumes no responsibility for water or chemical damage to the terminal or other equipment within the enclosure because of improper installation.

Connecting DC Power

The PanelView Plus and VersaView CE terminals have an integrated power supply that operates on 24V dc. The electrical input ratings of the power supply are:

- 24V dc nominal (18…32V dc)
- 70 Watts maximum (2.9A @24V dc)

The power supply is internally protected against reverse polarity.

The input power, terminal block on the power supply is removable and supports the following wire sizes:

Wire Type	Wire Size	Terminal Block Screw Torque
Stranded	#16 to #22 AWG	.23 - .45 N•m (2 - 4 in-lbs)
Solid	#18 to #22 AWG	

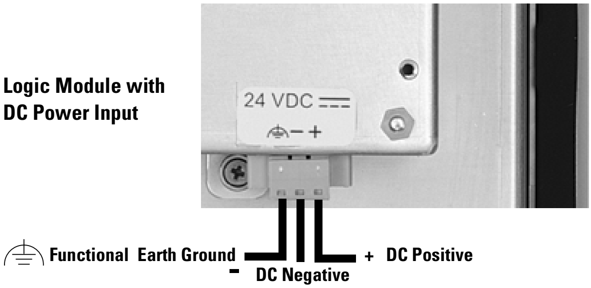
The terminals using 24V dc power are EN 61131-2 Equipment Class II devices.

ATTENTION

Use a Class 2/SELV (Safety Extra-Low Voltage), isolated and ungrounded power supply as input power to the terminals. This power source provides protection so that under nominal and single fault conditions, the voltage between conductors and between conductors and Functional Earth/Protective Earth does not exceed a safe value.

To connect DC power:

1. Secure the DC power wires to the terminal block screws.
2. Secure the Functional Earth (FE) ground wire to the ⏚ terminal block screw.
3. Apply 24V dc power to the terminal.



European Communities (EC) Directive Compliance

If this product has the CE mark it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet the Council Directive 89/336/EC Electromagnetic Compatibility (EMC) by applying the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2 EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 61000-6-2 EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests. For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the Allen-Bradley publication Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, publication 1770-4.1.

Open style devices must be provided with environmental and safety protection by proper mounting in enclosures designed for specific application conditions. See NEMA Standards publication 250 and IEC publication 529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

Product Specifications

Electrical	
DC Power	
Input Voltage DC	24V dc nominal (18…32V dc)
Power Consumption DC	70 Watts maximum (2.9 A @24V dc)

Display	
Display Type	Color Active Matrix, Thin FilmTransistor (TFT), with Liquid Crystal Display (LCD)
Display Size	
700/700H	6.5 in
1000/1000H	10.4 in
1250/1250H	12.1 in
1500/1500H	15 in
Display Area (W x H)	
700/700H	132 x 99 mm (5.2 x 3.9 in)
1000/1000H	211 x 158 mm (8.3 x 6.2 in)
1250/1250H	246 x 184 mm (9.7 in x 7.2 in)
1500/1500H	304 x 228 mm (12.0 x 9.0 in)
Display Resolution	
700/700H	640 x 480
1000/1000H	640 x 480
1250/1250H	800 x 600
1500/1500H	1024 x 768
Touch Screen	Analog Resistive

Environmental	
Operating Temperature	0…55 °C (32…131 °F)
Storage Temperature	-20…70 °C (-13…158 °F)
Vibration	10…57 Hz, 0.012 pk-pk displacement 57…500 Hz 2.0 g pk acceleration
Shock Operating	15 g at 11 ms
Shock Non-Operating	30 g at 11 ms
Relative Humidity	5…95% without condensation
Ratings	NEMA Type 12, 13, 4X (indoor use only), IP54, IP65

Mechanical	
Dimensions H x W x D (for base configured unit without communication module)	
700/700H Keypad or Keypad & Touch	193 x 290 x 55 mm (7.58 x 11.40 x 2.18 in)
700/700H Touch	179 x 246 x 55 mm (7.04 x 9.68 x 2.18 in)
1000/1000H Keypad or Keypad & Touch	248 x 399 x 55 mm (9.77 x 15.72 x 2.18 in)
1000/1000H Touch	248 x 329 x 55 mm (9.77 x 12.97 x 2.18 in)
1250/1250H Keypad or Keypad & Touch	282 x 416 x 55 mm (11.12 x 16.36 x 2.18 in)
1250/1250H Touch	282 x 363 x 55 mm (11.12 x 14.30 x 2.18 in)
1500/1500H Keypad or Keypad & Touch	330 x 469 x 65 mm (12.97 x 18.46 x 2.55 in)
1500/1500H Touch	330 x 416 x 65 mm (12.97 x 16.36 x 2.55 in)
Weight (for base configured unit without communication module)	
700/700H Keypad or Keypad & Touch	1.9 kg (4.2 lb)
700/700H Touch	1.7 kg (3.8 lb)
1000/1000H Keypad or Keypad & Touch	2.9 kg (6.3 lb)
1000/1000H Touch	2.6 kg (5.7 lb)
1250/1250H Keypad or Keypad & Touch	3.4 kg (7.6 lb)
1250/1250H Touch	3.2 kg (7.1 lb)
1500/1500H Keypad or Keypad & Touch	4.6 kg (10.0 lb)
1500/1500H Touch	4.2 kg (9.3 lb)

Agency Certifications	
When product is marked:	CE Marked for all applicable directives c UL us UL Listed Industrial Control Equipment UL Listed Industrial Control Equipment for use in Canada UL Listed Industrial Control Equipment for use in • Class I, Div 2, Group A, B, C, D • Class II, Div 2 Groups F, G • Class III, Div 1 Hazardous Locations ✓ Marked for all applicable acts N223

Allen-Bradley

MicroLogix™ 1500 Programmable Controllers

Bulletin 1764

1764-28BXB

ITEM # 33

User Manual

Rockwell
Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Reproduction of the contents of this copyrighted publication, in whole or part, without written permission of Rockwell Automation, is prohibited.

Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard, avoid a potential hazard, and recognize the consequences of a potential hazard:

WARNING Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Summary of Changes

The information below summarizes the changes to this manual since the last printing.

To help you find new and updated information in this release of the manual, we have included change bars as shown to the right of this paragraph.

The table below lists the sections that document new features and additional or updated information on existing features.

For this information:	See
Series C support for up to 16 expansion I/O modules	Chapter 1
List of controller series, OS FRN numbers, and RSLogix versions	Page 1-5
Updated list of recommended surge suppressors	Page 3-6
Ethernet Connectivity	Page 4-23
Typical CPU hold-up time	Page A-1
Updated system loading and heat dissipation worksheets	Appendix F
System loading graphs for 1769 power supplies, including 1769-PA4 and 1769-PB4	pages F-5 through F-7

Preface

Chapter 1
Hardware Overview

Chapter 2
Installing Your Controller

Chapter 3

Wiring Your Controller

Chapter 4

Communication Connections

Chapter 5

Using Trim Pots and the Data Access Tool (DAT)

Chapter 6

Using Real-Time Clock and Memory Modules

Appendix A

Specifications

Appendix B

Replacement Parts

Appendix C

Troubleshooting Your System

Appendix D

Upgrading Your Operating System

Appendix E

Understanding Communication Protocols

Appendix F

System Loading and Heat Dissipation

Glossary

Index

Read this preface to familiarize yourself with the rest of the manual. It provides information concerning:

- who should use this manual
- the purpose of this manual
- related documentation
- conventions used in this manual
- Rockwell Automation support

Who Should Use this Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use MicroLogix 1500 controllers.

You should have a basic understanding of electrical circuitry and familiarity with relay logic. If you do not, obtain the proper training before using this product.

Purpose of this Manual

This manual is a reference guide for MicroLogix 1500 controllers. It describes the procedures you use to install, wire, and troubleshoot your controller. This manual:

- explains how to install and wire your controllers
- gives you an overview of the MicroLogix 1500 controller system

Refer to publication 1762-RM001, *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual* for the MicroLogix 1200 and 1500 instruction set and for application examples to show the instruction set in use. Refer to your programming software user documentation for more information on programming your MicroLogix 1500 controller.

Related Documentation

The documents listed on page P-2 contain additional information concerning Rockwell Automation products. If you would like a copy, you can:

- download a free electronic version from the internet: www.ab.com/micrologix or www.theautomationbookstore.com
- purchase a printed manual by:
  - contacting your local distributor or Rockwell Automation representative
  - visiting www.theautomationbookstore.com and placing your order
  - calling 1.800.963.9548 (USA/Canada) or 001.330.725.1574 (Outside USA/Canada)

For	**Read this Document**	**Document Number**
A technical overview of the MicroLogix 1500 and related products	MicroLogix 1500 Programmable Controllers Technical Data	1764-TD001
Information on the MicroLogix 1500 Controllers instruction set	MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual	1762-RM001
Information on mounting and wiring the MicroLogix 1500 Base Units, including a mounting template for easy installation	MicroLogix 1500 Programmable Controllers Base Unit Installation Instructions	1764-IN001
An overview of Compact I/O	Compact I/O System Overview	1769-SO001
More information on Compact I/O Power Supplies and Cables	1769 Compact I/O Power Supplies and Communication Bus Expansion Cables Technical Data	1769-TD001
More information on Compact Analog I/O and Temperature Input Modules	Compact Analog I/O and Temperature Input Modules Technical Data	1769-TD004
Detailed information on using Compact I/O Analog Modules	Compact I/O Analog Modules User Manual	1769-UM002
Detailed information on installing, configuring, and using 1769-IT6 Thermocouple/mV Input Modules	Compact I/O 1769-IT6 Thermocouple/mV Input Module User Manual	1769-UM004
Detailed information on installing, configuring, and using 1769-IR6 RTD/Resistance Input Modules	Compact I/O 1769-IR6 RTD/Resistance Input Module User Manual	1769-UM005
Detailed information on installing, configuring, and using 1769-HSC High Speed Counter Modules	Compact 1769-HSC High Speed Counter Module User Manual	1769-UM006
A description on how to install and connect an AIC+. This manual also contains information on network wiring.	Advanced Interface Converter (AIC+) User Manual	1761-6.4
Information on how to install, configure, and commission a DNI	DeviceNet™ Interface User Manual	1761-6.5
Information on installing, connecting, and configuring an ENI	Ethernet Interface User Manual	1761-UM001
Information on installing, configuring, and using a DeviceNet Scanner	Compact™ I/O 1769-SDN DeviceNet Scanner User Manual	1761-UM009
Information on DF1 open protocol.	DF1 Protocol and Command Set Reference Manual	1770-6.5.16
In-depth information on grounding and wiring Allen-Bradley programmable controllers	Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1
A description of important differences between solid-state programmable controller products and hard-wired electromechanical devices	Application Considerations for Solid-State Controls	SGI-1.1
An article on wire sizes and types for grounding electrical equipment	National Electrical Code - Published by the National Fire Protection Association of Boston, MA.	
A complete listing of current documentation, including ordering instructions. Also indicates whether the documents are available on CD-ROM or in multi-languages.	Allen-Bradley Publication Index	SD499
A glossary of industrial automation terms and abbreviations	Allen-Bradley Industrial Automation Glossary	AG-7.1

Common Techniques Used in this Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.

Rockwell Automation Support

Rockwell Automation offers support services worldwide, with over 75 Sales/Support Offices, 512 authorized Distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Rockwell Automation representatives in every major country in the world.

Local Product Support

Contact your local Rockwell Automation representative for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

Before you contact Rockwell Automation for technical assistance, we suggest you please review the troubleshooting information contained in this publication first.

If the problem persists, call your local Rockwell Automation representative or contact Rockwell Automation in one of the following ways:

Phone	United States/Canada	1.440.646.5800
	Outside United States/Canada	You can access the phone number for your country via the Internet: 1. Go to http://www.ab.com 2. Click on *Product Support* (http://support.automation.rockwell.com) 3. Under *Support Centers*, click on *Contact Information*
Internet	⇒	1. Go to http://www.ab.com 2. Click on *Product Support* (http://support.automation.rockwell.com)

Your Questions or Comments on this Manual

If you find a problem with this manual, or you have any suggestions for how this manual could be made more useful to you, please contact us at the address below:

Rockwell Automation
Automation Control and Information Group
Technical Communication, Dept. A602V
P.O. Box 2086
Milwaukee, WI 53201-2086

or visit our internet page at:

http://www.rockwellautomation.com

For the latest information on MicroLogix controllers, visit www.ab.com/micrologix

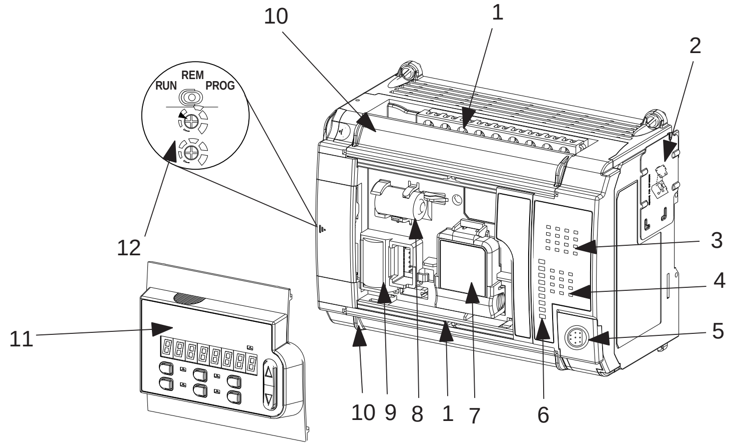
Chapter **1**

Hardware Overview

Hardware Features

The MicroLogix 1500 programmable controller is composed of a base unit, which contains a power supply, input and output circuits, and a processor. The controller is available with 24 or 28 points of embedded I/O. Additional I/O may be added using Compact™ I/O.

The hardware features of the controller are:



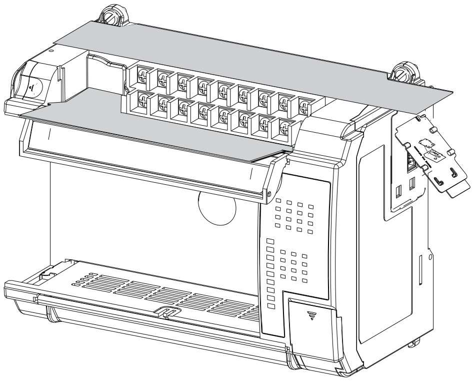
Feature	Description	Feature	Description
1	Removable Terminal Blocks	7	Memory Module/Real-Time Clock(1)
2	Interface to Expansion I/O, Removable ESD Barrier	8	Replacement Battery(1)
3	Input LEDs	9	Battery
4	Output LEDs	10	Terminal Doors and Label
5	Communication Port	11	Data Access Tool(1)
6	Status LEDs	12	Mode Switch, Trim Pots

(1) Optional.

MicroLogix 1500 Component Descriptions

A controller is composed of a processor (1764-LSP or enhanced 1764-LRP with RS-232 port) and one of the base units listed below. The FET transistor outputs are available on the 1764-28BXB base only.

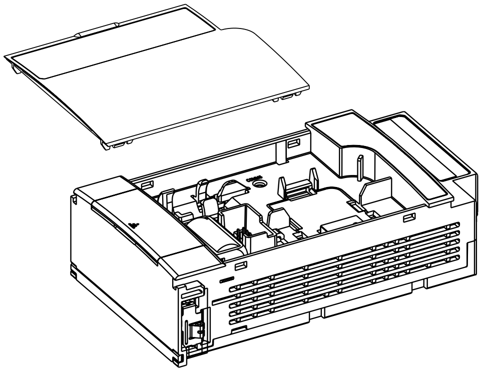
Base Units



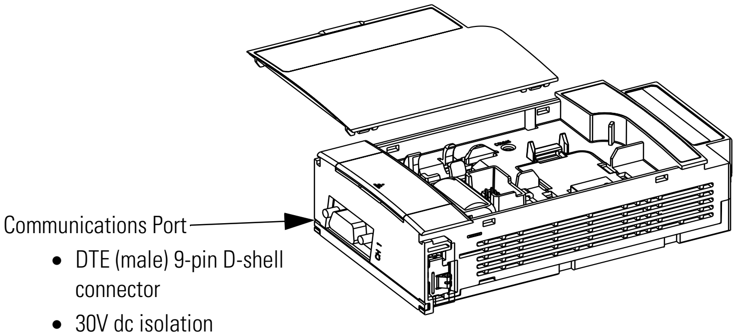
Catalog Number	Line Power	Inputs	Outputs	High Speed I/O
1764-24AWA	120/240V ac	(12) 120V ac	(12) Relay, 2 isolated relays per unit	n/a
1764-24BWA	120/240V ac	(8) Standard 24V dc (4) Fast 24V dc	(12) Relay, 2 isolated relays per unit	(4) 20 kHz input
1764-28BXB	24V dc	(8) Standard 24V dc (8) Fast 24V dc	(6) Relay, 2 isolated relays per unit (4) Standard 24V dc FET (2) Fast 24V dc FET	(8) 20 kHz input (2) 20 kHz output

Processors

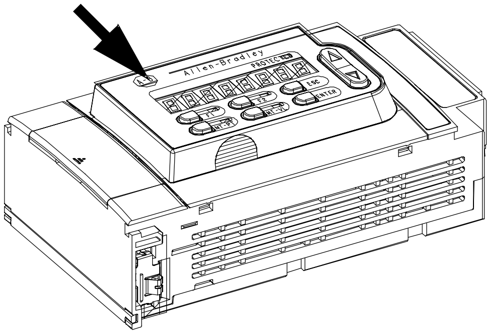
Processor (Catalog Number 1764-LSP)



Processor (Catalog Number 1764-LRP)

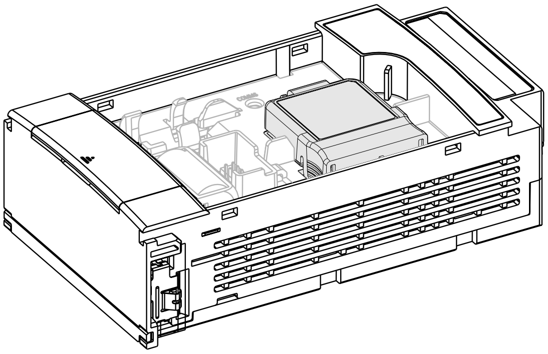


Data Access Tool (Catalog Number 1764-DAT)



1764-DAT mounted on 1764-LSP processor.

Memory Modules/Real-Time Clock


Memory module mounted on 1764-LSP processor.

The following memory modules and real-time clock modules are available:

Catalog Number	Function	Memory Size
1764-RTC	Real-Time Clock	not applicable
1764-MM1	Memory Module	8K
1764-MM1RTC	Memory Module and Real-Time Clock	8K
1764-MM2(1)	Memory Module	16K
1764-MM2RTC(1)	Memory Module and Real-Time Clock	16K

(1) For 1764-LRP programs greater than 8k, use the 1764-MM2 or 1764-MM2RTC.

Cables

Use only the following communication cables in Class I, Division 2 hazardous locations.

Table 1.1 Cables for Use in Class I, Division 2 Hazardous Environment

1761-CBL-PM02 Series C or later	2707-NC8 Series B or later
1761-CBL-HM02 Series C or later	2707-NC9 Series B or later
1761-CBL-AM00 Series C or later	2707-NC10 Series B or later
1761-CBL-AP00 Series C or later	2707-NC11 Series B or later

Programming

Programming the MicroLogix 1500 programmable controller is done using RSLogix™ 500, Rev. 4.0 or later. Certain features are only available when using the most current version of the software, as noted in System Requirements for Using Expansion Modules on page 1-7.

The following table lists the firmware release numbers, feature and functionality enhancements, and the required version of RSLogix 500 and RSLogix 500 Starter software.

Table 1.B Required Software Version by FRN Number

Controller	Firmware Release	Available for Sale Date	Catalog Number Series	Catalog Number Revision	OS FRN Number	Feature and Functionality Changes	Required Version of RSLogix 500/RSLogix 500 Starter Software
1764-LSP	Initial Release	February 1999	A	B	2	Initial Release	3.01.00
	Enhancement	October 1999	A	C	3	Power Supply and Expansion Cable Compatibility	3.01.00
	Series B Release	March 2000	B	A	4	String Data File Type, ASCII Instruction Set, Modbus RTU Slave Protocol, Ramping (when using PWM outputs), Static Data File Protection, RTC Messaging	4.00.00
	Enhancement	October 2000	B	B	5	PTO Controlled Stop, Memory Module Program Compare Bit Enhancement	4.50.00
	Series C Release	September 2001	C	A	6	Floating Point Data File Support, Programmable Limit Switch (PLS), Real Time Clock Adjust (Copy Word), Absolute Value, Gray Code, Recipe, Message Instruction Support for 1769-SDN	5.10.00
1764-LRP	Initial Release	March 2000	B	A	4	Initial Release - Same Functionality as 1764-LSP	4.00.00
	Enhancement	October 2000	B	B	5	PTO Controlled Stop, Memory Module Program Compare Bit Enhancement	4.50.00
	Series C Release	September 2001	C	A	6	Floating Point Data File Support, Programmable Limit Switch (PLS), Real Time Clock Adjust (Copy Word), Absolute Value, Gray Code, Recipe, Message Instruction Support for 1769-SDN	5.10.00

Communication Options

The MicroLogix 1500 can be connected to a personal computer. It can also be connected to the DH-485 network using an Advanced Interface Converter (1761-NET-AIC), to an Ethernet network using an Ethernet Interface (1761-NET-ENI), or to a DeviceNet™ network using a DeviceNet Interface (1761-NET-DNI) or through the DeviceNet Scanner module (1769-SDN). The controller can also be connected to Modbus™ SCADA networks as an RTU slave. See Communication Connections on page 4-1 for more information on connecting to the available communication options.

The 1764-LRP processor provides an additional communication port. Each of the communications ports can be independently configured for any supported communication protocol. (Channel 0 is on the base unit and Channel 1 is on the 1764-LRP processor.)

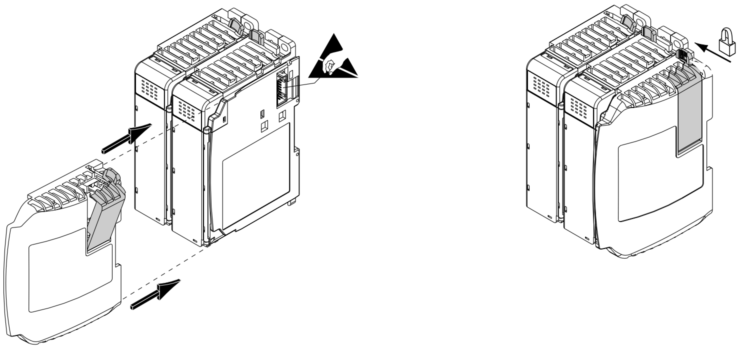
Compact™ Expansion I/O

Compact expansion I/O (Bulletin 1769) can be connected to the MicroLogix 1500 Controller. A maximum of either 8 or 16 expansion I/O modules can be used, depending upon your system. See System Requirements for Using Expansion Modules on page 1-7.

See System Loading and Heat Dissipation on page F-1 for more information on system configurations.

End Cap

An end cap terminator (catalog number 1769-ECR or 1769-ECL) must be used at the end of the group of I/O modules attached to the MicroLogix 1500 Controller. The end cap terminator is not provided with the base or processor units. It is required when using expansion I/O.



This illustration shows the right end cap (1769-ECR). The left end cap (1769-ECL) is shown on page 1-10.

Expansion Power Supply and Cables

With Operating System Revision Number (FRN) 3 or higher, you can connect an additional bank of I/O to your controller. Using an expansion power supply increases the system's capacity for adding expansion I/O modules. The additional I/O bank is connected to the controller via a specially designed cable. The additional I/O bank must include a power supply and an end cap.

TIP

Depending on the system configuration, each controller can support up to 16 expansion I/O modules. See the System Requirements for Using Expansion Modules below. Also see System Guidelines on page 1-9 for system limitations and illustrations of expansion I/O banks.

System Requirements for Using Expansion Modules

To support a maximum of 8 I/O modules in an additional I/O bank, you must have the following:

Table 1.3 Requirements to Support a Maximum of 8 I/O Modules

Product	Catalog Number	
MicroLogix 1500 Processor	1764-LSP, Series A, Revision C or higher 1764-LSP, Series B or higher 1764-LRP, Series B or higher	
MicroLogix 1500 Base Unit	1764-24AWA, Series A or higher 1764-24BWA, Series A or higher 1764-28BXB, Series A or higher	
Operating System Version	Firmware Revision Number (FRN) 3 or higher(1)	
Programming Software	1764-LSP, Series A	RSLogix 500, Version 3.01.09 or higher,
	1764-LSP, Series B 1764-LRP, Series B	RSLogix 500, Version 4.00.00 or higher.
	1764-LSP, Series C 1764-LRP, Series C	RSLogix 500, Version 5.00.00 or higher.
1 Power Supply (optional)	1769-PA2, 1769-PA4 1769-PB2, 1769-PB4	
1 Cable (optional)	1769-CRL1, 1769-CRL3, 1769-CRR1, 1769-CRR3	
1 End Cap (required)	1769-ECL, 1769-ECR	

(1) You can check the FRN by looking at word S:59 (Operating System FRN) in the Status File.

To support a maximum of 16 I/O modules in an additional I/O bank, you must have the following:

Table 1.4 Requirements to Support a Maximum of 16 I/O Modules

Product	Catalog Number
MicroLogix 1500 Processor	1764-LSP, Series C or higher 1764-LRP, Series C or higher
MicroLogix 1500 Base Unit	1764-24AWA, Series B or higher 1764-24BWA, Series B or higher 1764-28BXB, Series B or higher
Operating System Version	Firmware Revision Number (FRN) 6 or higher(1)
Programming Software	RSLogix 500, Version 5.10.00 or higher.
1 Power Supply (optional)	1769-PA2, 1769-PA4, 1769-PB2, 1769-PB4
1 Cable (optional)	1769-CRL1, 1769-CRL3, 1769-CRR1, 1769-CRR3
1 End Cap (required)	1769-ECL, 1769-ECR

(1) You can check the FRN by looking at word S:59 (Operating System FRN) in the Status File.

IMPORTANT

If your processor is at an older revision, you *must* upgrade the operating system to FRN 3 or higher to use an expansion cable and power supply (or to FRN 6 or higher to allow up to 16 expansion modules). On the Internet, go to **http://www.ab.com/micrologix** to download the operating system upgrade. Navigate to MicroLogix 1500 for further instructions and downloads.

MicroLogix 1500 base units are ***not*** field upgradeable from Series A to Series B.

Adding an I/O Bank

System Guidelines

A maximum of one 1769 Expansion Cable can be used in a MicroLogix 1500 system, allowing for two banks of I/O modules (one connected directly to the controller, and the other connected via the cable). Each I/O bank requires its own power supply (Bank 1 uses the controller's embedded power supply).

ATTENTION

LIMIT OF ONE EXPANSION POWER SUPPLY

The expansion power supply cannot be connected directly to the controller. It must be connected using an expansion cable. Only one power supply (embedded in the base unit or an expansion power supply) may be used on an I/O bank. Exceeding these limitations may damage the power supply and result in unexpected operation.

ATTENTION

REMOVE POWER

Remove system power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine operation
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector.

Refer to your power supply and I/O module's documentation for instructions on how to set up your system.

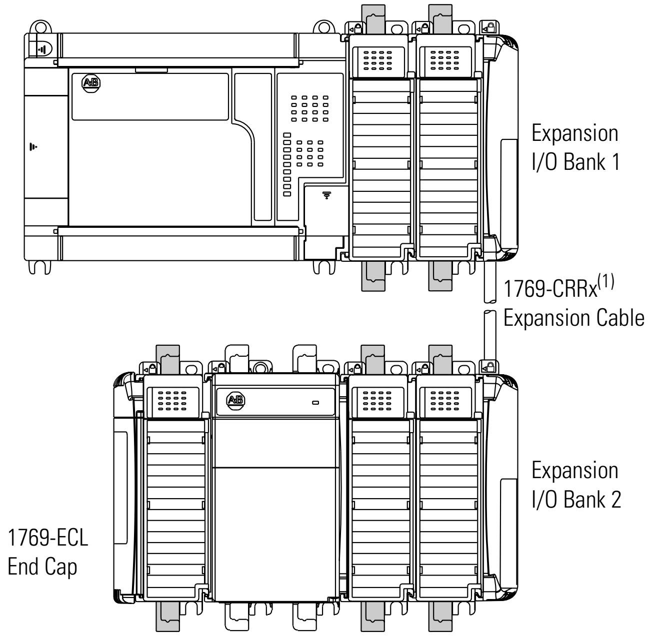
IMPORTANT

See the System Requirements for Using Expansion Modules on page 1-7 to determine the maximum number of expansion I/O modules you can use in your MicroLogix system.

Also see System Loading and Heat Dissipation on page F-1 for more information on system configurations.

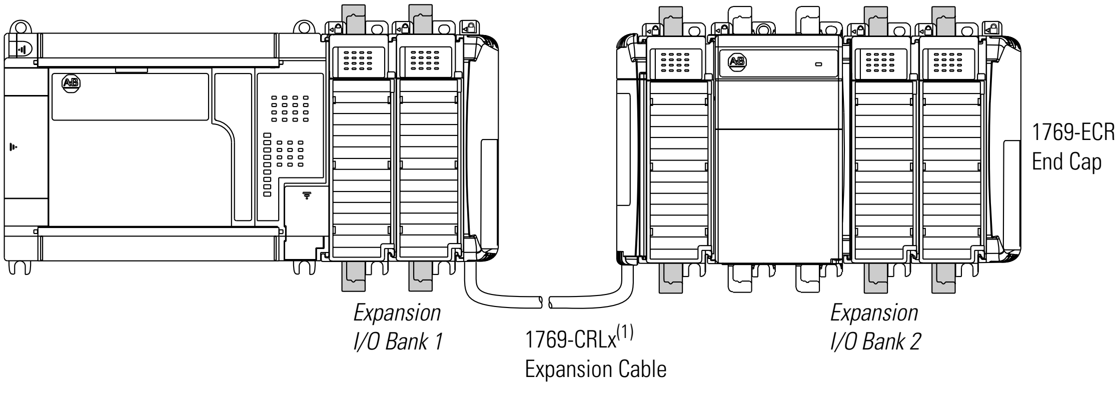
The following illustrations show a MicroLogix 1500 with an expansion I/O bank.

Vertical Orientation



(1) The x in this catalog number can be either a 1 or a 3 representing the length of the cable: 1 = 1 foot (305 mm) and 3 = 3.28 feet (1 meter).

Horizontal Orientation

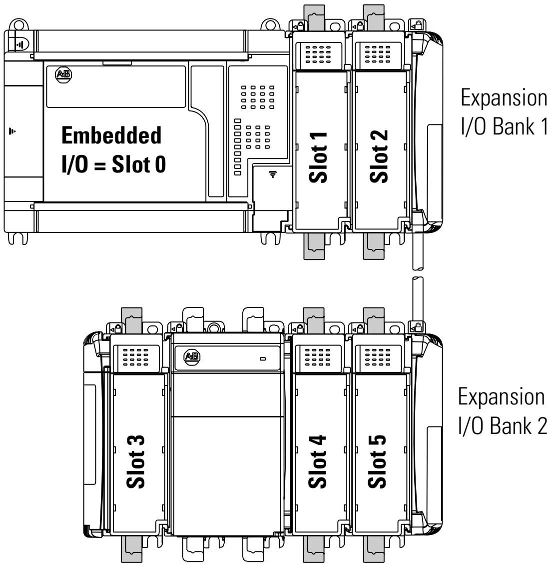


(1) The x in this catalog number can be either a 1 or a 3 representing the length of the cable: 1 = 1 foot (305 mm) and 3 = 3.28 feet (1 meter).

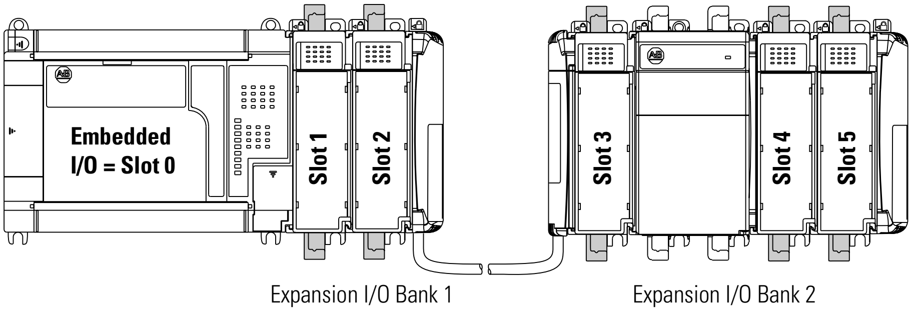
Addressing Expansion I/O

The expansion I/O is addressed as slots 1 through 16 (the controller's embedded I/O is addressed as slot 0). Power supplies and cables are not counted as slots. Modules are counted from left to right on each bank as shown in the illustrations below. For more information on addressing, refer to the *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001.

Vertical Orientation



Horizontal Orientation



Expansion I/O Power Failure

Expansion I/O errors represent failures of the I/O bus or the modules themselves. The error codes are listed in the *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001.

Installing Your Controller

This chapter shows you how to install your controller system. The only tools you require are a Flat or Phillips head screwdriver and drill. Topics include:

- agency certifications
- compliance to European Union Directives
- using in hazardous locations
- master control relay
- power considerations
- preventing excessive heat
- controller spacing
- mounting the controller

Agency Certifications

- UL 508
- C-UL under CSA C22.2 no. 142
- Class I, Division 2, Groups A, B, C, D
  (UL 1604, C-UL under CSA C22.2 no. 213)
- CE compliant for all applicable directives

Compliance to European Union Directives

This product has the CE mark and is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2
  EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2
  EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- *Industrial Automation Wiring and Grounding Guidelines for Noise Immunity*, publication 1770-4.1
- *Guidelines for Handling Lithium Batteries*, publication AG-5.4
- *Automation Systems Catalog*, publication B111

Installation Considerations

Most applications require installation in an industrial enclosure (Pollution Degree 2(1)) to reduce the effects of electrical interference (Over Voltage Category II(2)) and environmental exposure. Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the *Industrial Automation Wiring and Grounding Guidelines* publication 1770-4.1.

ATTENTION

Vertical mounting of the controller is not recommended due to heat build-up considerations.

ATTENTION

Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the base or processor unit could cause damage. Do not drill holes above a mounted controller if the protective debris strips are removed or the processor is installed.

---

(1) Pollution Degree 2 is an environment where normally only non-conductive pollution occurs except that occasionally temporary conductivity caused by condensation shall be expected.

(2) Overvoltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the products insulation.

Safety Considerations

Safety considerations are an important element of proper system installation. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance. We recommend reviewing the following safety considerations.

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off.
- Do not connect or disconnect components unless power has been switched off, or the area is known to be non-hazardous.
- This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.
- All wiring must comply with N.E.C. article 501-4(b).

WARNING

When installing any peripheral device (for example, push buttons, lamps) into a hazardous environment, ensure that they are Class I, Division 2 certified, or determined to be safe for the environment.

Use only the following communication cables in Class I, Division 2 hazardous locations.

Table 2.1 Cables for Use in Class I, Division 2 Hazardous Environment

1761-CBL-PM02 Series C or later	2707-NC8 Series B or later
1761-CBL-HM02 Series C or later	2707-NC9 Series B or later
1761-CBL-AM00 Series C or later	2707-NC10 Series B or later
1761-CBL-AP00 Series C or later	2707-NC11 Series B or later

Disconnecting Main Power

WARNING

EXPLOSION HAZARD

Do not replace components or disconnect equipment unless power has been switched off.

The main power disconnect switch should be located where operators and maintenance personnel have quick and easy access to it. In addition to disconnecting electrical power, all other sources of power (pneumatic and hydraulic) should be de-energized before working on a machine or process controlled by a controller.

Safety Circuits

WARNING

EXPLOSION HAZARD

Do not connect or disconnect connectors while circuit is live.

Circuits installed on the machine for safety reasons, like overtravel limit switches, stop push buttons, and interlocks, should always be hard-wired directly to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Power Distribution

There are some points about power distribution that you should know:

- The master control relay must be able to inhibit all machine motion by removing power to the machine I/O devices when the relay is de-energized. It is recommended that the controller remain powered even when the master control relay is de-energized.
- If you are using a dc power supply, interrupt the load side rather than the ac line power. This avoids the additional delay of power supply turn-off. The dc power supply should be powered directly from the fused secondary of the transformer. Power to the dc input and output circuits should be connected through a set of master control relay contacts.

Periodic Tests of Master Control Relay Circuit

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to assure they will stop machine motion when needed.

Power Considerations

The following explains power considerations for the micro controllers.

Isolation Transformers

You may want to use an isolation transformer in the ac line to the controller. This type of transformer provides isolation from your power distribution system to reduce the electrical noise that enters the controller and is often used as a step-down transformer to reduce line voltage. Any transformer used with the controller must have a sufficient power rating for its load. The power rating is expressed in volt-amperes (VA).

Power Supply Inrush

During power-up, the MicroLogix 1500 power supply allows a brief inrush current to charge internal capacitors. Many power lines and control transformers can supply inrush current for a brief time. If the power source cannot supply this inrush current, the source voltage may sag momentarily.

The only effect of limited inrush current and voltage sag on the MicroLogix 1500 is that the power supply capacitors charge more slowly. However, the effect of a voltage sag on other equipment should be considered. For example, a deep voltage sag may reset a computer connected to the same power source. The following considerations determine whether the power source must be required to supply high inrush current:

- The power-up sequence of devices in a system.
- The amount of the power source voltage sag if the inrush current cannot be supplied.
- The effect of voltage sag on other equipment in the system.

If the entire system is powered-up at the same time, a brief sag in the power source voltage typically will not affect any equipment.

Loss of Power Source

The power supply is designed to withstand brief power losses without affecting the operation of the system. The time the system is operational during power loss is called “program scan hold-up time after loss of power.” The duration of the power supply hold-up time depends on the type and state of the I/O, but is typically between 10 milliseconds and 3 seconds. When the duration of power loss reaches this limit, the power supply signals the processor that it can no longer provide adequate dc power to the system. This is referred to as a power supply shutdown. The processor then performs an orderly shutdown of the controller.

Input States on Power Down

The power supply hold-up time as described above is generally longer than the turn-on and turn-off times of the inputs. Because of this, the input state change from “On” to “Off” that occurs when power is removed may be recorded by the processor before the power supply shuts down the system. Understanding this concept is important. Write the user program, taking this effect into account.

Other Types of Line Conditions

Occasionally the power source to the system can be temporarily interrupted. It is also possible that the voltage level may drop substantially below the normal line voltage range for a period of time. Both of these conditions are considered to be a loss of power for the system.

Preventing Excessive Heat

For most applications, normal convective cooling keeps the controller within the specified operating range. Ensure that the specified temperature range is maintained. Proper spacing of components within an enclosure is usually sufficient for heat dissipation.

In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce “hot spots” near the controller.

Additional cooling provisions might be necessary when high ambient temperatures are encountered.

TIP

Do not bring in unfiltered outside air. Place the controller in an enclosure to protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to protect against heat build-up within the enclosure.

Master Control Relay

A hard-wired master control relay (MCR) provides a reliable means for emergency machine shutdown. Since the master control relay allows the placement of several emergency-stop switches in different locations, its installation is important from a safety standpoint. Overtravel limit switches or mushroom-head push buttons are wired in series so that when any of them opens, the master control relay is de-energized. This removes power to input and output device circuits. Refer to the figures on pages 2-10 and 2-11.

ATTENTION

Never alter these circuits to defeat their function since serious injury and/or machine damage could result.

TIP

If you are using an external dc power supply, interrupt the dc output side rather than the ac line side of the supply to avoid the additional delay of power supply turn-off.

The ac line of the dc output power supply should be fused.

Connect a set of master control relays in series with the dc power supplying the input and output circuits.

Place the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. If you mount a disconnect switch inside the controller enclosure, place the switch operating handle on the outside of the enclosure, so that you can disconnect power without opening the enclosure.

Whenever any of the emergency-stop switches are opened, power to input and output devices should be removed.

When you use the master control relay to remove power from the external I/O circuits, power continues to be provided to the controller’s power supply so that diagnostic indicators on the processor can still be observed.

The master control relay is not a substitute for a disconnect to the controller. It is intended for any situation where the operator must quickly de-energize I/O devices only. When inspecting or installing terminal connections, replacing output fuses, or working on equipment within the enclosure, use the disconnect to shut off power to the rest of the system.

TIP Do not control the master control relay with the controller. Provide the operator with the safety of a direct connection between an emergency-stop switch and the master control relay.

Using Emergency-Stop Switches

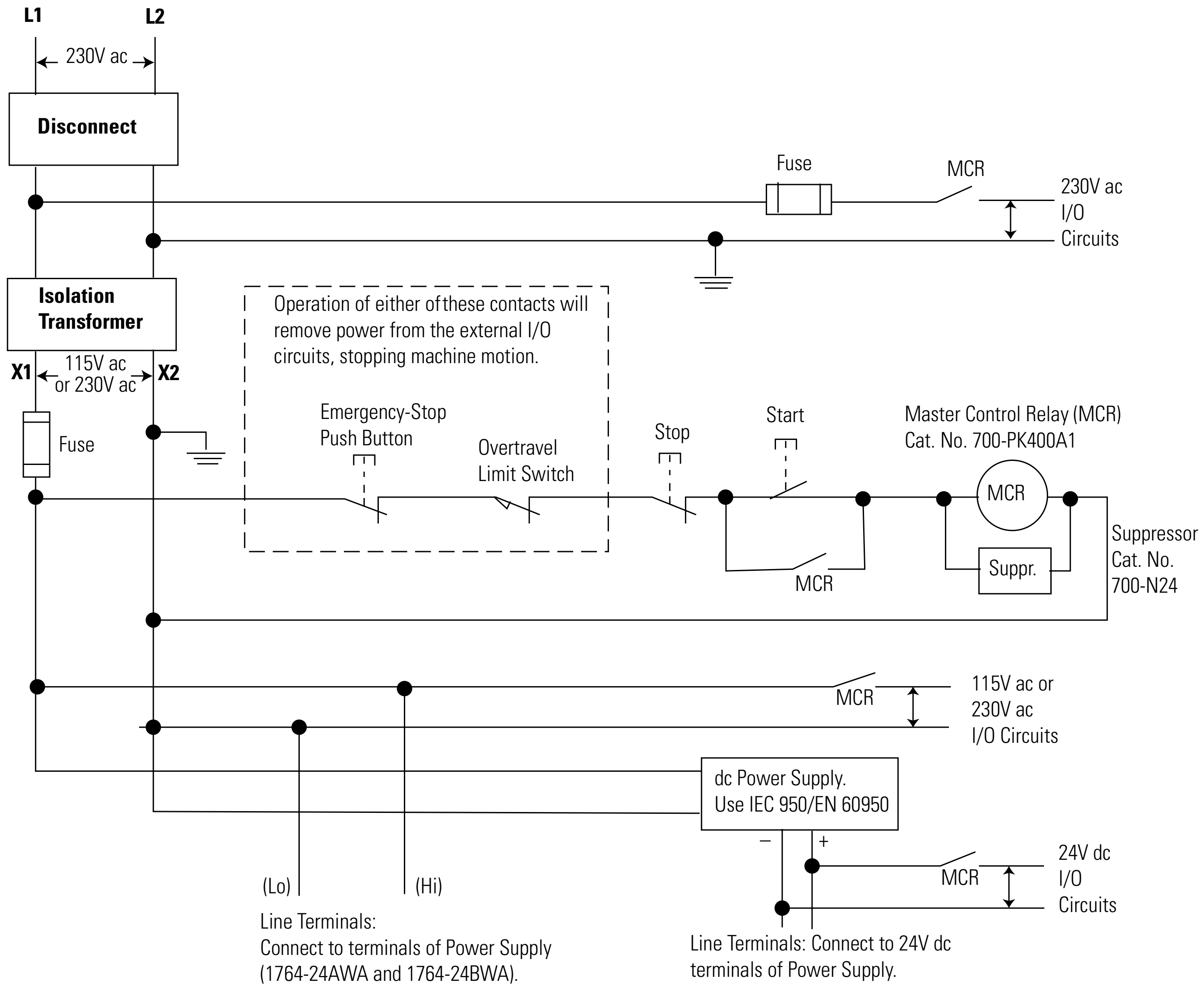
When using emergency-stop switches, adhere to the following points:

- Do not program emergency-stop switches in the controller program. Any emergency-stop switch should turn off all machine power by turning off the master control relay.
- Observe all applicable local codes concerning the placement and labeling of emergency-stop switches.
- Install emergency-stop switches and the master control relay in your system. Make certain that relay contacts have a sufficient rating for your application. Emergency-stop switches must be easy to reach.
- In the following illustration, input and output circuits are shown with MCR protection. However, in most applications, only output circuits require MCR protection.

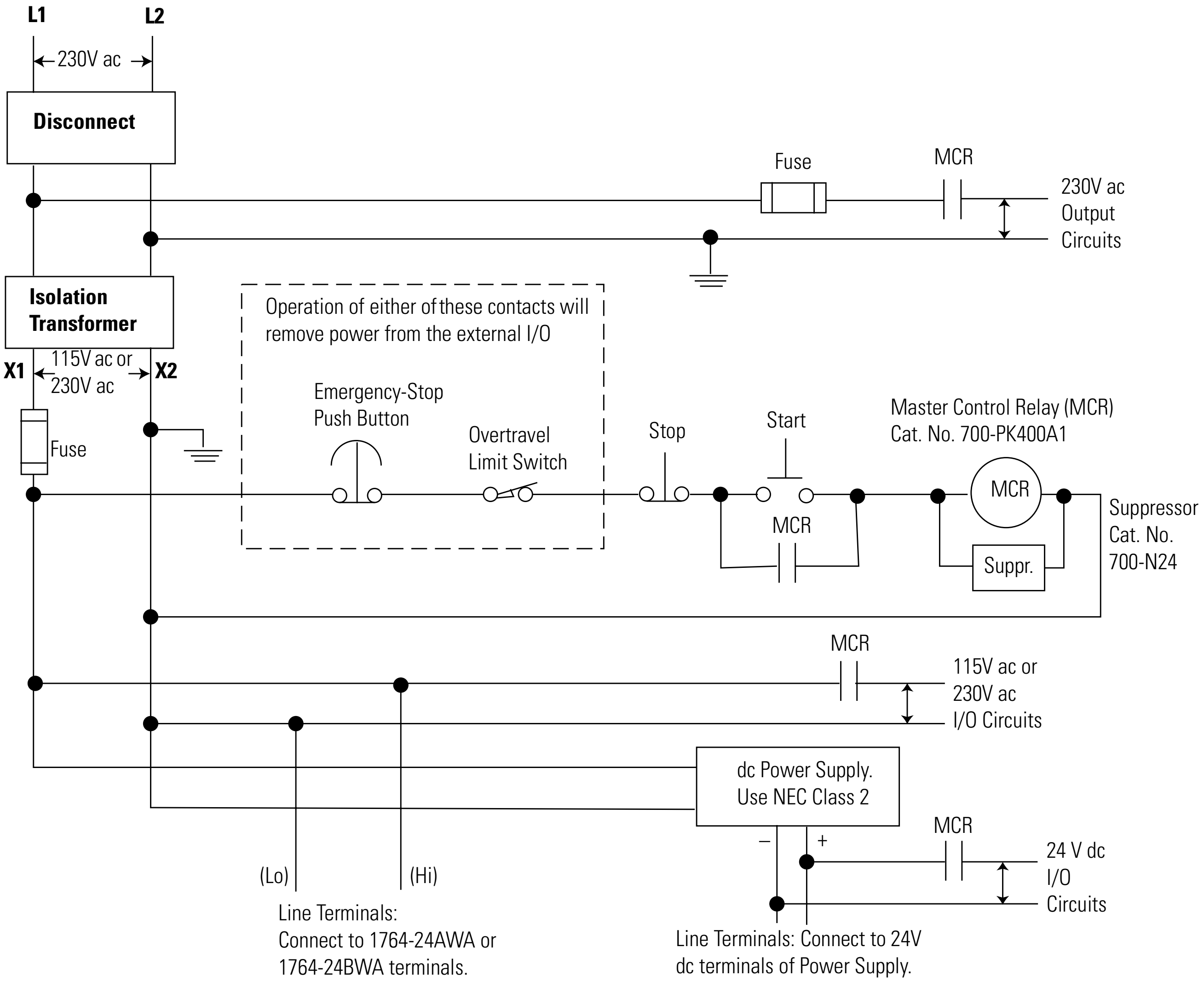
The following illustrations show the Master Control Relay wired in a grounded system.

TIP In most applications input circuits do not require MCR protection; however, if you need to remove power from all field devices, you must include MCR contacts in series with input power wiring.

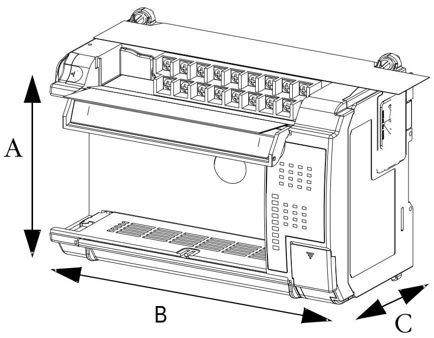
Schematic (Using IEC Symbols)



Schematic (Using ANSI/CSA Symbols)



Base Unit Mounting Dimensions

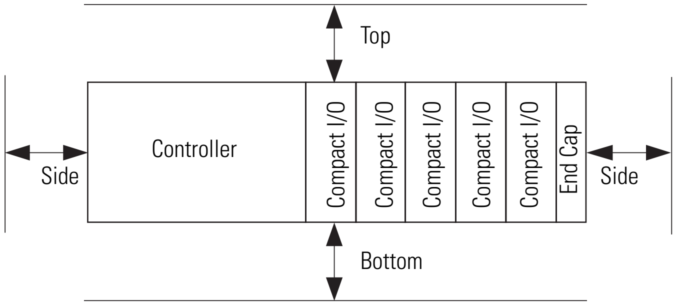


Dimension(1)	**1764-24AWA**	**1764-24BWA**	**1764-28BXB**
Height (A)	DIN latch open: 138 mm (5.43 in.), DIN latch closed: 118 mm (4.65 in.)		
Width (B)	168 mm (6.62 in.)		
Depth (C)	87 mm (3.43 in.)		

(1) See Controller Dimensions on page A-9 for more dimensional information.

Controller Spacing

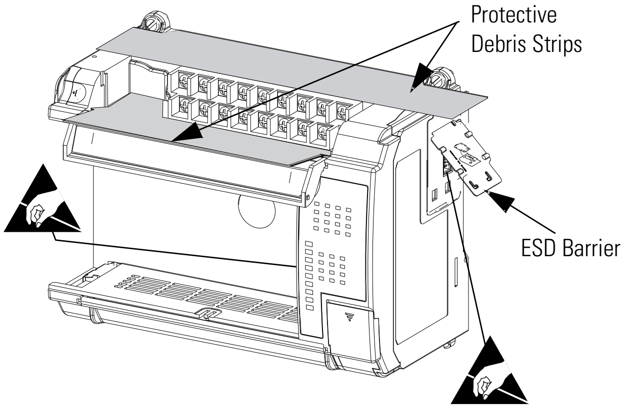
The base unit is designed to be mounted horizontally, with the Compact™ expansion I/O extending to the right of the base unit. Allow 50 mm (2 in.) minimum of space on all sides for adequate ventilation, as shown below.



Mounting the Controller

ATTENTION

Do not remove protective debris strips until after the base and all other equipment in the panel near the base is mounted and wiring is complete. The debris strips are there to prevent drill fragments, wire strands and other dirt from getting into the controller. Once wiring is complete, remove protective debris strips and install processor unit. Failure to remove strips before operating can cause overheating.



ATTENTION

Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the controller could cause damage. Do not drill holes above a mounted controller if the protective debris strips have been removed.

ATTENTION

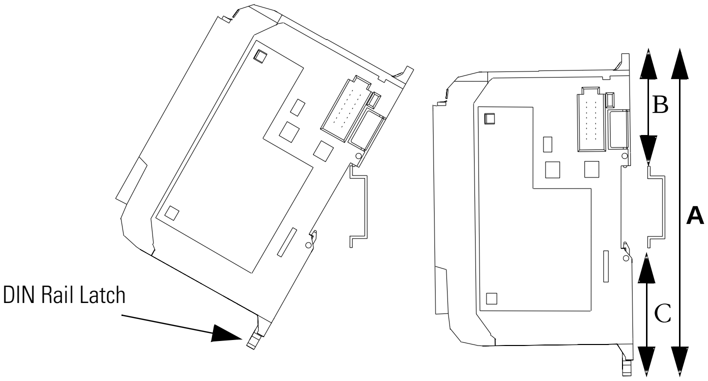
Electrostatic discharge can damage semiconductor devices inside the base unit. Do not touch the connector pins or other sensitive areas.

TIP

If additional I/O modules are required for the application, remove the ESD barrier to install expansion I/O modules. A maximum of 16 I/O modules may be connected to the base. (See page 1-7 for system requirements.) The I/O module's current requirements and power consumption may further limit the number of modules connected to the base. See System Loading and Heat Dissipation on page F-1. An end cap terminator (catalog number 1769-ECR or 1769-ECL) is required at the end of the group of I/O modules attached to the base.

Using a DIN Rail

The base unit and expansion I/O DIN rail latches lock in the open position so that an entire system can be easily attached to or removed from the DIN rail. The maximum extension of the latch is 15 mm (0.67 in.) in the open position. A flat-blade screw driver is required for removal of the base unit. The base can be mounted to EN50022-35x7.5 or EN50022-35x15 DIN rails. DIN rail mounting dimensions are shown below.



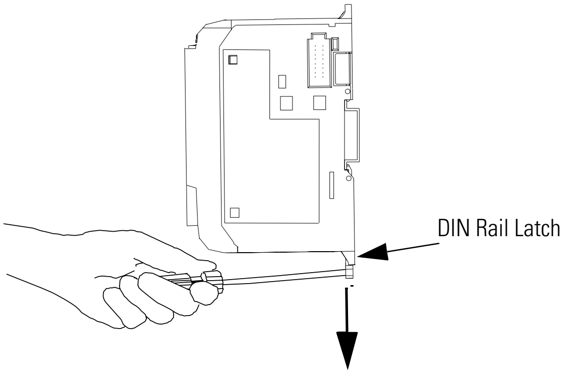
Dimension	Height
A	DIN latch open: 138 mm (5.43 in.), DIN latch closed: 118 mm (4.65 in.)
B	47.6 mm (1.875 in.)
C	47.6 mm (1.875 in) DIN latch closed 54.7 mm (2.16 in.) DIN latch open

To install your base unit on the DIN rail:

1. Mount your DIN rail. (Make sure that the placement of the base unit on the DIN rail meets the recommended spacing requirements, see Controller Spacing on page 2-12. Refer to the mounting template from the inside back cover of the *MicroLogix 1500 Programmable Controller Base Units Installation Instructions*, publication 1764-IN001.
2. Hook the top slot over the DIN rail.
3. While pressing the base unit down against the top of the rail, snap the bottom of the base unit into position. Ensure DIN latches are in the up (secured) position.
4. Leave the protective debris strip attached until you are finished wiring the base unit and any other devices.

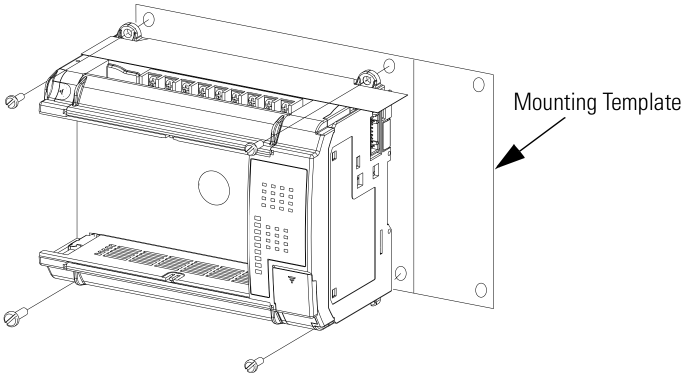
To remove your base unit from the DIN rail:

1. Place a flat-blade screwdriver in the DIN rail latch at the bottom of the base unit.
2. Holding the base unit, pry downward on the latch until the latch locks in the open position. Repeat this procedure with the second latch. This releases the base unit from the DIN rail.



Base Unit Panel Mounting

Mount to panel using #8 or M4 screws.



To install your base unit using mounting screws:

1. Remove the mounting template from the inside back cover of the *MicroLogix 1500 Programmable Controller Base Units Installation Instruction*, publication 1764-IN001.
2. Secure the template to the mounting surface. (Make sure your base unit is spaced properly, see Controller Spacing on page 2-12).
3. Drill holes through the template.
4. Remove the mounting template.
5. Mount the base unit.
6. Leave the protective debris strips attached until you are finished wiring the base unit and any other devices.

Installing Controller Components

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors if you touch bus connector pins. Follow these guidelines when you handle any module:

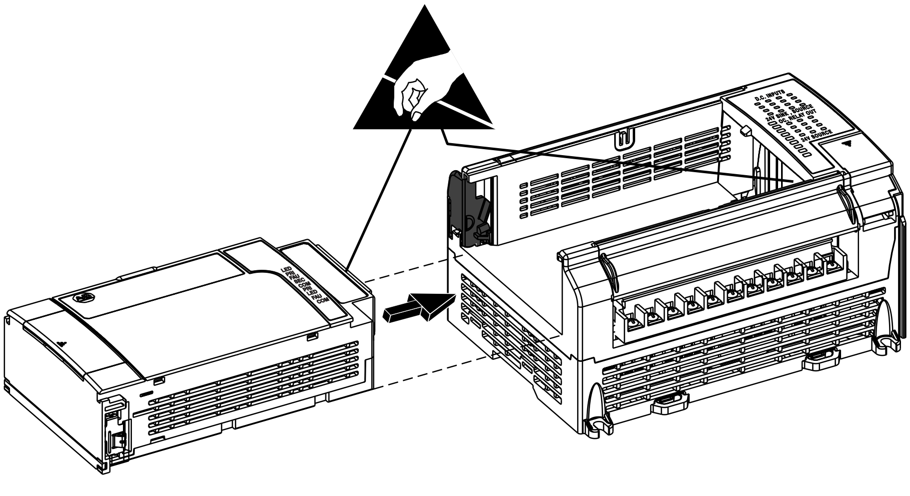
- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.

When not in use, keep the module in its static-shield bag.

ATTENTION

Be sure the base unit is free of all metal fragments before removing protective debris strips and installing the processor unit. Failure to remove strips before operating can cause overheating.

Processor



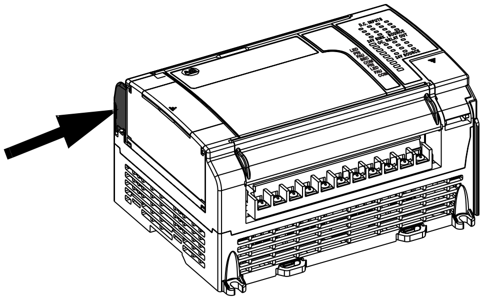
1. Be sure base unit power is off.

2. Slide the processor into the base unit using the guide rails for alignment.

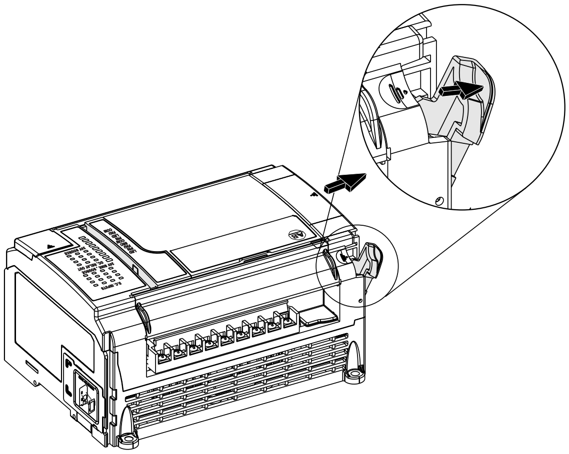
3. Push until a click is heard. Be careful not to push on the connector when installing the 1764-LRP processor.

IMPORTANT	It is critical that the processor is fully engaged and locked into place.

4. Make sure the actuator is pushed closed.

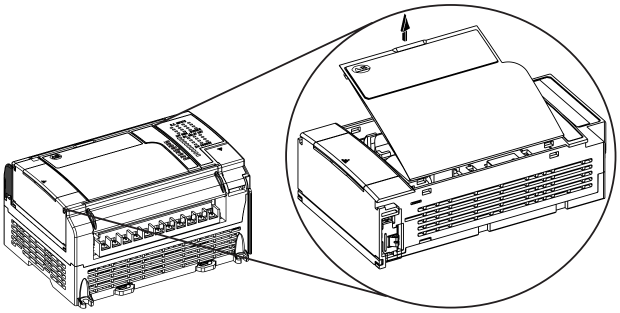


5. To remove the processor from the base unit, make sure base unit power is off. Push the actuator to the open position until the processor is ejected slightly. Once the processor has been ejected, it can be removed from the base unit.

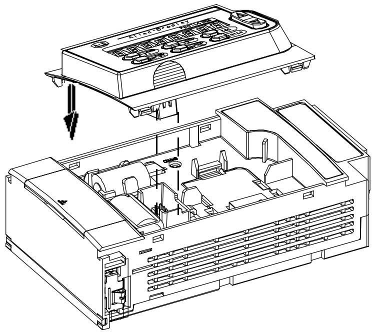


Data Access Tool (DAT)

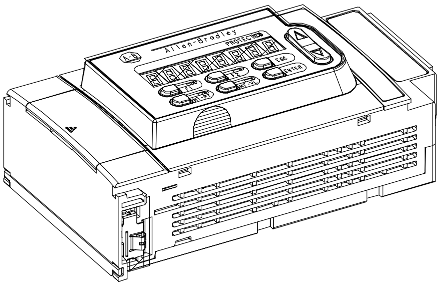
1. Remove cover from processor.



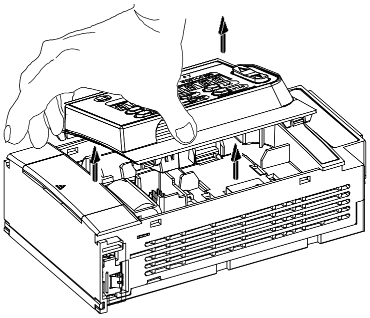
2. Holding the DAT in the proper orientation (as shown), place the DAT onto processor. Align DAT port on the processor with the plug on the DAT.



3. Firmly seat DAT on processor; make sure it seats into place.

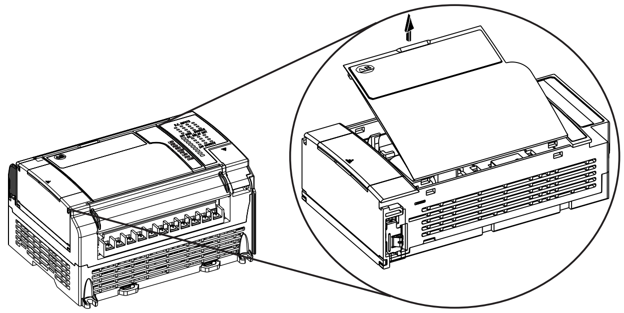


4. To remove DAT, grasp using finger areas and pull upward.



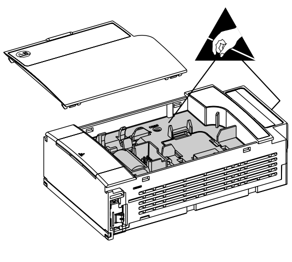
Memory Module/Real-Time Clock

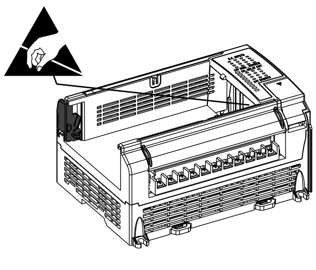
1. Remove the cover (or DAT if installed) from the processor as shown below.



ATTENTION

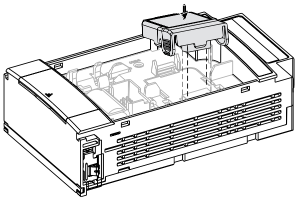
Electrostatic discharge can damage semiconductor devices inside the base and processor units. Do not touch the connector pins or other sensitive areas.



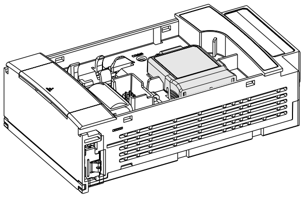


---

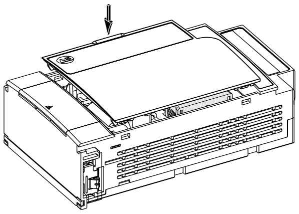
2. Align connector on the memory module with the connector pins on the processor.



3. Firmly seat the memory module in the processor making sure the locking tabs click into place.



4. Replace the cover (or DAT if used).



Compact I/O

Attach and Lock Module (Module-to-Controller or Module-to-Module)

A Compact I/O module can be attached to the controller or an adjacent I/O module before or after mounting to the panel or DIN rail. The module can be detached and replaced while the system is mounted to a panel or DIN rail.

ATTENTION

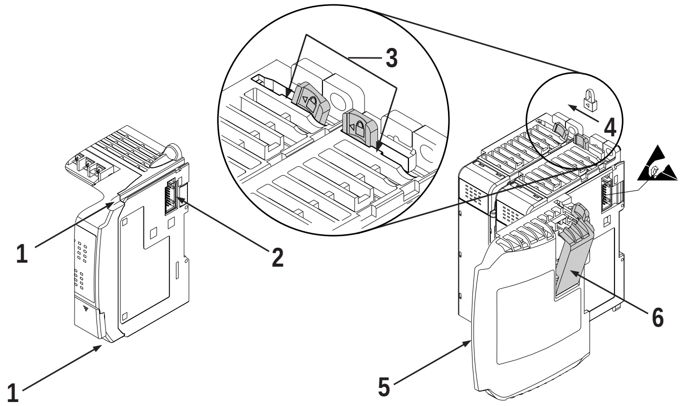
Remove power before removing or inserting an I/O module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing the controller to fault
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance, reducing product reliability.

ATTENTION

When attaching I/O modules, it is very important that they are securely locked together to ensure proper electrical connection.



To attach and lock modules:

TIP

Remove ESD barrier when attaching I/O modules to a MicroLogix 1500 base unit.

1. Disconnect power.
2. Check that the bus lever of the module to be installed is in the unlocked (fully right) position.
3. Use the upper and lower tongue-and-groove slots (1) to secure the modules together (or to a controller).
4. Move the module back along the tongue-and-groove slots until the bus connectors (2) line up with each other.
5. Push the bus lever back slightly to clear the positioning tab (3). Use your fingers or a small screw driver.
6. To allow communication between the controller and module, move the bus lever fully to the left (4) until it clicks. Ensure it is locked firmly in place.

ATTENTION

When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

7. Attach an end cap terminator (5) to the last module in the system by using the tongue-and-groove slots as before.

8. Lock the end cap bus terminator (6).

IMPORTANT A 1769-ECR right end cap (or a 1769-ECL left end cap if I/O bank is located below the controller) must be used to terminate the end of the serial communication bus.

See Controller Dimensions on page A-9 for mounting dimensions.

Chapter 3

Wiring Your Controller

This chapter describes how to wire your controller. Topics include:

- wiring requirements
- using surge suppressors
- grounding guidelines
- sinking and sourcing circuits
- wiring diagrams, input voltage ranges, and output voltage ranges
- minimizing noise

Wiring Requirements

Wire Type		Wire Size[1]	Wiring Torque
Solid	Cu-90°C (194°F)	#14 to #22 AWG	1.13 Nm (10 in-lb) rated 1.3 Nm (12 in-lb) maximum
Stranded	Cu-90°C (194°F)	#14 to #22 AWG	

(1) Two wires maximum per terminal screw.

ATTENTION

Be careful when stripping wires. Wire fragments that fall into the controller could cause damage. Once wiring is complete, be sure the base unit is free of all metal fragments before removing protective debris strips and installing the processor unit. Failure to remove strips before operating can cause overheating.

Wiring Recommendation

ATTENTION

Before you install and wire any device, disconnect power to the controller system.

ATTENTION

Calculate the maximum possible current in each power and common wire. Observe all electrical codes dictating the maximum current allowable for each wire size. Current above the maximum ratings may cause wiring to overheat, which can cause damage.

United States Only: If the controller is installed within a potentially hazardous environment, all wiring must comply with the requirements stated in the National Electrical Code 501-4 (b).

- Allow for at least 50 mm. (2 in.) between I/O wiring ducts or terminal strips and the controller.
- Route incoming power to the controller by a path separate from the device wiring. Where paths must cross, their intersection should be perpendicular.

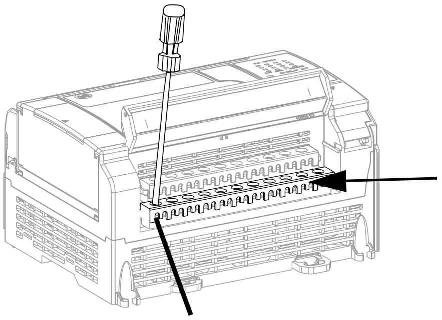
TIP

Do not run signal or communications wiring and power wiring in the same conduit. Wires with different signal characteristics should be routed by separate paths.

- Separate wiring by signal type. Bundle wiring with similar electrical characteristics together.
- Separate input wiring from output wiring.
- Label wiring to all devices in the system. Use tape, shrink-tubing, or other dependable means for labeling purposes. In addition to labeling, use colored insulation to identify wiring based on signal characteristics. For example, you may use blue for dc wiring and red for ac wiring.

Wiring without Spade Lugs

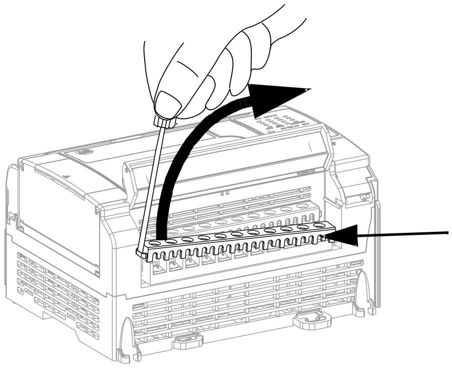
When wiring without spade lugs, it is recommended to keep the finger-safe covers in place. Loosen the terminal screw and route the wires through the opening in the finger-safe cover. Tighten the terminal screw making sure the pressure plate secures the wire.



Wiring with Spade Lugs

The diameter of the terminal screw head is 5.5 mm (0.220 in.). The input and output terminals of the MicroLogix 1500 base unit are designed for a 6.35mm (0.25 in.) wide spade (standard for #6 screw for up to 14 AWG) or a 4 mm (metric #4) fork terminal.

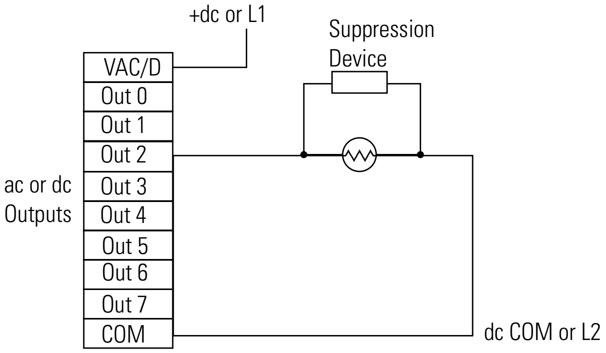
When using spade lugs, use a small, flat-blade screwdriver to pry the finger-safe cover from the terminal blocks as shown below. Then loosen the terminal screw.



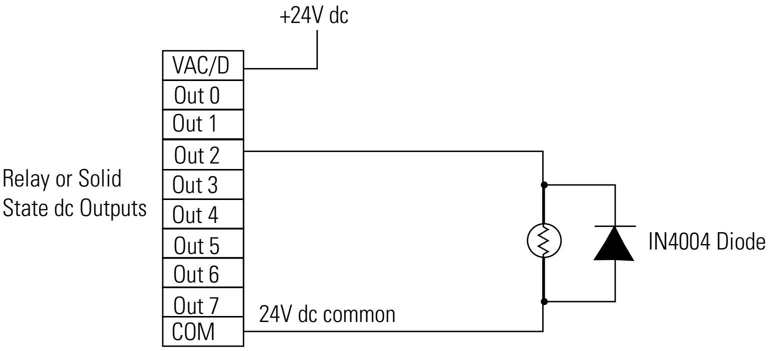
Using Surge Suppressors

Inductive load devices, such as motor starters and solenoids, require the use of some type of surge suppression to protect and extend the operating life of the controller's output contacts. Switching inductive loads without surge suppression can *significantly* reduce the life expectancy of relay contacts. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the output or relay contacts. You also reduce the effects of voltage transients and electrical noise from radiating into adjacent systems.

The following diagram shows an output with a suppression device. We recommend that you locate the suppression device as close as possible to the load device.

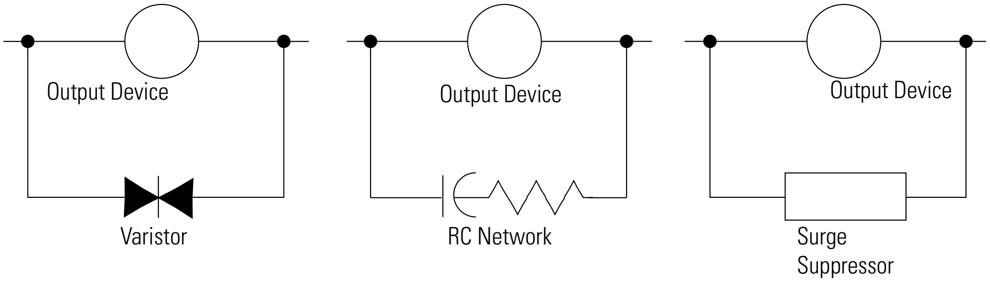


If the outputs are dc, we recommend that you use an 1N4004 diode for surge suppression, as shown below.



Suitable surge suppression methods for inductive ac load devices include a varistor, an RC network, or an Allen-Bradley surge suppressor, all shown below. These components must be appropriately rated to suppress the switching transient characteristic of the particular inductive device. See the table on page 3-6 for recommended suppressors.

Surge Suppression for Inductive ac Load Devices

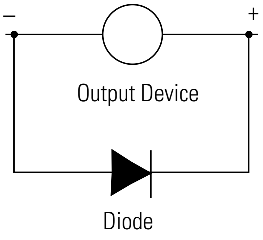


If you connect an expansion I/O triac output to control an inductive load, we recommend that you use varistors to suppress noise. Choose a varistor that is appropriate for the application. The suppressors we recommend for triac outputs when switching 120V ac inductive loads are a Harris MOV, part number V175 LA10A, or an Allen-Bradley MOV, catalog number 599-K04 or 599-KA04. Consult the varistor manufacturer's data sheet when selecting a varistor for your application

For inductive dc load devices, a diode is suitable. A 1N4004 diode is acceptable for most applications. A surge suppressor can also be used. See the table on page 3-6 for recommended suppressors.

As shown in the illustration below, these surge suppression circuits connect directly across the load device.

Surge Suppression for Inductive dc Load Devices



(A surge suppressor can also be used.)

Recommended Surge Suppressors

Use the Allen-Bradley surge suppressors shown in the following table for use with relays, contactors, and starters.

Suppressor Device	Coil Voltage	Catalog Number
Bulletin 509 Motor Starter Bulletin 509 Motor Starter	120V ac 240V ac	599-K04(1) 599-KA04(1)
Bulletin 100 Contactor Bulletin 100 Contactor	120V ac 240V ac	199-FSMA1(2) 199-FSMA2(2)
Bulletin 709 Motor Starter	120V ac	1401-N10
Bulletin 700 Type R, RM Relays	ac coil	None Required
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	12V dc 12V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	24V dc 24V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	48V dc 48V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	115-125V dc 115-125V dc	199-FSMA10
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	230-250V dc 230-250V dc	199-FSMA11
Bulletin 700 Type N, P, or PK Relay	150V max, ac or DC	700-N24(2)
Miscellaneous electromagnetic devices limited to 35 sealed VA	150V max, ac or DC	700-N24(2)

(1) Varistor – Not recommended for use on relay outputs.

(2) RC Type – Do not use with triac outputs.

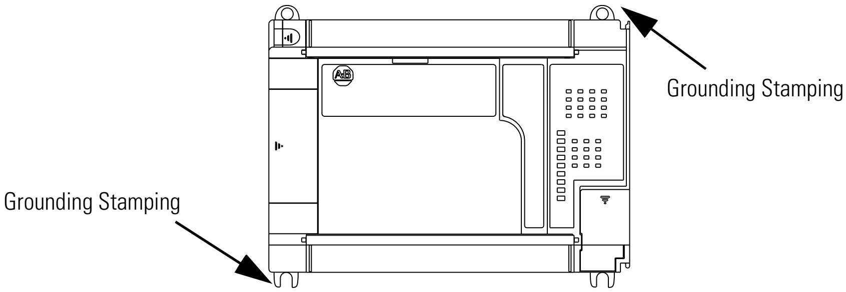
Grounding the Controller

In solid-state control systems, grounding and wire routing helps limit the effects of noise due to electromagnetic interference (EMI). Run the ground connection from the ground screw of the base unit to the electrical panel's ground bus prior to connecting any devices. Use AWG #14 wire. This connection must be made for safety purposes.

This product is intended to be mounted to a well grounded mounting surface such as a metal panel. Refer to the *Industrial Automation Wiring and Grounding Guidelines,* publication 1770-4.1, for additional information. Additional grounding connections from the mounting tabs or DIN rail, if used, are not required unless the mounting surface cannot be grounded. You must also provide an acceptable grounding path for each device in your application.

TIP

It is recommended to use all four mounting positions for panel mounting installation.



TIP

This ⏚ symbol denotes a protective earth ground terminal which provides a low impedance path between electrical circuits and earth for safety purposes and provides noise immunity improvement. This connection must be made for safety purposes

ATTENTION

Remove the protective debris strips before applying power to the controller. Failure to remove the strips may cause the controller to overheat.

Wiring Diagrams

This section shows the wiring diagrams for the MicroLogix 1500 controllers. Controllers with dc inputs can be wired as either sinking or sourcing configuration. (Sinking and sourcing does not apply to ac inputs.) See pages 3-12 through 3-15 for sinking and sourcing wiring diagrams.

TIP

This ⏚ symbol denotes a protective earth ground terminal which provides a low impedance path between electrical circuits and earth for safety purposes and provides noise immunity improvement. This connection must be made for safety purposes.

Miswiring - 1764-28BXB Only

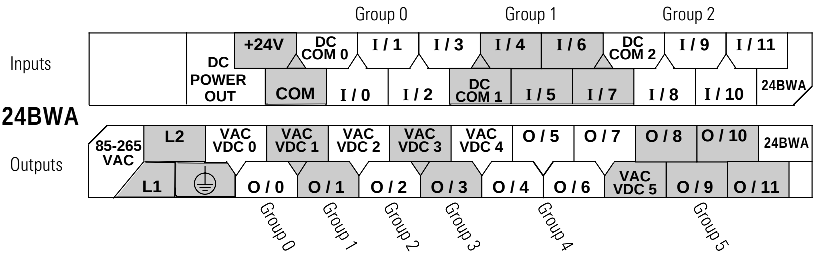
The following table shows miswiring conditions and the consequences of improper wiring:

Condition	Result
Operating with Voltage Less than 20.4V dc	This will not damage the base unit. The base unit may not power up. **IMPORTANT** This is not recommended. You must verify that the line voltage remains within specified limits.
Reverse Wiring of the Line Terminals (0 to 30V dc)	Reverse wiring will not damage the base unit. The base unit will not power up.
Applied Voltage Level Exceeds the Published Recommended Value (i.e. applying 120V ac to 240V ac)	Exceeding the published recommended voltage may result in permanent damage to the base unit.

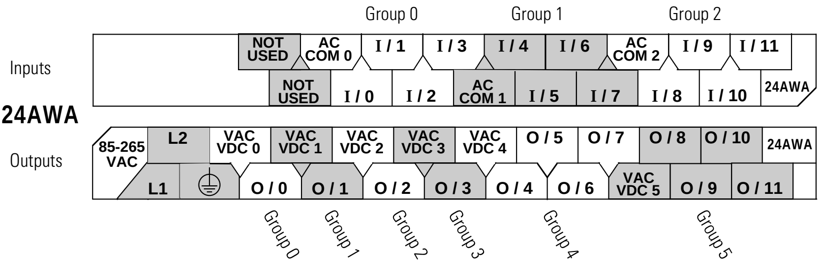
Terminal Block Layouts

The base unit terminal block layouts are shown below. The shading on the labels indicates how the terminals are grouped. A detail of the groupings is shown in the table following the terminal block layouts.

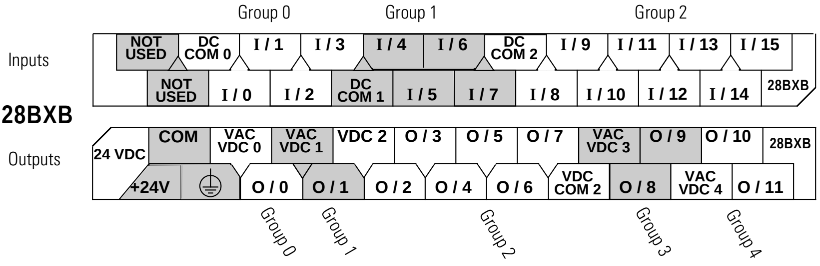
1764-24BWA



1764-24AWA



1764-28BXB



Terminal Groupings

Controller	Inputs		
	Input Group	**Common Terminal**	**Input Terminal**
1764-24BWA	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/7
	Group 2	DC COM 2	I/8 through I/11
1764-24AWA	Group 0	AC COM 0	I/0 through I/3
	Group 1	AC COM 1	I/4 through I/7
	Group 2	AC COM 2	I/8 through I/11
1764-28BXB	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/7
	Group 2	DC COM 2	I/8 through I/15

Controller	Outputs		
	Output Group	**Voltage Terminal**	**Output Terminal**
1764-24BWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2
	Group 3	VAC/VDC 3	O/3
	Group 4	VAC/VDC 4	O/4 through O/7
	Group 5	VAC/VDC 5	O/8 through O/11
1764-24AWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2
	Group 3	VAC/VDC 3	O/3
	Group 4	VAC/VDC 4	O/4 through O/7
	Group 5	VAC/VDC 5	O/8 through O/11
1764-28BXB	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VDC 2, VDC COM 2	O/2 through O/7
	Group 3	VAC/VDC 3	O/8 and O/9
	Group 4	VAC/VDC 4	O/10 and O/11

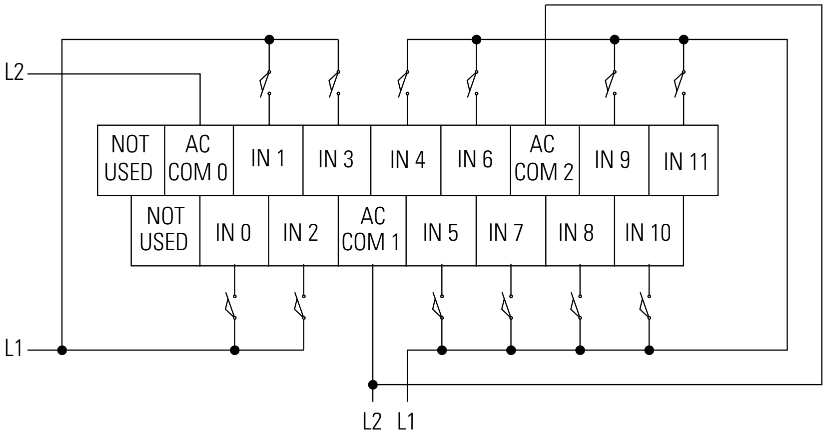
Sinking and Sourcing Input Circuits

Any of the MicroLogix 1500 DC embedded input groups can be configured as sinking or sourcing depending on how the DC COM is wired on the group. See pages 3-12 through 3-15 for sinking and sourcing wiring diagrams.

Type	Definition
Sinking Input *connection of a PNP sourcing device*	The input energizes when high-level voltage is applied to the input terminal (active high). Connect the power supply VDC (-) to the DC COM terminal.
Sourcing Input *connection of an NPN sinking device*	The input energizes when low-level voltage is applied to the input terminal (active low). Connect the power supply VDC (+) to the DC COM terminal.

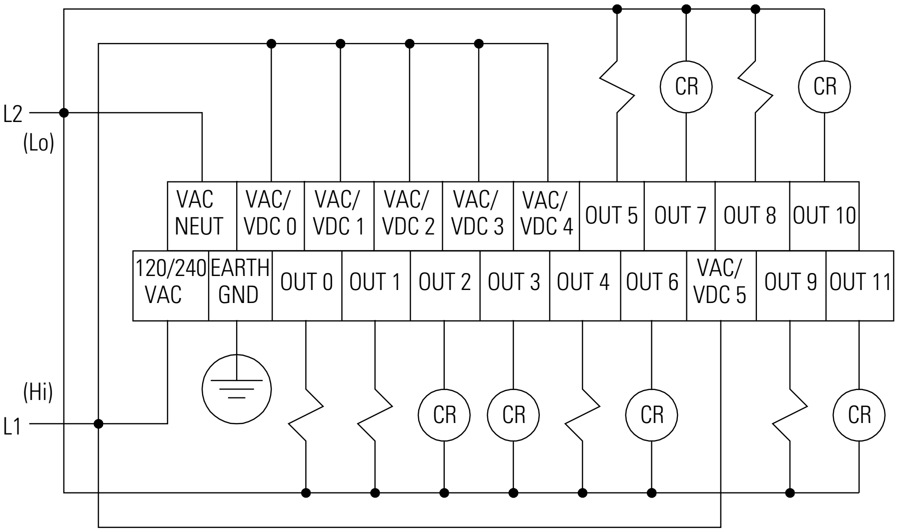
1764-24AWA Wiring Diagram

Input Terminals



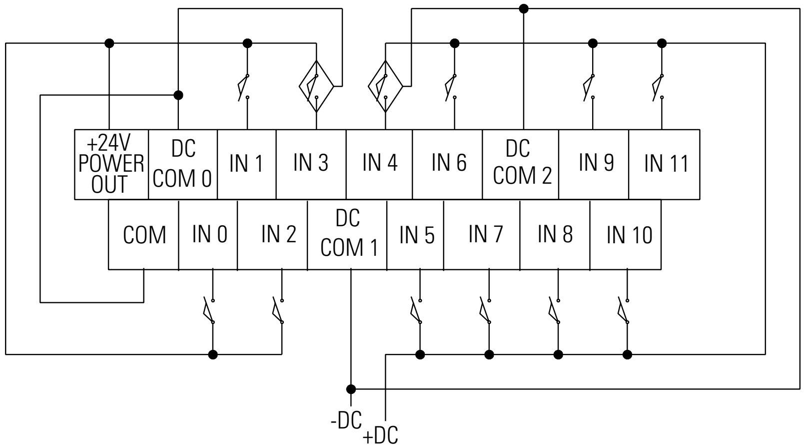
"NOT USED" terminals are not intended for use as connection points.

Output Terminals

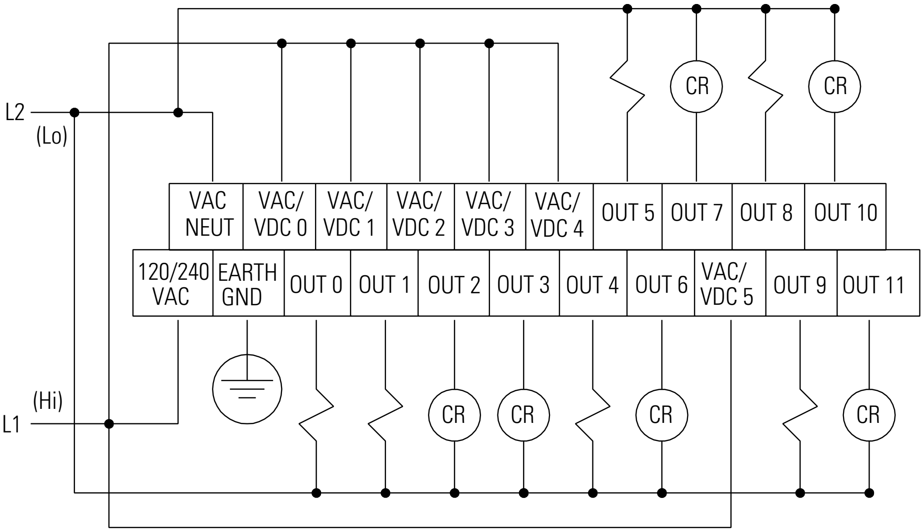


1764-24BWA Wiring Diagram with Sinking Inputs

Input Terminals

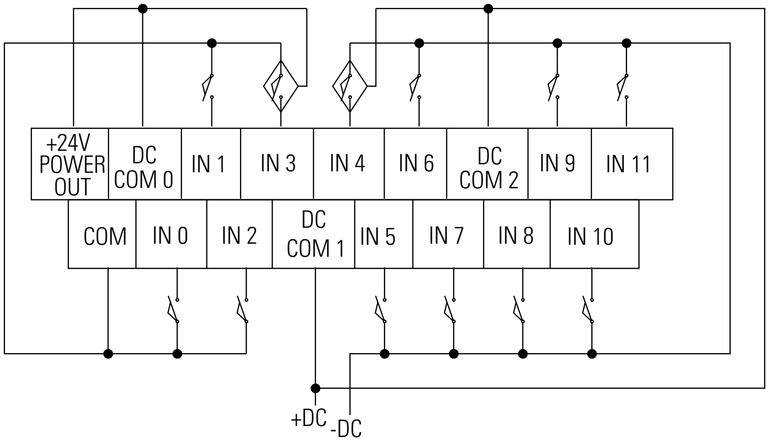


Output Terminals

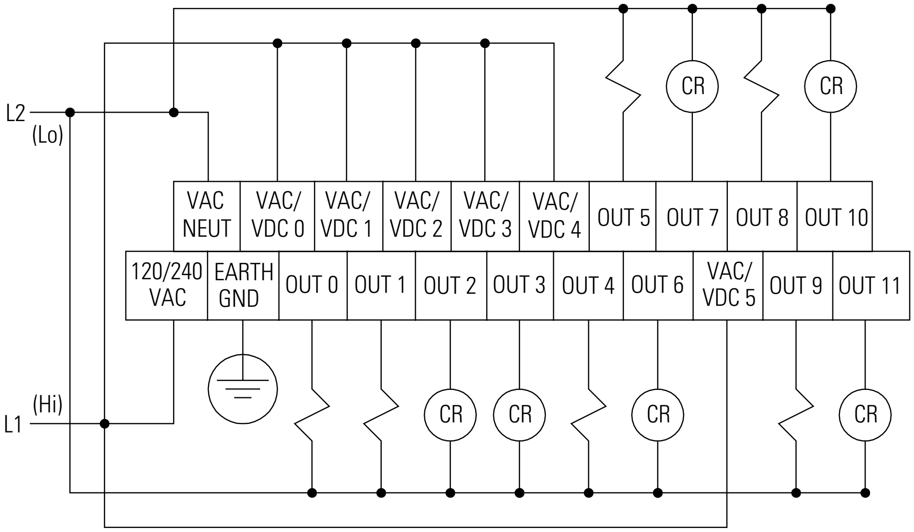


1764-24BWA Wiring Diagram with Sourcing Inputs

Input Terminals

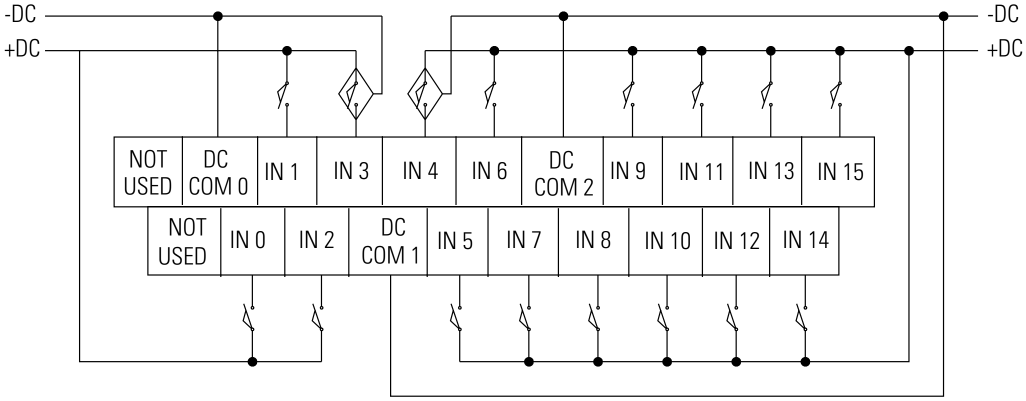


Output Terminals



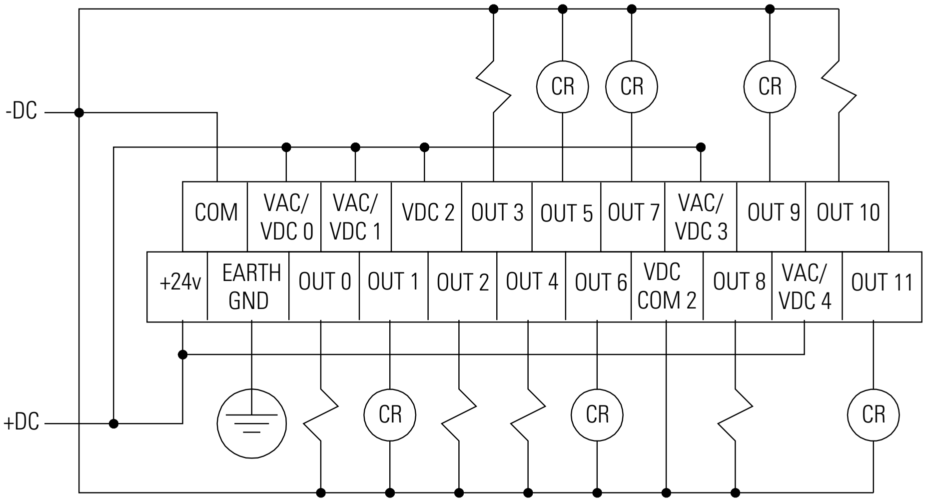
1764-28BXB Wiring Diagram with Sinking Inputs

Input Terminals



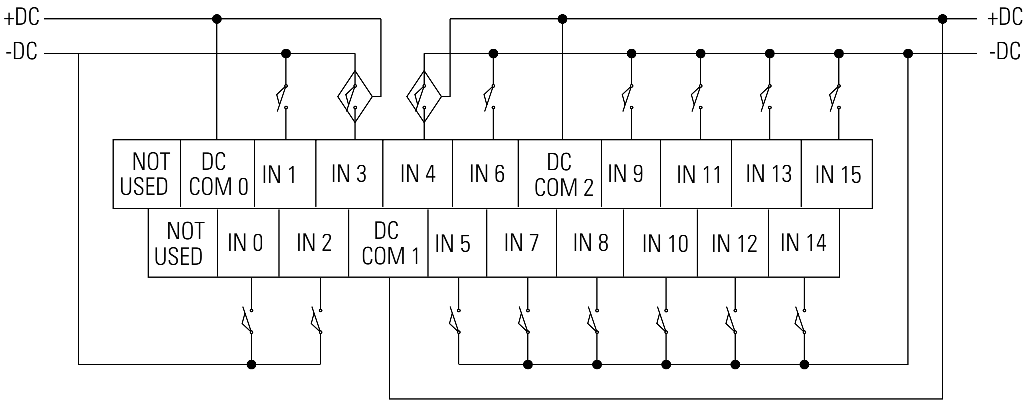
"NOT USED" terminals are not intended for use as connection points.

Output Terminals (FET Outputs Are Sourcing Only)



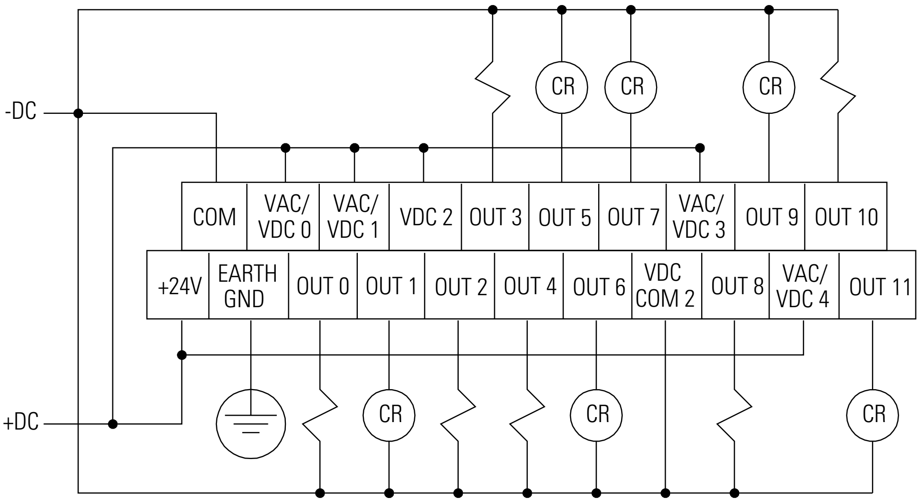
1764-28BXB Wiring Diagram with Sourcing Outputs

Input Terminals



“NOT USED” terminals are not intended for use as connection points.

Output Terminals (FET Outputs Are Sourcing Only)



Controller I/O Wiring

Minimizing Electrical Noise

Because of the variety of applications and environments where controllers are installed and operating, it is impossible to ensure that all environmental noise will be removed by input filters. To help reduce the effects of environmental noise, install the MicroLogix 1500 system in a properly rated (i.e. NEMA) enclosure. Make sure that the MicroLogix 1500 system is properly grounded.

A system may malfunction may occur due to a change in the operating environment after a period of time. We recommend periodically checking system operation, particularly when new machinery or other noise sources are installed near the Micrologix 1500 system.

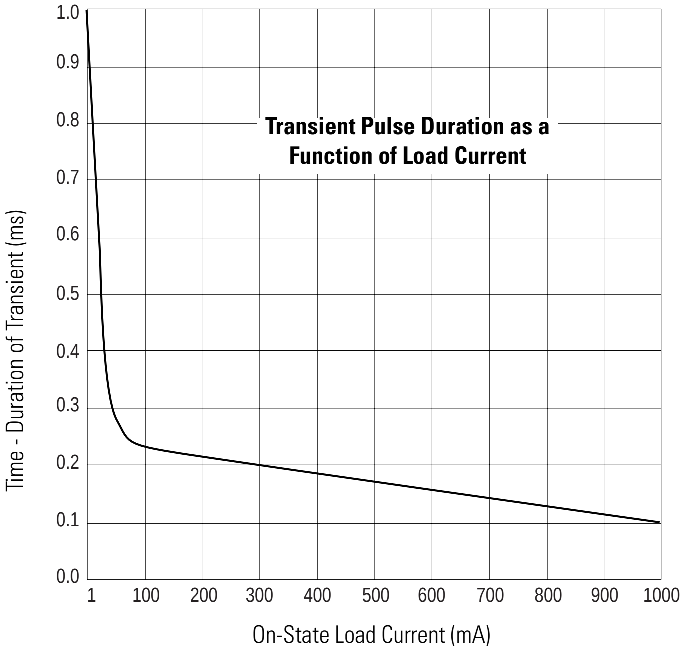
Transistor Output Transient Pulses

ATTENTION

A brief transient current pulse may flow through transistor outputs if the external supply voltage is suddenly applied at the V dc and V dc com terminals (e.g. via the master control relay). It is a fast rate-of-change of voltage at the terminals that causes the pulse. This condition is inherent in transistor outputs and is common to solid state devices. The transient pulses may occur regardless of whether the controller is powered or running.

The transient energy is dissipated in the load, and the pulse duration is longer for loads with high impedance. The graph below illustrates the relation between pulse duration and load current. Power-up transients will not exceed the times shown in the graph. For most applications the pulse energy is not sufficient to energize the load.

To reduce the possibility of inadvertent operation of devices connected to transistor outputs, consider adding an external resistor in parallel to the load to increase the on-state load current. The duration of the transient pulse is reduced when the on-state load current is increased or the load impedance is decreased.


Transient Pulse Duration as a Function of Load Current
Time - Duration of Transient (ms)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
100
200
300
400
500
600
700
800
900
1000
On-State Load Current (mA)

Chapter 4

Communication Connections

This chapter describes how to set up communications for your control system. The method you use and cabling required depend on your application. This chapter also describes how the controller establishes communication with the appropriate network. Topics include:

- Default Communication Configuration
- Communications Toggle Push Button
- Connecting to the RS-232 Port
- Connecting to a DH-485 Network
- Connecting to DeviceNet
- Connecting to Ethernet

ATTENTION All devices communicating within a network, must use the same protocol.

Default Communication Configuration

The MicroLogix 1500 has the following default communication configuration.

Table 4.1 DF1 Full-Duplex Configuration Parameters

Parameter	Default
Baud Rate	19.2K
Parity	none
Source ID (Node Address)	1
Control Line	no handshaking
Error Detection	CRC
Embedded Responses	auto detect
Duplicate Packet (Message) Detect	enabled
ACK Timeout	50 counts
NAK retries	3 retries
ENQ retries	3 retries
Stop Bits	1

TIP

The default configuration is present when:

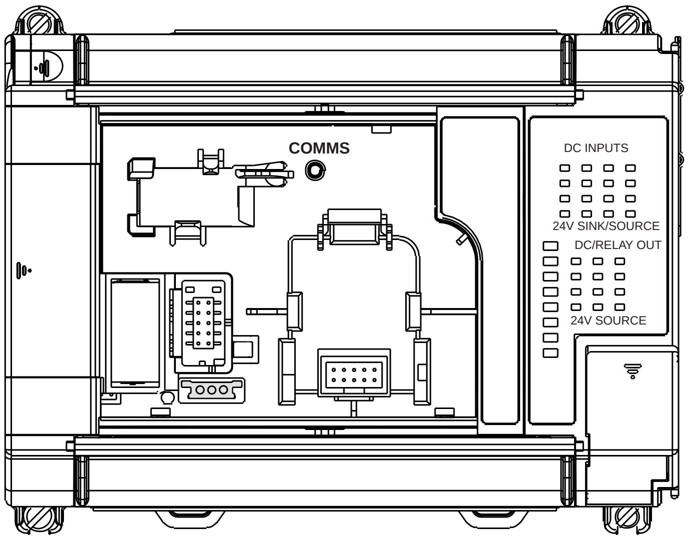
- The controller is powered-up for the first time.
- The communications toggle push button specifies default communications (the DCOMM LED is on).
- An OS upgrade is completed.

For more information about communications, see Understanding Communication Protocols on page E-1.

Communications Toggle Push Button

The Communications Toggle Push Button is located on the processor. You must remove processor door or DAT to access the Communications Toggle Push Button.

Use the Communications Toggle Push Button to change from the user-defined communication configuration to the default communications configuration and back. The Default Communications (DCOMM) LED operates to show when the controller is in the default communications mode (settings shown on page 4-1).



TIP

The Communication Toggle Push Button must be pressed and held for two seconds to activate.

The Communication Toggle Push Button only affects the communication configuration of Channel 0.

Connecting to the RS-232 Port

DF1 Full-Duplex Communication Parameters

When a communication channel is configured for DF1 Full-Duplex, the following parameters can be changed.

Table 4.2 DF1 Full-Duplex Configuration Parameters

Parameter	Options	Default
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K	19.2K
Parity	none, even	none
Source ID (Node Address)	0 to 254 decimal	1
Control Line	no handshaking, Full-Duplex modem handshaking	no handshaking
Error Detection	CRC, BCC	CRC
Embedded Responses	auto-detect, enabled	auto detect
Duplicate Packet (Message) Detect	enabled, disabled	enabled
ACK Timeout	1 to 65535 counts (20 ms increments)	50 counts
NAK retries	0 to 255	3 retries
ENQ retries	0 to 255	3 retries
Stop Bits	not a setting, always 1	1

Making a DF1 Full-Duplex Point-to-Point Connection

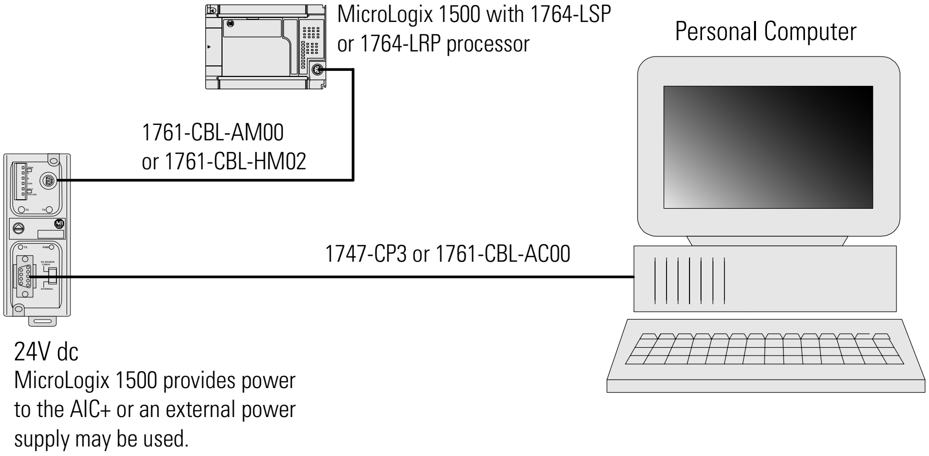
You can connect the MicroLogix 1500 programmable controller to your personal computer using a serial cable from your personal computer's serial port to the controller, as shown in the illustrations below.

ATTENTION

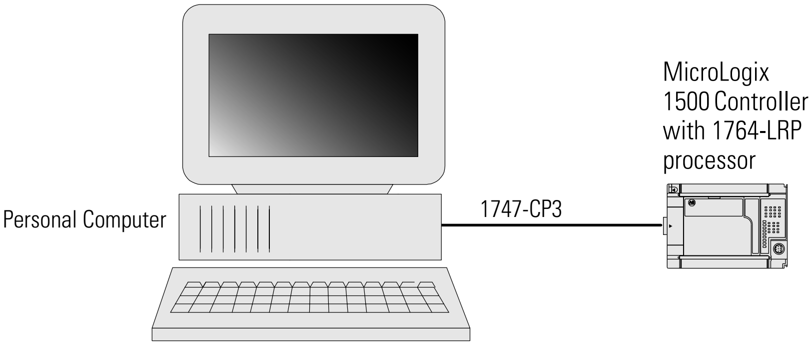
Chassis ground, internal 24V ground, user 24V dc ground, and RS-232 ground are internally connected. You must connect the chassis ground terminal screw to ground prior to connecting any devices. It is important that you understand your personal computer's grounding system before connecting to the controller. An optical isolator, such as the 1761-NET-AIC, is recommended between the controller and your personal computer when using Channel 0. An isolator is not required when using Channel 1 (1764-LRP).

Channel 0

We recommend using an Advanced Interface Converter (AIC+), catalog number 1761-NET-AIC, or similar optical isolator, as shown below. See page 4-16 for specific AIC+ cabling information.

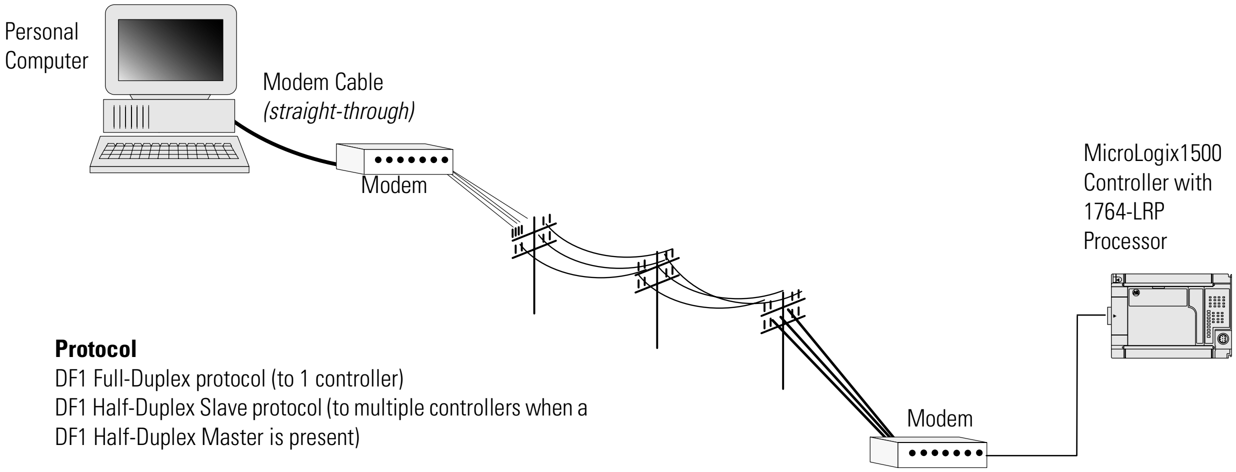


Channel 1



Using a Modem

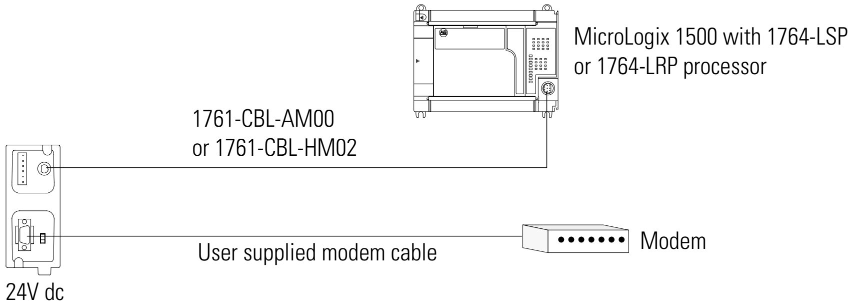
You can use modems to connect a personal computer to one MicroLogix 1500 controller (using DF1 Full-Duplex protocol), or to multiple controllers (using DF1 Half-Duplex protocol), or Modbus Slave RTU protocol, as shown in the following illustration. Do not use DH-485 protocol through modems under any circumstance. (See Using Modems with MicroLogix 1500 Programmable Controllers on page E-3 for information on types of modems you can use with the MicroLogix controllers.)



Protocol
DF1 Full-Duplex protocol (to 1 controller)
DF1 Half-Duplex Slave protocol (to multiple controllers when a DF1 Half-Duplex Master is present)

Isolated Modem Connection

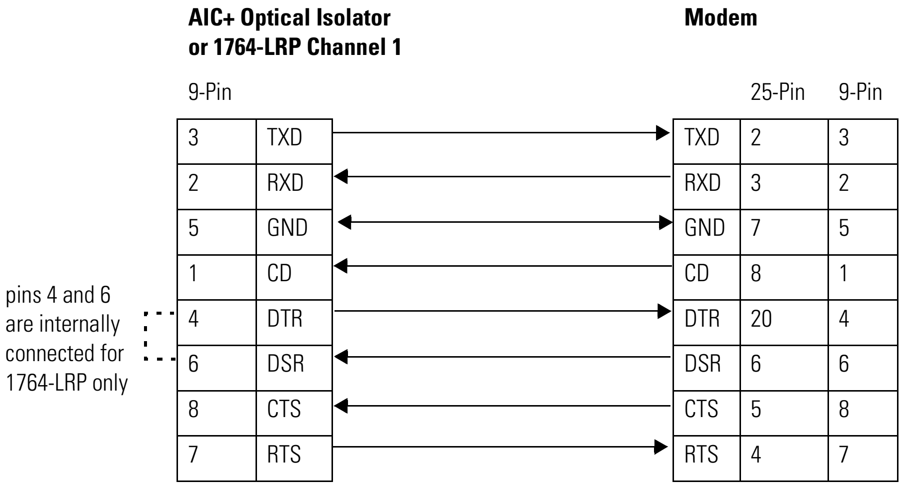
We recommend using an AIC+, catalog number 1761-NET-AIC, as your optical isolator for Channel 0. See page 4-16 for specific AIC+ cabling information. Using an AIC+ to isolate the modem is illustrated below:



MicroLogix 1500 provides power to the AIC+ or an external power supply may be used.

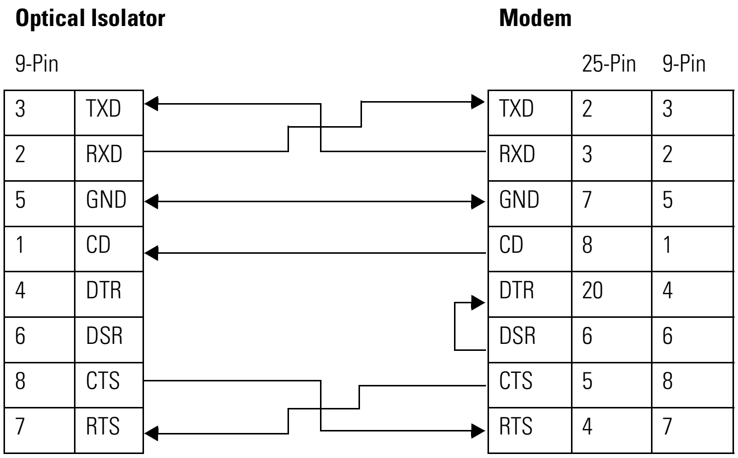
Constructing Your Own Modem Cable

If you construct your own modem cable, the maximum cable length is 15.24 m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout for constructing a *straight-through* cable:



Constructing Your Own Null Modem Cable

If you construct your own null modem cable, the maximum cable length is 15.24m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout:



Connecting to a DF1 Half-Duplex Network

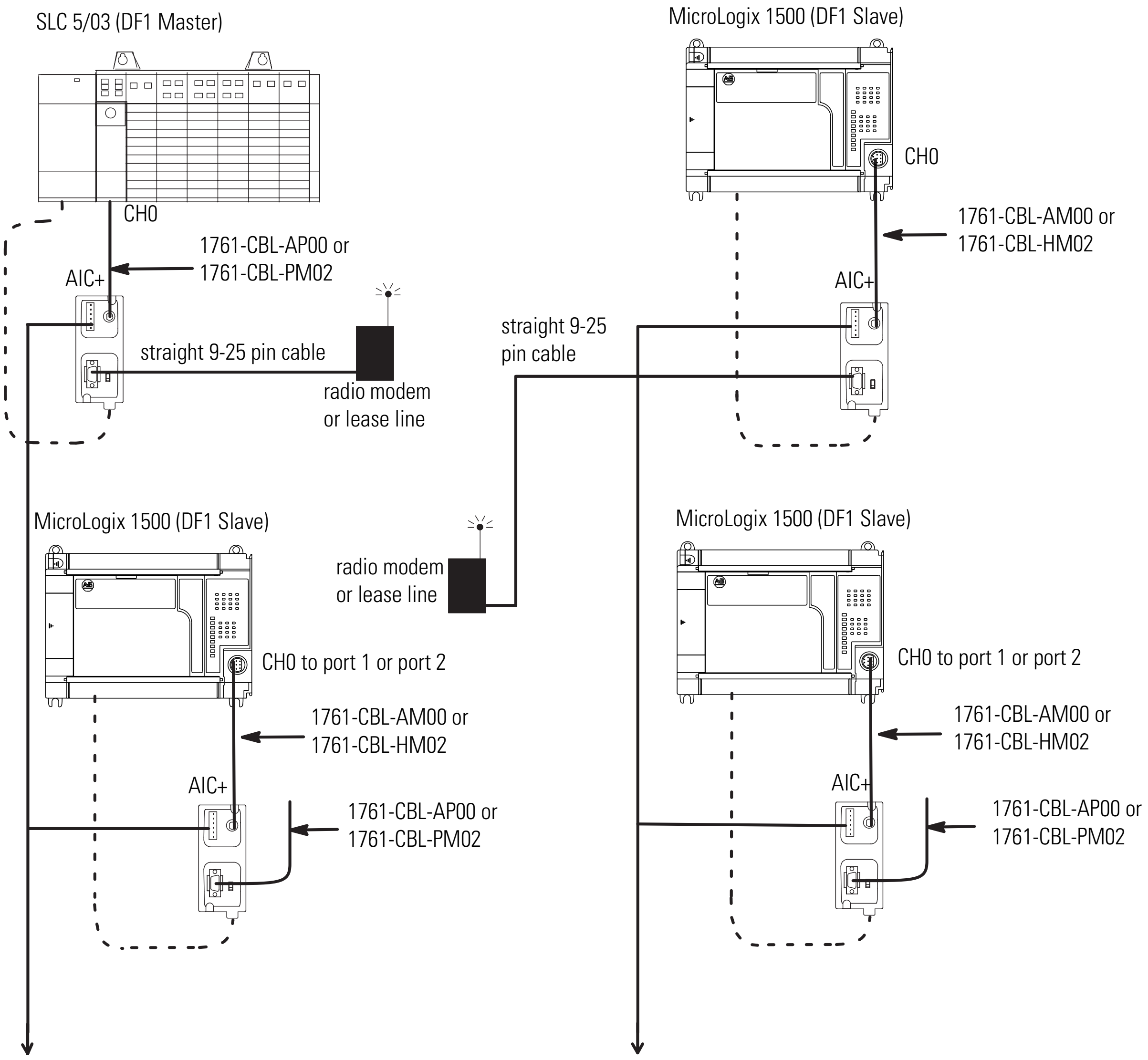
When a communication port is configured for DF1 Half-Duplex Slave, available parameters include:

Table 4.3 DF1 Half-Duplex Configuration Parameters

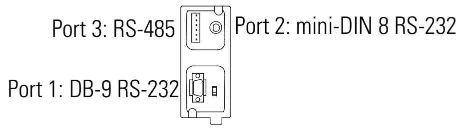
Parameter	Options
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K
Parity	none, even
Source ID (Node Address)	0 to 254 decimal
Control Line	no handshaking, handshaking
Error Detection	CRC, BCC
EOT Suppression	enabled, disabled When EOT Suppression is enabled, the slave does not respond when polled if no message is queued. This saves modem transmission power and time when there is no message to transmit.
Duplicate Packet (Message) Detect	enabled, disabled Detects and eliminates duplicate responses to a message. Duplicate packets may be sent under noisy communication conditions if the sender's Message Retries are not set to 0.
Poll Timeout (x20 ms)	0 to 65535 (can be set in 20 ms increments) Poll Timeout only applies when a slave device initiates a MSG instruction. It is the amount of time that the slave device waits for a poll from the master device. If the slave device does not receive a poll within the Poll Timeout, a MSG instruction error is generated, and the ladder program needs to requeue the MSG instruction. If you are using a MSG instruction, it is recommended that a Poll Timeout value of zero not be used. Poll Timeout is disabled when set to zero.
RTS Off Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the delay time between when the last serial character is sent to the modem and when RTS is deactivated. Gives the modem extra time to transmit the last character of a packet.
RTS Send Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the time delay between setting RTS until checking for the CTS response. For use with modems that are not ready to respond with CTS immediately upon receipt of RTS.
Message Retries	0 to 255 Specifies the number of times a slave device attempts to resend a message packet when it does not receive an ACK from the master device. For use in noisy environments where message packets may become corrupted in transmission.
Pre Transmit Delay (x1 ms)	0 to 65535 (can be set in 1 ms increments) • When the Control Line is set to *no handshaking*, this is the delay time before transmission. Required for 1761-NET-AIC physical Half-Duplex networks. The 1761-NET-AIC needs delay time to change from transmit to receive mode. • When the Control Line is set to *DF1 Half-Duplex Modem*, this is the minimum time delay between receiving the last character of a packet and the RTS assertion.

DF1 Half-Duplex Master-Slave Network

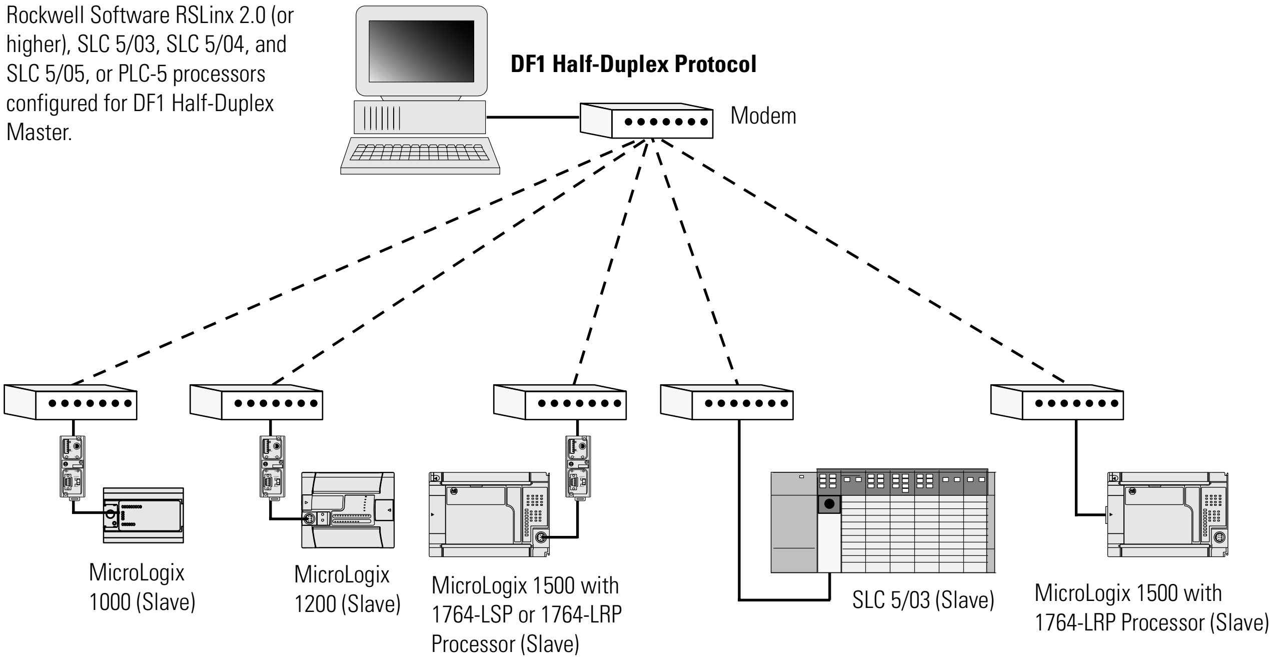
Use this diagram for DF1 Half-Duplex Master-Slave protocol without hardware handshaking.



REFERENCE: AIC+ Port Identification



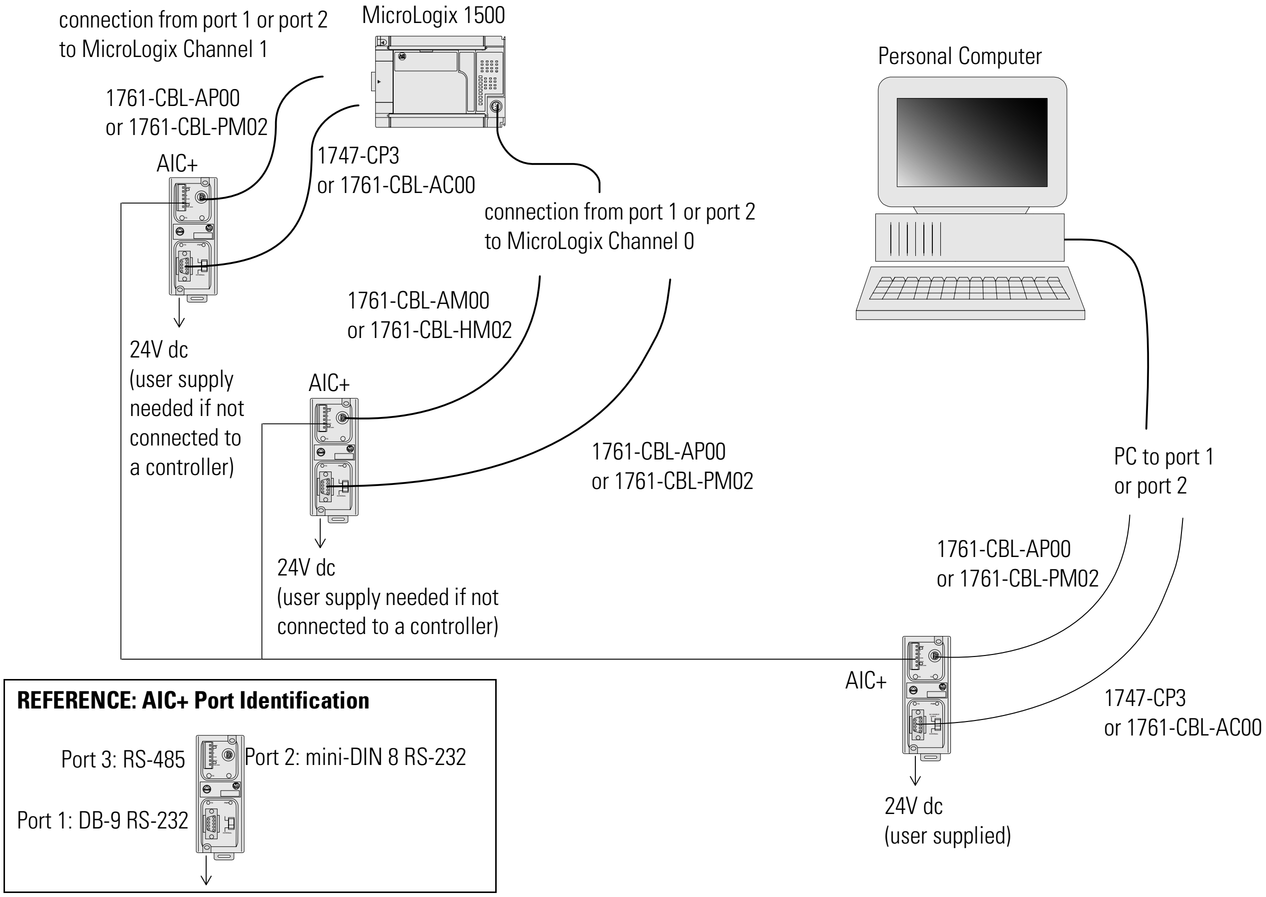
DF1 Half-Duplex Network (Using PC and Modems)



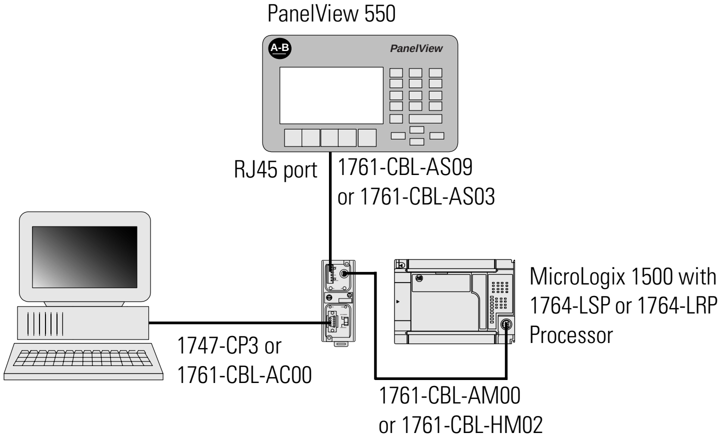
Connecting to a DH-485 Network

The following network diagrams provide examples of how to connect MicroLogix 1500 controllers to the DH-485 network using the Advanced Interface Converter (AIC+, catalog number 1761-NET-AIC). For more information on the AIC+, see the *Advanced Interface Converter and DeviceNet Interface Installation Instructions*, Publication 1761-5.11.

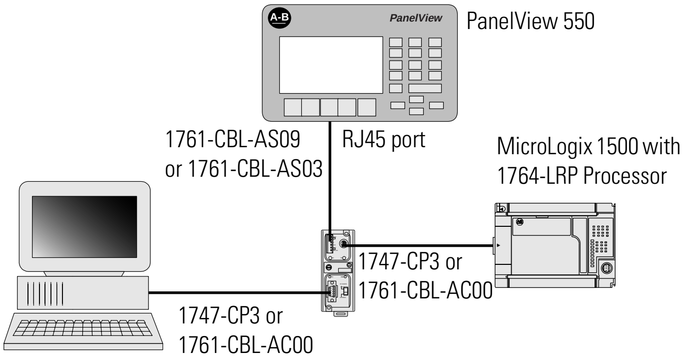
DH-485 Network with a MicroLogix 1500 Controller



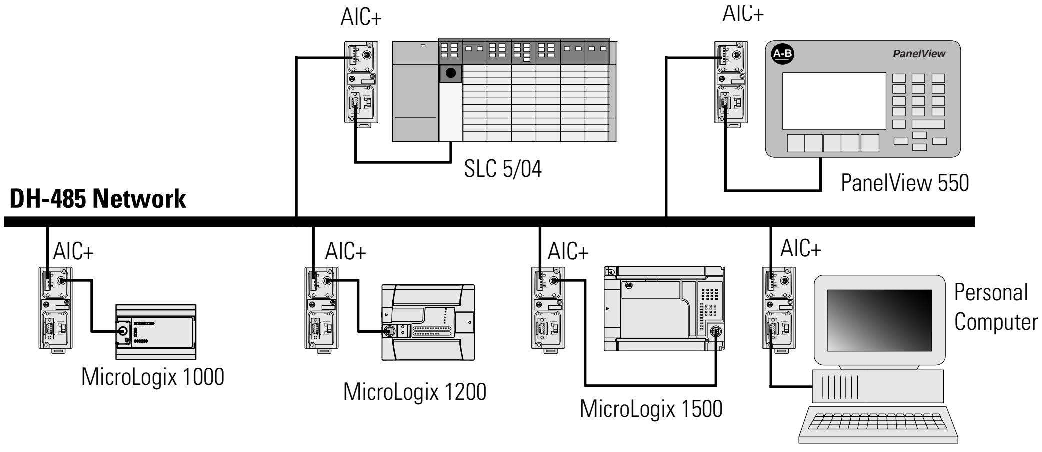
Typical 3-Node Network (Channel 0 Connection)



Typical 3-Node Network (Channel 1 Connection)



Networked Operator Interface Device and MicroLogix Controllers



DH-485 Configuration Parameters

When MicroLogix communications are configured for DH-485, the following parameters can be changed:

Table 4.4 DF1 Full-Duplex Configuration Parameters

Parameter	Options
Baud Rate	9600, 19.2K
Node Address	1 to 31 decimal
Token Hold Factor	1 to 4

See Software Considerations on page E-10 for tips on setting the parameters listed above.

Recommended Tools

To connect a DH-485 network, you need tools to strip and attach the shielded cable. We recommend the following equipment (or equivalent):

Table 4.5 Working with Cable for DH-485 Network

Description	Part Number	Manufacturer
Shielded Twisted Pair Cable	#3106A or #9842	Belden
Stripping Tool	45-164	Ideal Industries
1/8" Slotted Screwdriver	Not Applicable	Not Applicable

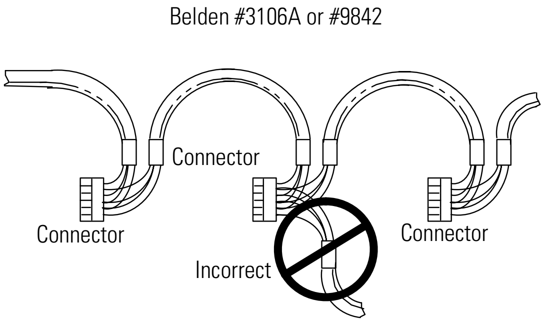
DH-485 Communication Cable

The communication cable consists of a number of cable segments daisy-chained together. The total length of the cable segments cannot exceed 1219 m (4000 ft). However, two segments can be used to extend the DH-485 network to 2438m (8000 ft). For additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual,* publication 1761-6.4.

Communication Cable Connection to the DH-485 Connector

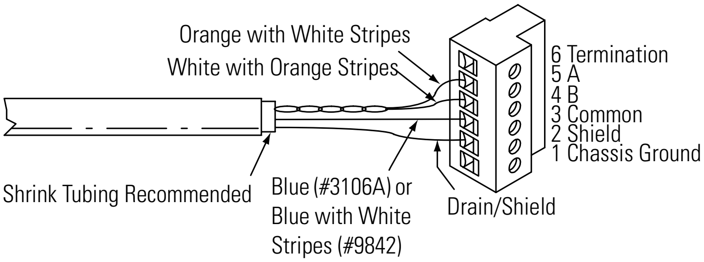
TIP

A daisy-chained network is recommended.
We do *not* recommend the following:



Single Cable Connection

When connecting a single cable to the DH-485 connector, use the following diagram.



Multiple Cable Connection

When connecting multiple cables to the DH-485 connector, use the following diagram.

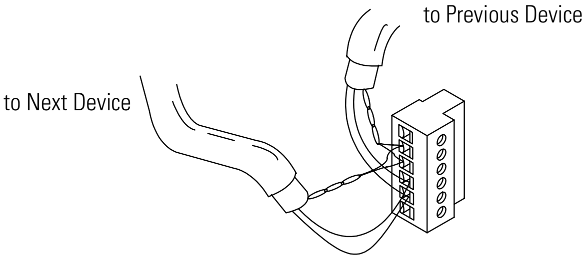


Table 4.6 Connections using Belden #3106A Cable

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue	Blue	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

Table 4.7 Connections using Belden #9842 Cable

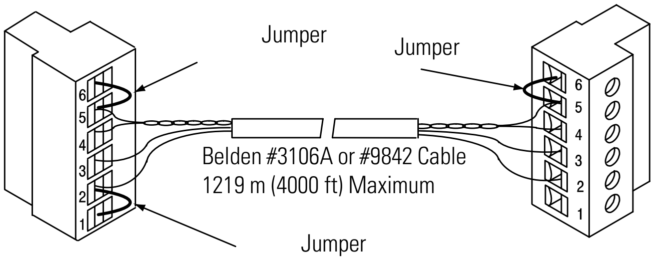
For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue/White	White with Blue Stripe	Cut back - no connection(1)
	Blue with White Stripe	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

(1) To prevent confusion when installing the communication cable, cut back the white with blue stripe wire immediately after the insulation jacket is removed. This wire is not used by DH-485.

Grounding and Terminating the DH-485 Network

Only one connector at the end of the link must have Terminals 1 and 2 jumpered together. This provides an earth ground connection for the shield of the communication cable. Both ends of the network must have Terminals 5 and 6 jumpered together, as shown below. This connects the termination impedance (of 120Ω) that is built into each AIC+ as required by the DH-485 specification.

End-of-Line Termination



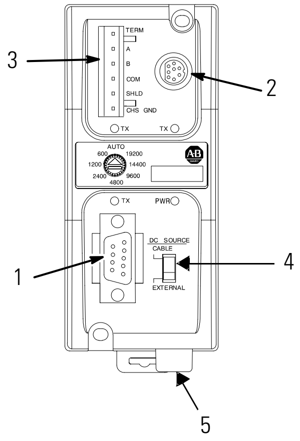
Connecting the AIC+

The AIC+, catalog number 1761-NET-AIC, enables MicroLogix controllers to connect to a DH-485 network when they are configured for DH-485 protocol. The AIC+ has two isolated RS-232 ports and one RS-485 port. When two MicroLogix controllers are closely positioned, you can connect a controller to each of the RS-232 ports on the AIC+.

The AIC+ can also be used as an RS-232 isolator, providing an isolation barrier between the controllers communications port and any equipment connected to it (i.e. personal computer, modem, etc.)

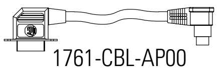
The following figure shows the connections and specifications of the AIC+.

Item	Description
1	Port 1 - DB-9 RS-232, DTE
2	Port 2 - mini-DIN 8 RS-232 DTE
3	Port 3 - RS-485 Phoenix plug
4	DC Power Source selector switch (cable = port 2 power source, external = external power source connected to item 5)
5	Terminals for external 24V dc power supply and chassis ground



For additional information on connecting the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual,* publication 1761-6.4.

Cable Selection Guide

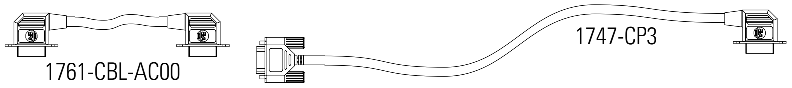


Cable	**Length**	**Connections from**	**to AIC+**	**External Power Supply Required**[1]	**Power Selection Switch Setting**[1]
1761-CBL-AP00 1761-CBL-PM02	45cm (17.7 in) 2m (6.5 ft)	1764-LRP processor, channel 1	port 2	yes	external
		SLC 5/03 or SLC 5/04 processors, channel 0	port 2	yes	external
		MicroLogix 1000 or 1500	port 1	yes	external
		PanelView 550 through NULL modem adapter	port 2	yes	external
		DTAM Plus / DTAM Micro	port 2	yes	external
		PC COM port	port 2	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

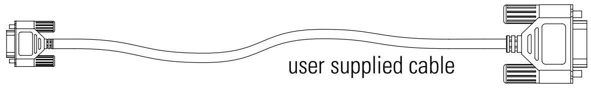
Cable	**Length**	**Connections from**	**to AIC+**	**External Power Supply Required**[1]	**Power Selection Switch Setting**[1]
1761-CBL-AM00 1761-CBL-HM02	45cm (17.7 in) 2m (6.5 ft)	MicroLogix 1000 or 1500	port 2	no	cable
		to port 2 on another AIC+	port 2	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.



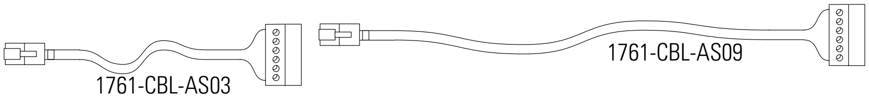
Cable	Length	Connections from	to AIC+	External Power Supply Required[1]	Power Selection Switch Setting[1]
1747-CP3 1761-CBL-AC00	3m (9.8 ft) 45cm (17.7 in)	1764-LRP processor, channel 1	port 1	yes	external
		SLC 5/03 or SLC 5/04 processor, channel 0	port 1	yes	external
		PC COM port	port 1	yes	external
		PanelView 550 through NULL modem adapter	port 1	yes	external
		DTAM Plus / DTAM Micro™	port 1	yes	external
		Port 1 on another AIC+	port 1	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.



Cable	Length	Connections from	to AIC+	External Power Supply Required[1]	Power Selection Switch Setting[1]
straight 9-25 pin	—	modem or other communication device	port 1	yes	external

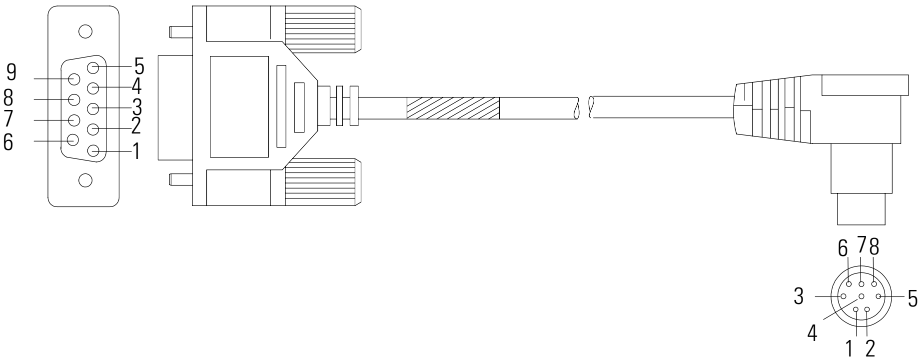
(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.



Cable	Length	Connections from	to AIC+	External Power Supply Required[1]	Power Selection Switch Setting[1]
1761-CBL-AS03 1761-CBL-AS09	3m (9.8 ft) 9.5m (31.17 ft)	SLC 500 Fixed, SLC 5/01, SLC 5/02, and SLC 5/03 processors	port 3	yes	external
		PanelView 550 RJ45 port	port 3	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

1761-CBL-PM02 (or equivalent) Cable Wiring Diagram

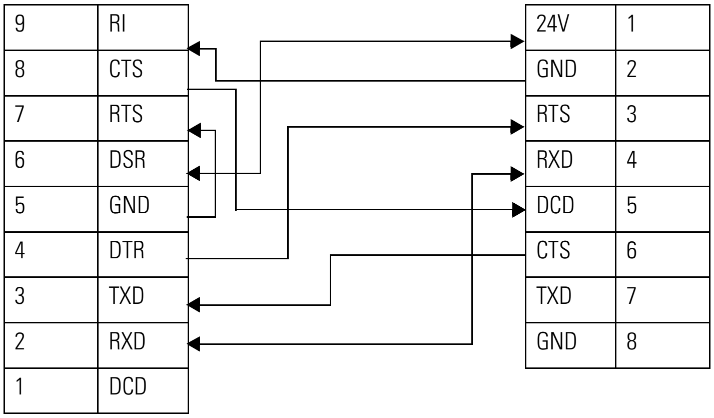


Programming Device

9-Pin D-Shell

Controller

8-Pin Mini Din



9	RI
8	CTS
7	RTS
6	DSR
5	GND
4	DTR
3	TXD
2	RXD
1	DCD

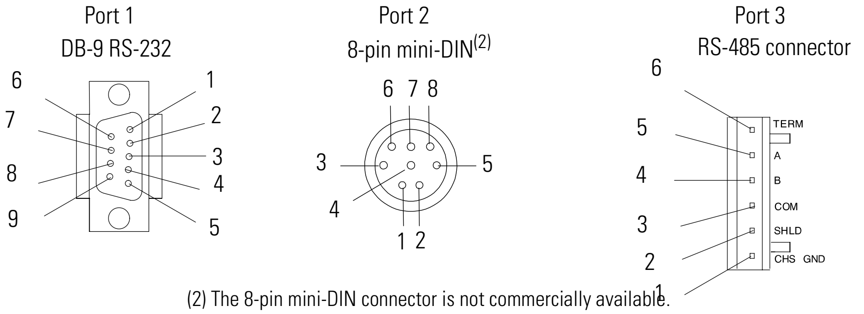
24V	1
GND	2
RTS	3
RXD	4
DCD	5
CTS	6
TXD	7
GND	8

Recommended User-Supplied Components

The components in Table 4.8 can be purchased from your local electronics supplier.

Table 4.8 User Supplied Components

Component	Recommended Model
external power supply and chassis ground	power supply rated for 20.4-28.8V dc
NULL modem adapter	standard AT
straight 9-25 pin RS-232 cable	see table below for port information if making own cables



(2) The 8-pin mini-DIN connector is not commercially available.

Table 4.9 AIC+ Terminals

Pin	Port 1: DB-9 RS-232	Port 2[2]	Port 3: RS-485 Connector
1	received line signal detector (DCD)	24V dc	chassis ground
2	received data (RxD)	ground (GND)	cable shield
3	transmitted data (TxD)	request to send (RTS)	signal ground
4	DTE ready (DTR)[1]	received data (RxD)	DH-485 data B
5	signal common (GND)	received line signal detector (DCD)	DH-485 data A
6	DCE ready (DSR)[2]	clear to send (CTS)	termination
7	request to send (RTS)	transmitted data (TxD)	not applicable
8	clear to send (CTS)	ground (GND)	not applicable
9	not applicable	not applicable	not applicable

(1) On port 1, pin 4 is electronically jumpered to pin 6. Whenever the AIC+ is powered on, pin 4 will match the state of pin 6.

(2) An 8-pin mini DIN connector is used for making connections to port 2. This connector is not commercially available.

Safety Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.

.

WARNING

EXPLOSION HAZARD

This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.

See Safety Considerations on page 2-3 for additional information.

Installing and Attaching the AIC+

1. Take care when installing the AIC+ in an enclosure so that the cable connecting the MicroLogix 1500 controller to the AIC+ does not interfere with the enclosure door.

2. Carefully plug the terminal block into the RS-485 port on the AIC+ you are putting on the network. Allow enough cable slack to prevent stress on the plug.

3. Provide strain relief for the Belden cable after it is wired to the terminal block. This guards against breakage of the Belden cable wires.

Powering the AIC+

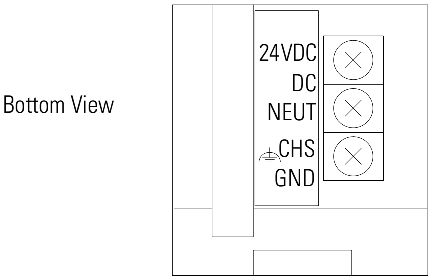
In normal operation with a MicroLogix programmable controller connected to port 2 of the AIC+, the controller powers the AIC+. Any AIC+ not connected to a MicroLogix controller requires a 24V dc power source. The AIC+ requires 120 mA at 24V dc.

If both the controller and external power are connected to the AIC+, the power selection switch determines what device powers the AIC+.

ATTENTION

If you use an external power supply, it must be 24V dc. Permanent damage results if higher voltage is used.

Set the DC Power Source selector switch to EXTERNAL before connecting the power supply to the AIC+. The following illustration shows where to connect external power for the AIC+.



ATTENTION Always connect the CHS GND (chassis ground) terminal to the nearest earth ground. This connection must be made whether or not an external 24V dc supply is used.

Power Options

Below are two options for powering the AIC+:

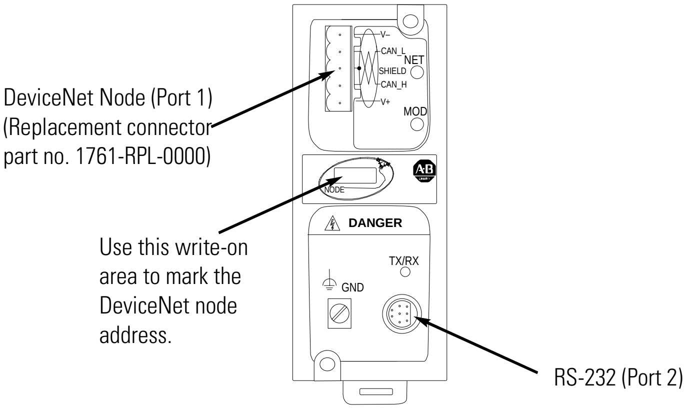
- Use the 24V dc user power supply built into the MicroLogix 1500 controller. The AIC+ is powered through a hard-wired connection using a communication cable (1761-CBL-HM02, or equivalent) connected to port 2.
- Use an external DC power supply with the following specifications:
  - operating voltage: 24V dc +20% or -15%
  - output current: 150 mA minimum
  - rated NEC Class 2

  Make a hard-wired connection from the external supply to the screw terminals on the bottom of the AIC+.

ATTENTION If you use an external power supply, it must be 24V dc. Permanent damage results if miswired with the wrong power source.

Connecting to DeviceNet

You can connect a MicroLogix 1500 using DF1 Full-Duplex protocol to a DeviceNet network using the DeviceNet Interface (DNI), catalog number 1761-NET-DNI. For additional information on using the DNI, refer to the *DeviceNet Interface User Manual*, publication 1761-6.5. The following figure shows the external wiring connections of the DNI.



DeviceNet Node (Port 1)
(Replacement connector part no. 1761-RPL-0000)

Use this write-on area to mark the DeviceNet node address.

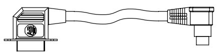
RS-232 (Port 2)

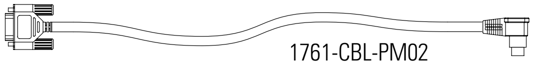
Cable Selection Guide


1761-CBL-AM00


1761-CBL-HM02

Cable	Length	Connections from	to DNI
1761-CBL-AM00 1761-CBL-HM02	45 cm (17.7 in) 2m (6.5 ft)	MicroLogix 1000	port 2
		MicroLogix 1500	port 2

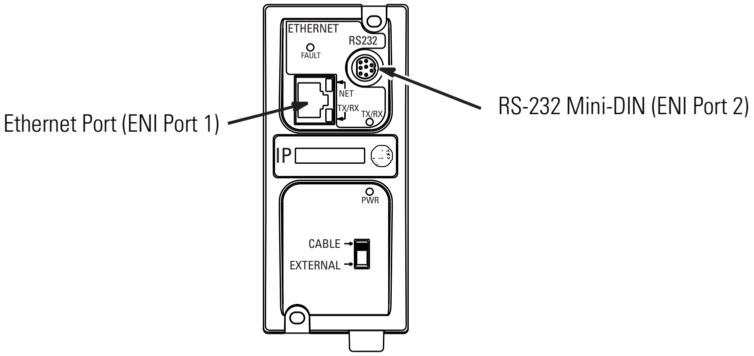

1761-CBL-AP00


1761-CBL-PM02

Cable	Length	Connections from	to DNI
1761-CBL-AP00 1761-CBL-PM02	45 cm (17.7 in) 2m (6.5 ft)	SLC 5/03 or SLC 5/04 processors, channel 0	port 2
		PC COM port	port 2
		1764-LRP processor, channel 1	port 2

Connecting to Ethernet

You can connect a MicroLogix 1500 to an Ethernet network using the Ethernet Interface (ENI), catalog number 1761-NET-ENI. For additional information on using the ENI, refer to the *Ethernet Interface User Manual*, publication 1761-UM006. The following figure shows the external wiring connections of the ENI.



Ethernet Connections

The Ethernet connector, port 1, is an RJ45, 10Base-T connector. The pin-out for the connector is shown below:

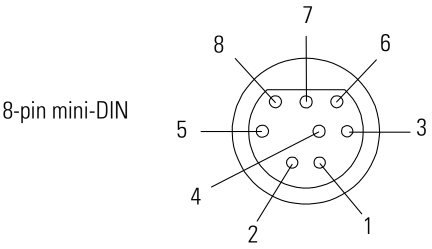
Pin	Pin Name
1	Tx+
2	Tx-
3	Rx+
4	not used by 10Base-T
5	not used by 10Base-T
6	Rx-
7	not used by 10Base-T
8	not used by 10Base-T

When to use straight-through and cross-over cable:

- ENI Ethernet port to 10Base-T Ethernet switch cables utilize a straight-through pin-out (1-1, 2-2, 3-3, 6-6).
- Direct point-to-point 10Base-T cables connecting the ENI Ethernet port directly to another ENI Ethernet port (or a computer 10Base-T port) require a cross-over pin-out (1-3, 2-6, 3-1, 6-2).

RS-232 Connections

Port 2 of the ENI is an 8-pin mini-DIN RS-232 port that provides connection to DF1 compatible RS-232 devices. The connector pin assignments are shown below.



Pin	Port 2
1	24V dc
2	ground (GND)
3	no connection
4	ENI input data, RxD
5	no connection
6	no connection
7	ENI output data, TxD
8	ground (GND)

The table below describes the RS-232 compatible cables.

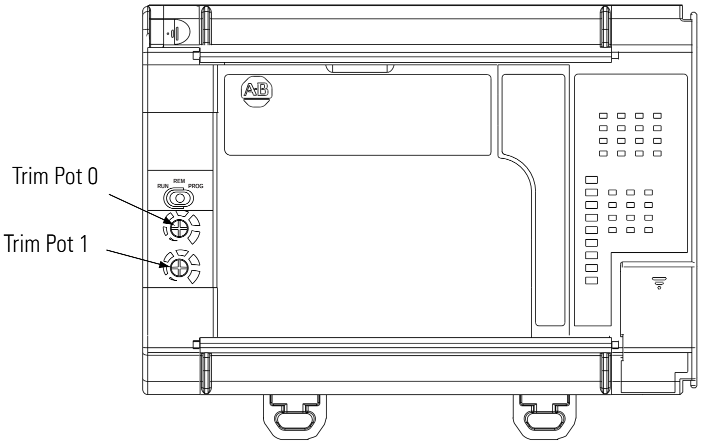
ENI Connected to:	Catalog Number	Use Cable
MicroLogix (all series)		Mini DIN to Mini DIN
	1761-CBL-AM00	45 cm (17.7 in)
	1761-CBL-HM02	2m (6.5 ft.)
SLC 5/03, SLC 5/04, or		Mini DIN to D-Shell
SLC 5/05 Channel 0	1761-CBL-AP00	45 cm (17.7 in)
	1761-CBL-PM02	2m (6.5 ft.)
PLC-5		Mini DIN to D-Shell
	1761-CBL-AP00	45 cm (17.7 in)
	1761-CBL-PM02	2m (6.5 ft.)

Using Trim Pots and the Data Access Tool (DAT)

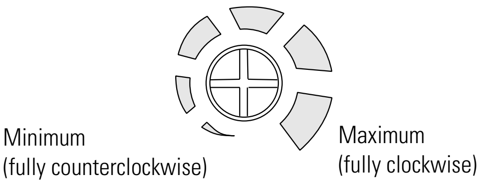
Trim Pot Operation

The processor has two trimming potentiometers (trim pots) which allow modification of data within the controller. Adjustments to the trim pots change the value in the corresponding Trim Pot Information (TPI) register. The data value of each trim pot can be used throughout the control program as timer, counter, or analog presets depending upon the requirements of the application.

The trim pots are located below the mode switch under the left access door of the processor.



Use a small flathead screwdriver to turn the trim pots. Adjusting their value causes data to change within a range of 0 to 250 (fully clockwise). The maximum rotation of each trim pot is three-quarters, as shown below. Trim pot stability over time and temperature is typically ±2 counts.



Trim pot data is updated continuously whenever the controller is powered-up.

Trim Pot Information Function File

The composition of the Trim Pot Information (TPI) Function File is described in the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001.

Error Conditions

If the controller detects a problem/error with either trim pot, the last values read remain in the data location, and an error code is put in the error code byte of the TPI file for whichever trim pot had the problem. Once the problem/error is corrected, the error code is cleared. The error codes are described in the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001.

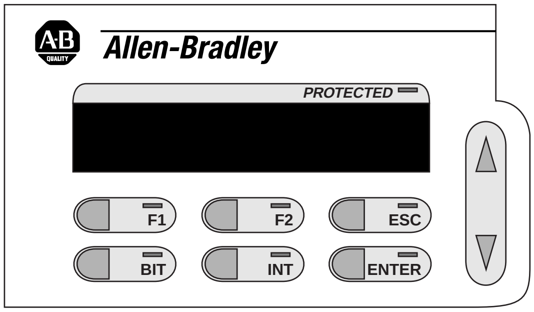
Data Access Tool (DAT)

The DAT is a convenient and simple tool that provides an interface for editing and monitoring data. The DAT has five primary features:

- provides direct access to 48 bit elements
- provides direct access to 48 integer elements
- provides two function keys
- displays controller faults
- allows removal/insertion under power

DAT Keypad and Indicator Light Functions

The DAT has a digital display, 6 keys, an up/down key, and 7 indicator lights. Their functions are described in the table on page 5-3.



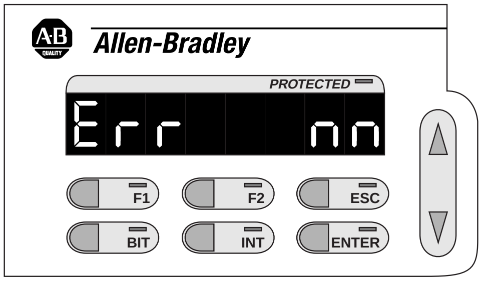
Feature	**Function**
Digital Display	Displays address elements, data values, faults and errors.
Up/Down Key	Selects element numbers and change data values. The up/down key scrolls when held.
F1 Key and Indicator Light	Controls the F1 status bit. When the F1 key is pressed or latched, the F1 indicator LED is lit.
F2 Key and Indicator Light	Controls the F2 status bit. When the F2 key is pressed or latched, the F2 indicator LED is lit.
ESC Key	Cancels a current operation.
BIT Key and Indicator Light	Pressing the BIT key puts the DAT in bit mode. The bit indicator light is on when the DAT is in bit mode.
INT Key and Indicator Light	Pressing the INT key puts the DAT in integer mode. The integer indicator light is on when the DAT is in integer mode.
ENTER Key	Press to select the flashing element number or enter data value.
PROTECTED Indicator Light	Indicates element data cannot be changed using the DAT (element is read-only).

TIP The F1, F2, ESC, BIT, INT, and ENTER keys do not repeat when held. Holding down any one of these keys results in only one key press. The Up/Down arrow key is the only key that repeats when held.

Power-Up Operation

The DAT receives power when it is plugged into the controller. Upon power-up, the DAT performs a self-test.

If the test fails, the DAT displays an error code, all indicator lights are deactivated, and the DAT does not respond to any key presses. See DAT Error Codes on page 5-10.

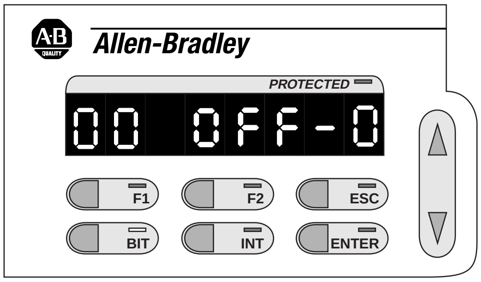


After a successful self-test, the DAT reads the DAT function file to determine its configuration.

DAT Function File

DAT configuration is stored in the processor in a specialized configuration file called the DAT Function File. The DAT Function File, which is part of the user's control program, is described in the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001.

Following a successful power-up sequence, the DAT enters the bit monitoring mode.



Power Save Timeout (PST) Parameter

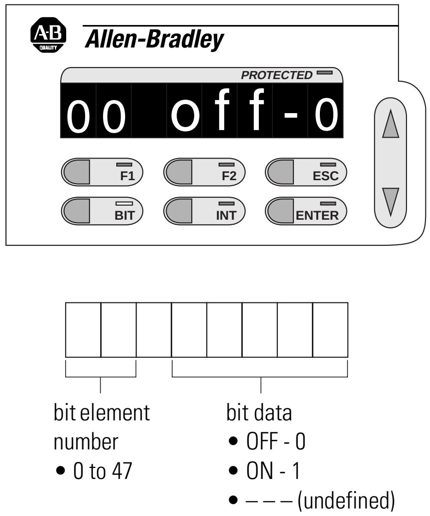
The power save timeout turns off the DAT display after keypad activity has stopped for a user-defined period of time. The power-save (DAT:0.PST) value is set in the DAT Function File. The valid range is 0 to 255 minutes. The power-save feature can be disabled by setting the PST value to 0, which keeps the display on continuously. The default value is 0.

In power-save mode, a dash flashes in the left-most segment of the display. Press any key (except F1 or F2) to return the DAT to its previous mode. If F1 or F2 is pressed, the DAT will change the value of the F1 or F2 status bits, but the display remains in power-save mode.

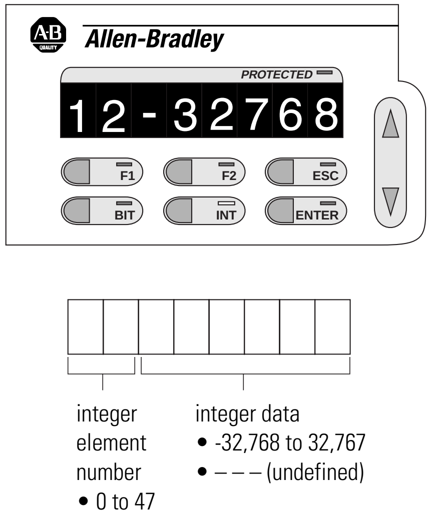
Understanding the DAT Display

When the DAT enters either the bit or integer mode, the element number and its data are displayed, as shown below. The element number is either the integer or bit location.

Bit Mode Display

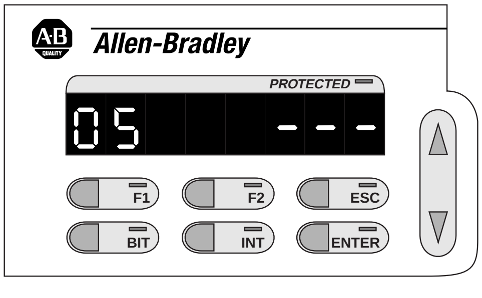


Integer Mode Display



If the displayed element is defined in the controller's data file, and is not protected, the element number flashes, indicating that it can be modified. If the displayed element is protected, the PROTECTED indicator light illuminates, and the element number does not flash, indicating that the element cannot be modified.

If the element is undefined, the data field displays three dashes. The element number does not flash because the element does not exist.



Entering Bit Mode

Bit mode allows you to view and modify up to 48 contiguous bit locations in the controller. The DAT enters the bit mode automatically following a successful power-up. The bit mode can also be selected by pressing the BIT key. If the bit mode was previously active, the DAT displays the last bit element monitored. If the integer mode was active, the DAT displays the first bit element in the data file. However, there may be a brief delay while the DAT requests information from the controller. During the delay, the working screen will display. See Working Screen Operation on page 5-7.

Entering Integer Mode

Integer mode allows you to view and modify up to 48 contiguous 16-bit integer data locations in the controller. To initiate integer mode, press the INT key. If the integer mode was previously active, the DAT displays the last integer element monitored. If the bit mode was active, the DAT displays the first integer element in the data file. However, there may be a brief delay while the DAT requests information from the controller. If there is a delay, the working screen is displayed. See Working Screen Operation on page 5-7.

Monitoring and Editing

1. Press the INT or BIT key to enter the desired mode. The element number flashes (if not protected).

2. Use the up/down key to scroll and select an element (to scroll rapidly, hold the up/down key).

3. Press ENTER to edit the element. The element number becomes steady and the data flashes if it is not protected.

4. Use the up/down key to change the data. Bit values toggle between “ON” and “OFF”. Integer values increment or decrement. Holding down the up/down key causes the integer value to increment or decrement quickly.

TIP

If the data is protected or undefined, pressing the up/down key scrolls to the next element in the list.

5. Press ENTER to load the new data. Press ESC or INT/BIT to discard the new data.

F1 and F2 Functions

The function keys, F1 and F2, correspond to bits and can be used throughout the control program as desired. They have no effect on bit or integer monitoring.

Each key has two corresponding bits in the DAT function file. The bits within the DAT function file are shown in the table below.

Key	Bits	Address	Data Format	Type	User Program Access
F1 Key	Pressed	DAT:0/F1P	Binary	Status	Read/Write
	Latched	DAT:0/F1L	Binary	Status	Read/Write
F2 Key	Pressed	DAT:0/F2P	Binary	Status	Read/Write
	Latched	DAT:0/F2L	Binary	Status	Read/Write

F1 or F2 Key Pressed

The pressed bits (DAT:0/F1P and DAT:0/F2P) function as push-buttons and provide the current state of either the F1 or F2 key on the keypad. When the F1 or F2 key is pressed, the DAT sets (1) the corresponding pressed key bit. When the F1 or F2 key is not pressed, the DAT clears (0) the corresponding pressed key bit.

F1 or F2 Key Latched

The latched bits (DAT:0/F1L and DAT:0/F2L) function as latched push-buttons and provide latched/toggle key functionality. When the F1 or F2 key is pressed, the DAT sets (1) the corresponding latched key bit within the DAT Function File. When the F1 or F2 key is pressed a second time, the DAT clears (0) the corresponding latched key bit.

Working Screen Operation

Because the DAT is a communications device, its performance is affected by the scan time of the controller. Depending on the user program, if a long scan time is encountered and the DAT waits for information from the controller, a working screen is displayed. The working screen consists of three dashes that move across the display from left to right. While the working screen is displayed, key presses are not recognized. Once the DAT receives data from the controller, it returns to its normal mode of operation.

If you encounter excessive working screen conditions, you can minimize the effect by adding an SVC instruction to the control program. Refer to the *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001, for information on the SVC instruction.

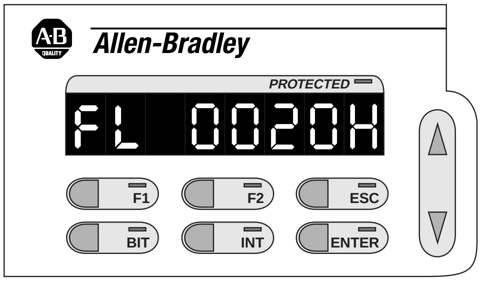
Non-Existent Elements

When the DAT determines that an element number does not exist in the controller, the element value displays as three dashes.

If the protection bit for an element is undefined, the DAT will assume that the element is unprotected.

Controller Faults

The DAT checks for controller faults every 10 seconds. When the DAT detects a controller fault, the display shows "FL" in the element number field and the value of the controller's major fault word (S2:6) is displayed in the value field, as shown below.



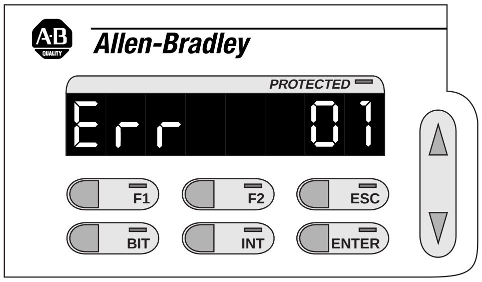
TIP

If an element value is being modified when the fault is detected, the fault is stored until the modification is accepted or discarded. Then, the fault will be displayed.

Pressing ESC while the fault is being displayed returns the DAT to its previous mode. The fault is not removed from the controller, just from the DAT display screen. The fault that was on screen will not display again and cannot be “recalled”. If a new fault is detected, it will be displayed. If the initial fault is cleared and returns at a later time, the DAT will display the fault at that time.

Error Conditions

When the DAT detects an error in its own operation, it displays the error screen. The error screen consists of “Err” and a two-digit error code, as shown below.



The DAT can experience two different types of errors, internal errors and communication errors.

Internal DAT Errors

Internal DAT errors are non-recoverable. When the DAT experiences an internal error, it displays the error screen, and does not respond to any key presses. Remove and re-install the DAT. If this does not clear the error, the DAT must be replaced.

Communication Errors

The DAT continually monitors the interface between the DAT and the controller to ensure a good communication path. If the DAT loses communication with the controller for more than three seconds, it generates an interface time-out error. The DAT automatically attempts to re-establish communications. The error screen displays until the DAT regains communications with the processor. All key presses are ignored until the display clears.

DAT Error Codes

Error Code	Description	Caused by	Recommended Action
00	Interface time-out	Communication traffic	Add SVC instructions to ladder program
01 to 02	Power-up test failure	Internal failure	Remove and re-insert the DAT. If failure persists, replace the unit.
03 to 07	internal error	Internal failure	Remove and re-insert the DAT. If failure persists, replace the unit.
08	processor owned(1)	Another device has ownership of the controller	Release ownership by the other device
09	access denied	Cannot access that file because another device has ownership	Release file ownership by the other device
31 to 34	internal error	Internal failure	Remove and re-insert the DAT. If failure persists, replace the unit.

(1) This error can occur after a download in which communications configurations are changed. This error can be cleared by removing and re-installing the DAT, or by cycling power to the controller.

Using Real-Time Clock and Memory Modules

Five modules with different levels of functionality are available for use with the MicroLogix 1500 controller.

Catalog Number	Function	Memory Size
1764-RTC	Real-Time Clock	not applicable
1764-MM1	Memory Module	8K
1764-MM1RTC	Memory Module and Real-Time Clock	8K
1764-MM2(1)	Memory Module	16K
1764-MM2RTC(1)	Memory Module and Real-Time Clock	16K

(1) For 1764-LRP programs greater than 8k, use the 1764-MM2 or 1764-MM2RTC.

Real-Time Clock Operation

Removal/Insertion Under Power

The real-time clock module can be installed or removed at any time without risk of damage to either the module or the controller. If a module is installed while the MicroLogix 1500 is in an executing mode (Run or Remote Run), the module is not recognized until either a power cycle occurs, or until the controller is placed in a non-executing mode (program mode or fault condition).

Removal of the memory module is detected within one program scan. Removal of the real-time clock under power causes the controller to write zeros to the (RTC) Function File.

Real-Time Clock Function File

The real-time clock provides year, month, day of month, day of week, hour, minute, and second information to the Real-Time Clock (RTC) Function File in the controller. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001 for information about the RTC function file.

Accuracy

The following table indicates the expected accuracy of the real-time clock at various temperatures.

Ambient Temperature	Accuracy[1]
0°C (+32°F)	+34 to -70 seconds/month
+25°C (+77°F)	+36 to -68 seconds/month
+40°C (+104°F)	+29 to -75 seconds/month
+55°C (+131°F)	-133 to -237 seconds/month

(1) These numbers are expected worst case values over a 31 day month.

Writing Data to the Real-Time Clock

When valid data is sent to the real-time clock from the programming device, the new values take effect immediately.

The real-time clock does not allow you to write invalid date or time data.

RTC Battery Operation

The real-time clock has an internal battery that is not replaceable. The RTC Function File features a battery low indicator bit (RTC:0/BL), which shows the status of the RTC battery. When the battery is low, the indicator bit is set (1). This means that the battery may fail within 14 days and the real-time clock module needs to be replaced. When the battery low indicator bit is clear (0), the battery level is acceptable or a real-time clock is not attached.

If the RTC battery is low and the controller is powered, the RTC operates normally. If the controller power is removed and the RTC battery is low, RTC data may be lost.

Use the *Disable Clock* button in your programming device to disable the real-time clock before storing a module. This decreases the drain on the battery during storage.

Table 6.1 RTC Battery Life Expectancy

Battery State	Temperature	Time Duration
Operating	0°C to +40°C (+32°F to +104°F)	5 years(1)
Storage	-40°C to +25°C (-40°F to +77°F)	5 years minimum
	+26°C to +60°C (+79°F to +140°F)	3 years minimum

(1) The operating life of the battery is based on 6 months of storage time before the real-time clock is used.

ATTENTION

Operating with a low battery indication for more than 14 days may result in invalid RTC data if controller power is lost.

Memory Module Operation

The memory module supports program back-up as well as the following features:

- User Program and Data Back-Up
- Program Compare
- Data File Download Protection
- Memory Module Write Protection
- Removal/Insertion Under Power

User Program and Data Back-Up

The memory module provides a simple and flexible program/data transport mechanism, allowing the user to transfer the program and data to the controller without the use of a personal computer and programming software.

The memory module can store one user program at a time.

During transfers from a memory module, the controller's RUN LED flashes.

Program Compare

The memory module can also provide application security, allowing you to specify that if the program stored in the memory module does not match the program in the controller, the controller will not enter an executing (run or remote run) mode. To enable this feature, set the S:2/9 bit in the system status file. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual,* publication 1762-RM001, for more information.

Data File Download Protection

The memory module allows the user to specify individual data files in the controller that are protected from the download procedure. This allows user data to be saved (not overwritten) during a download.

TIP

Data file download protection is only functional if the processor does not have a fault and if all protected data files in the memory module exactly match the protected data file structure within the controller. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual,* publication 1762-RM001, for information on protecting data files during download.

Memory Module Write Protection

The memory module supports write-once, read-many behavior. Write protection is enabled using your programming software.

IMPORTANT Once set, write protection cannot be removed. A change cannot be made to the control program or data stored in a write-protected memory module. If a change is required, you must use a different memory module.

Removal/Insertion Under Power

The memory module can be installed or removed at any time without risk of damage to either the memory module or the controller. If a memory module is installed while the MicroLogix 1500 is executing, the memory module will not be recognized until either a power cycle occurs, or until the controller is placed in a non-executing mode (program mode or fault condition).

Memory Module Information File

The controller has a Memory Module Information (MMI) File which provides status from the attached memory module. At power-up or on detection of a memory module being inserted, the catalog number, series, revision, and type (memory module and/or real-time clock) are identified and written to the MMI file. If a memory module and/or real-time clock is not attached, zeros are written to the MMI file. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual*, publication 1762-RM001, for more information.

Appendix A

Specifications

Controller Specifications

Table A.1 General Specifications

Description	1764-24BWA	1764-24AWA	1764-28BXB
Number of I/O	12 inputs 12 outputs	12 inputs 12 outputs	16 inputs 12 outputs
Line Power	85 to 265V ac at 47 to 63 Hz	85 to 265V ac at 47 to 63 Hz	20.4 to 30V dc
Power Supply Usage	88 VA	70 VA	30W(2)
Power Supply Inrush	120V ac = 25A for 8 ms 240V ac = 40A for 4 ms	120V ac = 25A for 8 ms 240V ac = 40A for 4 ms	24V dc = 4A for 150 ms
User Power Output	24V dc at 400 mA, 400 µF max.	none	none
Input Circuit Type	24V dc, sink/source	120V ac	24V dc, sink/source
Output Circuit Type	relay	relay	6 relay, 6 FET transistor (24V dc source)
Typical CPU Hold-up Time	10 to 3000 ms		
Operating Temp.	+0°C to +55°C (+32°F to +131°F) ambient		
Storage Temp.	-40°C to +85°C (-40°F to +185°F) ambient (1)		
Operating Humidity	5% to 95% relative humidity (non-condensing)		
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. max. peak-to-peak Relay Operation: 2G		
Shock (without Data Access Tool installed)	Operating: 30G panel mounted (15G DIN Rail mounted) Relay operation: 7.5G panel mounted (5G DIN Rail mounted) Non-Operating: 40G panel mounted (30G DIN Rail mounted)		
Shock (with Data Access Tool installed)	Operating: 20G panel mounted (15G DIN Rail mounted) Relay operation: 7.5G panel mounted (5G DIN Rail mounted) Non-Operating: 30G panel mounted (20G DIN Rail mounted)		
Agency Certification	• UL 508 • C-UL under CSA C22.2 no. 142 • Class I, Div. 2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 no. 213) • CE compliant for all applicable directives • C-Tick marked for all applicable acts		

Table A.1 General Specifications

Description	1764-24BWA	1764-24AWA	1764-28BXB
Electrical/EMC	The module has passed testing at the following levels: • EN61000-4-2: 4 kV contact, 8 kV air, 4 kV indirect • EN61000-4-3: 10 V/m • EN61000-4-4: 2 kV, 5 kHz; communications cable: 1 kV, 5 kHz • EN61000-4-5: communications cable1 kv galvanic gun -I/O: 2 kV CM, 1 kV DM, -Power Supply (1764-24AWA/1764-24BWA): 4 kV CM, 2 kV DM -Power Supply (1764-28BXB): 0.5 kV CM, 0.5 kV DM • EN61000-4-6: 10V, communications cable 3V		
Terminal Screw Torque	1.13 Nm (10 in-Ib) rated; 1.3 Nm (12 in-Ib) maximum		
Programming Software	For 1764-LSP Series A Processors: RSLogix 500, Version 3.01.09 or higher For 1764-LSP and 1764-LRP Series B Processors: RSLogix 500, Version 4.00.00 or higher.		

(1) Recommended storage temperature for maximum battery life (5 years typical with normal operating/storage conditions) of the 1764-RTC, 1764-MM1RTC, and 1764-MM2RTC is -40°C to +40°C (-40°F to +104°F). Battery life is significantly shorter at elevated temperatures.

(2) See Choosing a Power Supply on page A-2.

Choosing a Power Supply

This section contains information for selecting a power supply for applications using a 1764-28BXB base unit. Use the tables in Appendix F to calculate the total power (Watts) consumed by the system. With that information, use the graphs below to chose a power supply. You can use either current or power, depending on how the power supply is rated.

Figure 1.1 Input Current Required

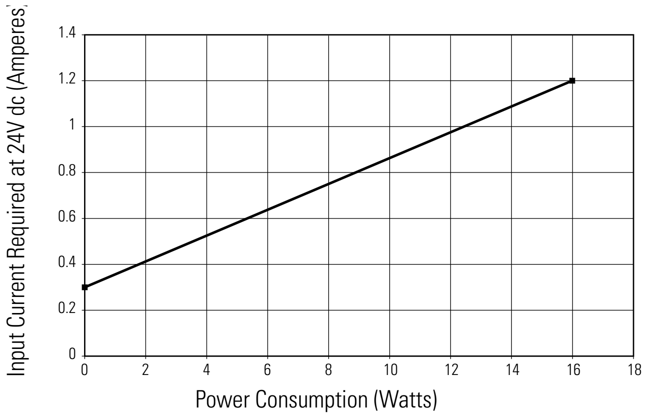


Figure 1.2 Input Power Required

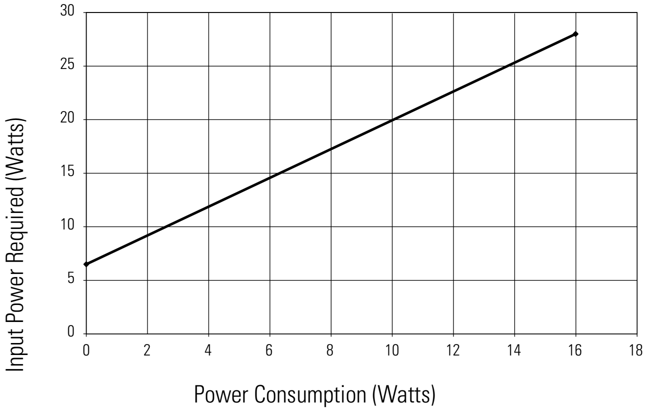


Table A.2 Input Specifications

Description	1764-24AWA	1764-24BWA and 1764-28BXB	
		Inputs 0 thru 7	**Inputs 8 and Higher**
On-State Voltage Range	79 to 132V ac	14 to 30.0V dc at 30°C (86°F) 14 to 26.4V dc at 55°C (131°F)	10 to 30.0V dc at 30°C (86°F) 10 to 26.4V dc at 55°C (131°F)
Off-State Voltage Range	0 to 20V ac	0 to 5V dc	
Operating Frequency	Not Applicable	1 kHz to 20 kHz	1 kHz to 500 Hz(1)
On-State Current: • minimum • nominal • maximum	 • 5.0 mA at 79V ac • 12.0 mA at 120V ac • 16.0 mA at 132V ac	 • 2.5 mA at 14V dc • 7.3 mA at 24V dc • 12.0 mA at 30V dc	 • 2.0 mA at 10V dc • 8.9 mA at 24V dc • 12.0 mA at 30V dc
Off-State Leakage Current	2.5 mA minimum	1.5 mA minimum	
Nominal Impedance	12k ohms at 50 Hz 10k ohms at 60 Hz	3.3k ohms	2.7k ohms
Inrush Current (max.)	250 mA at 120V ac	Not Applicable	Not Applicable

(1) Scan-time dependant.

TIP

The 1764-24AWA input circuits (inputs 0-11) do not support adjustable filter settings. They have maximum turn-on and maximum turn-off times of 20 milliseconds.

Table A.3 Response Times for High-Speed dc Inputs 0 Through 7 (applies to 1764-24BWA and 1764-28BXB)

Maximum High-Speed Counter Frequency at 50% Duty Cycle (KHz)	Filter Setting (ms)	Minimum ON Delay (ms)	Maximum ON Delay (ms)	Minimum OFF Delay (ms)	Maximum OFF Delay (ms)
20.000	0.025	0.005	0.025	0.005	0.025
6.700	0.075	0.040	0.075	0.045	0.075
5.000	0.100	0.050	0.100	0.060	0.100
2.000	0.250	0.170	0.250	0.210	0.250
1.000	0.500	0.370	0.500	0.330	0.500
0.500	1.000	0.700	1.000	0.800	1.000
0.250	2.000	1.700	2.000	1.600	2.000
0.125	4.000	3.400	4.000	3.600	4.000
0.063	8.000(1)	6.700	8.000	7.300	8.000
0.031	16.000	14.000	16.000	14.000	16.000

(1) This is the default setting.

Table A.4 Response Times for Normal dc Inputs 8 Through 11 (1764-24BWA) and 8 Through 15 (1764-28BXB)

Maximum Frequency at 50% Duty Cycle (kHz)	Filter Setting (ms)	Minimum ON Delay (ms)	Maximum ON Delay (ms)	Minimum OFF Delay (ms)	Maximum OFF Delay (ms)
1.000	0.500	0.090	0.500	0.020	0.500
0.500	1.000	0.500	1.000	0.400	1.000
0.250	2.000	1.100	2.000	1.300	2.000
0.125	4.000	2.800	4.000	2.700	4.000
0.063	8.000(1)	5.800	8.000	5.300	8.000
0.031	16.000	11.000	16.000	10.000	16.000

(1) This is the default setting.

IMPORTANT The relay current must stay within the limits defined in Tables A.5 and A.6.

Table A.5 Relay Contact Rating Table 1764-24AWA, -24BWA, -28BXB

Maximum Volts	Amperes		Amperes Continuous	Voltamperes	
	Make	Break		Make	Break
240V ac	7.5A	0.75A	2.5A	1800VA	180VA(2)
120V ac	15A	1.5A			
125V dc	0.22A(1)		1.0A	28VA	
24V dc	1.2A(1)		2.0A	28VA	

(1) For dc voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28 VA by the applied dc voltage. For example, 28 VA/48V dc = 0.58A. For dc voltage applications less than 14V, the make/break ratings for relay contacts cannot exceed 2A.

(2) The total load controlled by the 1764-24AWA and 1764-24BWA is limited to 1440VA (break).

Table A.6 Output Specifications - Maximum Continuous Relay Current

Specification		1764-24AWA, -24BWA	1764-28BXB
Current per Common		8A	8A
Current per Controller	at 150V Maximum	24A	18A
	at 240V Maximum	20A	18A

Table A.7 1764-28BXB FET Output Specifications

Specification		General Operation (Outputs 2 thru 7)	High Speed Operation(1) (Outputs 2 and 3 Only)
User Supply Voltage	minimum	20.4V dc	20.4V dc
	maximum	26.4V dc	26.4V dc
On-State Voltage Drop	at maximum load current	1V dc	Not Applicable
	at maximum surge current	2.5V dc	Not Applicable
Current Rating per Point	maximum load	1A at 55°C (131°F) 1.5A at 30°C (86°F)	100 mA
	minimum load	1.0 mA	10 mA
	maximum leakage	1.0 mA	1.0 mA

Table A.7 1764-28BXB FET Output Specifications

Specification		**General Operation (Outputs 2 thru 7)**	**High Speed Operation[1] (Outputs 2 and 3 Only)**
Surge Current per Point	peak current	4.0A	Not Applicable
	maximum surge duration	10 msec	Not Applicable
	maximum rate of repetition at 30°C (86°F)	once every second	Not Applicable
	maximum rate of repetition at 55°C (131°F)	once every 2 seconds	Not Applicable
Current per Common	maximum total	6A	Not Applicable
On-State Current	minimum	2.5 mA at 14V dc	2.0 mA at 10V dc
Off-State Leakage Current	maximum	1 mA	1 mA
Turn-On Time	maximum	0.1 msec	6 µsec
Turn-Off Time	maximum	1.0 msec	18 µsec
Repeatability	maximum	n/a	2 µsec
Drift	maximum	n/a	1 µsec per 5°C (1 µsec per 9°F)

(1) Outputs 2 and 3 are designed to provide increased functionality over the other FET outputs (4 through 7). They may be used like the other FET transistor outputs, but in addition, within a limited current range, they may be operated at a higher speed. Outputs 2 and 3 also provide a pulse train output (PTO) or pulse width modulation output (PWM) function.

Table A.8 Working Voltage (1764-24AWA)

Specification	1764-24AWA
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 151V ac for 1 second or 2145V dc for 1 second
	132V Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation).

Table A.9 Working Voltage (1764-24BWA)

Specification	1764-24BWA
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Power Supply User 24V Output to Backplane Isolation	Verified by one of the following dielectric tests: 600V ac for 1 second or 848V dc for 1 second
	50V Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation).
Output Group to Output Group Isolation.	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

Table A.10 Working Voltage (1764-28BXB)

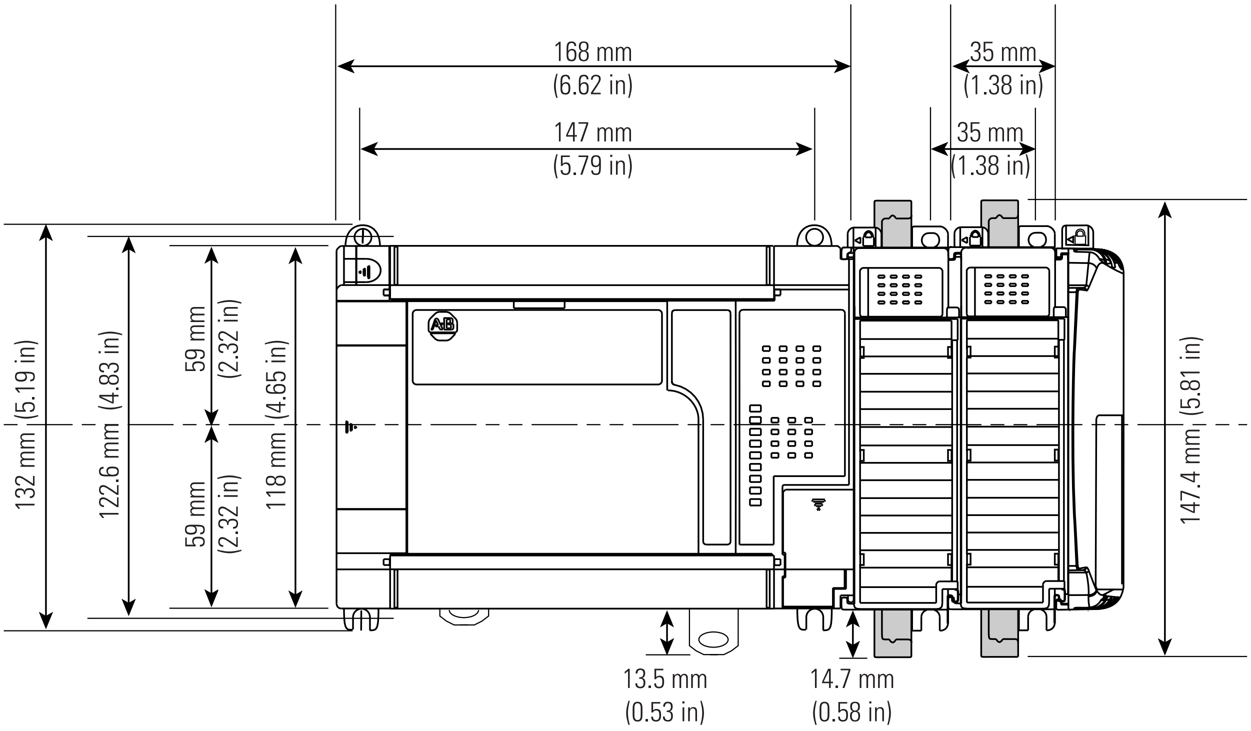
Specification	1764-28BXB
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
FET Output Group to Backplane Isolation and FET Outputs Group to Group	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Relay Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (IEC Class 2 reinforced insulation)
Relay Output Group to Relay and FET Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

Transistor Output Transient Pulses

Refer to page 3-16 for “Transistor Output Transient Pulses”.

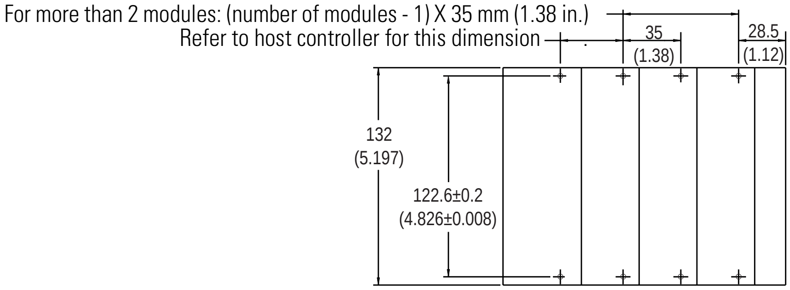
Controller Dimensions

See page 2-12 for Base Unit Mounting Dimensions.



Compact I/O Dimensions

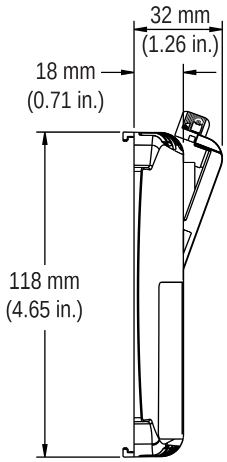
Panel Mounting



NOTE: All dimensions are in mm (inches). Hole spacing tolerance: ±0.4 mm (0.016 in.)

End Cap

This illustration shows the 1769-ECR right end cap. For the 1769-ECL left end cap, the drawing would be reversed.



Dimensions are in mm (inches).

Replacement Parts

This chapter contains the following information:

- a table of MicroLogix 1500 replacement parts
- procedure for replacing the lithium battery
- illustrations of the MicroLogix 1500 replacement doors and terminal blocks

MicroLogix 1500 Replacement Kits

The table below provides a list of replacement parts and their catalog number.

Description	Catalog Number
Lithium Battery (See page B-2.)	1747-BA
ESD Barrier	1764-RPL-TRM1
Base Terminal Doors (See page B-6.)	1764-RPL-TDR1
Processor Access Door (See page B-6.)	1764-RPL-CDR1
Door Combination Kit, includes ESD Barrier, Terminal Door, Access Door, Base Comms Door (See page B-6.), and Trim Pots/Mode Switch Cover Door (See page B-6.)	1764-RPL-DR
17-Point Terminal Block (for inputs on 1764-24AWA and -24BWA bases) (See page B-5.)	1764-RPL-TB1
21-Point Terminal Block (for inputs of 1764-28BXB and outputs for all base units)(See page B-5.)	1764-RPL-TB2

Lithium Battery (1747-BA)

IMPORTANT When the processor's Battery Low indicator is lit, install a backup battery immediately. After the indicator turns on, the battery lasts for at least:

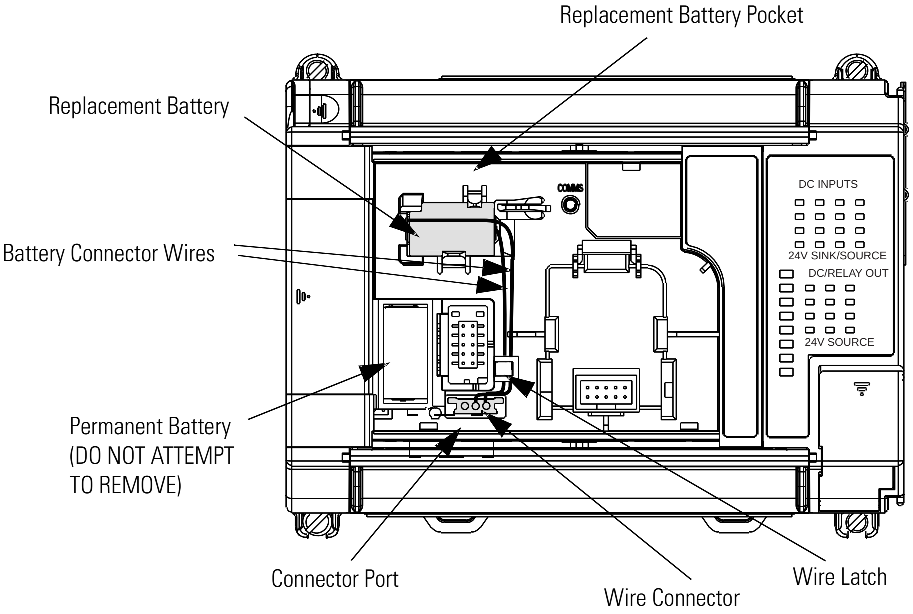
- 14 days for the 1764-LSP
- 7 days for the 1764-LRP

Installing

Follow the procedure below to ensure proper replacement battery installation.

IMPORTANT Do not remove the permanent battery when installing replacement battery.

1. Insert battery into replacement battery pocket with wires facing up.
2. Insert replacement battery wire connector into connector port.
3. Secure battery wires under wire latch (as shown below).



Battery Handling

Follow the procedure below to ensure proper battery operation and reduce personnel hazards.

- Use only for the intended operation.
- Do not ship or dispose of cells except according to recommended procedures.
- Do not ship on passenger aircraft.

ATTENTION

- Do not charge the batteries. An explosion could result or the cells could overheat causing burns.
- Do not open, puncture, crush, or otherwise mutilate the batteries. A possibility of an explosion exists and/or toxic, corrosive, and flammable liquids would be exposed.
- Do not incinerate or expose the batteries to high temperatures. Do not attempt to solder batteries. An explosion could result.
- Do not short positive and negative terminals together. Excessive heat can build up and cause severe burns.

Storing

Store lithium batteries in a cool, dry environment, typically +20°C to +25°C (+68°F to 77°F) and 40% to 60% humidity. Store the batteries and a copy of the battery instruction sheet in the original container, away from flammable materials.

Transporting

One or Two Batteries

Each battery contains 0.23 grams of lithium. Therefore, up to two batteries can be shipped together within the United States without restriction. Regulations governing shipment to or within other countries may differ.

Three or More Batteries

Procedures for the transportation of three or more batteries shipped together within the United States are specified by the Department of Transportation (DOT) in the Code of Federal Regulations, CFR49, “Transportation.” An exemption to these regulations, DOT - E7052, covers the transport of certain hazardous materials classified as flammable solids. This exemption authorizes transport of lithium batteries by motor vehicle, rail freight, cargo vessel, and cargo-only aircraft, providing certain conditions are met. Transport by passenger aircraft is not permitted.

A special provision of DOT-E7052 (11th Rev., October 21, 1982, par. 8-a) provides that:

> “Persons that receive cell and batteries covered by this exemption may reship them pursuant to the provisions of 49 CFR 173.22a in any of these packages authorized in this exemption including those in which they were received.”

The Code of Federal Regulations, 49 CFR 173.22a, relates to the use of packaging authorized under exemptions. In part, it requires that you must maintain a copy of the exemption at each facility where the packaging is being used in connection with shipment under the exemption.

Shipment of depleted batteries for disposal may be subject to specific regulation of the countries involved or to regulations endorsed by those countries, such as the IATA Articles Regulations of the International Air Transport Association, Geneva, Switzerland.

IMPORTANT Regulations for transportation of lithium batteries are periodically revised.

Disposing

ATTENTION Do not incinerate or dispose of lithium batteries in general trash collection. Explosion or violent rupture is possible. Batteries should be collected for disposal in a manner to prevent against short-circuiting, compacting, or destruction of case integrity and hermetic seal.

For disposal, batteries must be packaged and shipped in accordance with transportation regulations, to a proper disposal site. The U.S. Department of Transportation authorizes shipment of “Lithium batteries for disposal” by motor vehicle only in regulation 173.1015 of CFR 49 (effective January 5, 1983). For additional information contact:

U.S. Department of Transportation
Research and Special Programs Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

Although the Environmental Protection Agency at this time has no regulations specific to lithium batteries, the material contained may be considered toxic, reactive, or corrosive. The person disposing of the material is responsible for any hazard created in doing so. State and local regulations may exist regarding the disposal of these materials.

For a lithium battery product safety data sheet, contact the manufacturer:

Sanyo Energy Corporation
2001 Sanyo Avenue
San Diego, CA 92173
(619) 661-4801

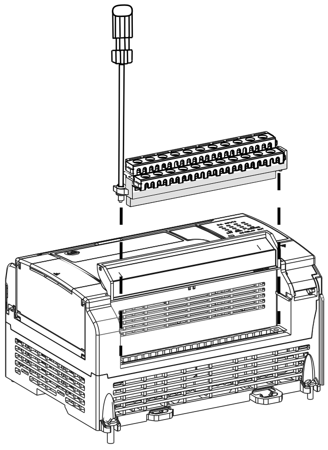
Tadarand Electronic Industries
2 Seaview Blvd.
Port Washington, NY 11050
(516) 621-4980

Replacement Terminal Blocks

This figure illustrates how to replace the MicroLogix 1500 terminal blocks.

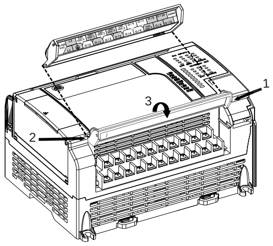
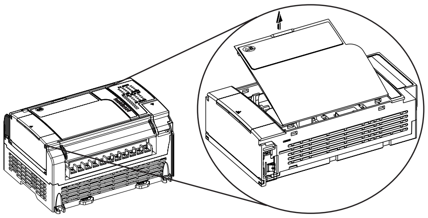
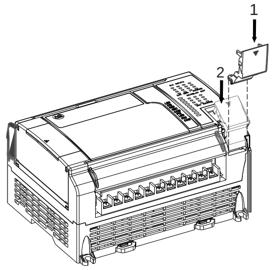
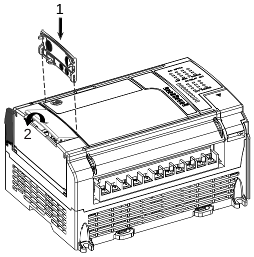
Catalog Numbers:

- 1764-RPL-TB1: 17-point terminal block
- 1764-RPL-TB2: 21-point terminal block



Replacement Doors

The following figures illustrate the procedure for installing the MicroLogix 1500 replacement doors.

Base Terminal Door (1764-RPL-TDR1)	
Processor Access Door (1764-RPL-CDR1)	
Base Comms Door (included in 1764-RPL-DR)	
Trim Pots/Mode Switch Cover Door (included in 1764-RPL-DR)	

Appendix C

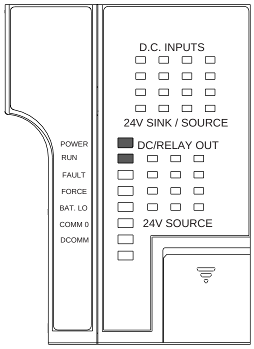
Troubleshooting Your System

This chapter describes how to troubleshoot your controller. Topics include:

- understanding the controller LED status
- controller error recovery model
- identifying controller faults
- calling Rockwell Automation for assistance

Understanding Controller LEDs

The controller status LEDs provide a mechanism to determine the current status of the controller if a programming device is not present or available.



LED	Color	Indicates
POWER	off	no input power
	green	power on
RUN	off	controller is not in Run mode or REM Run
	green	controller is in Run mode or REM Run
	green flashing	system is not in Run mode; memory module transfer is in progress
FAULT	off	no fault detected
	red flashing	faulted user program
	red	processor hardware fault or critical fault
FORCE	off	no forces installed
	amber	forces installed
BATTERY LOW	off	battery OK
	red	battery needs replacement (See page B-2.)
COMM 0	off	flashes when communications are active
	green	
COMM 1 (1764-LRP only)	off	flashes when communications are active
	green	
DCOMM(1)	off	user configured communications mode is active
	green	default communications mode active

LED	**Color**	**Indicates**
INPUTS	off	input is not energized
	amber	input is energized (logic status)
OUTPUTS	off	output is not energized
	amber	output is energized (logic status)

(1) When using a 1764-LRP processor, the DCOMM LED applies only to Channel 0.

When Operating Normally

The POWER and RUN LEDs are on. If a force condition is active, the FORCE LED turns on and remains on until all forces are removed.

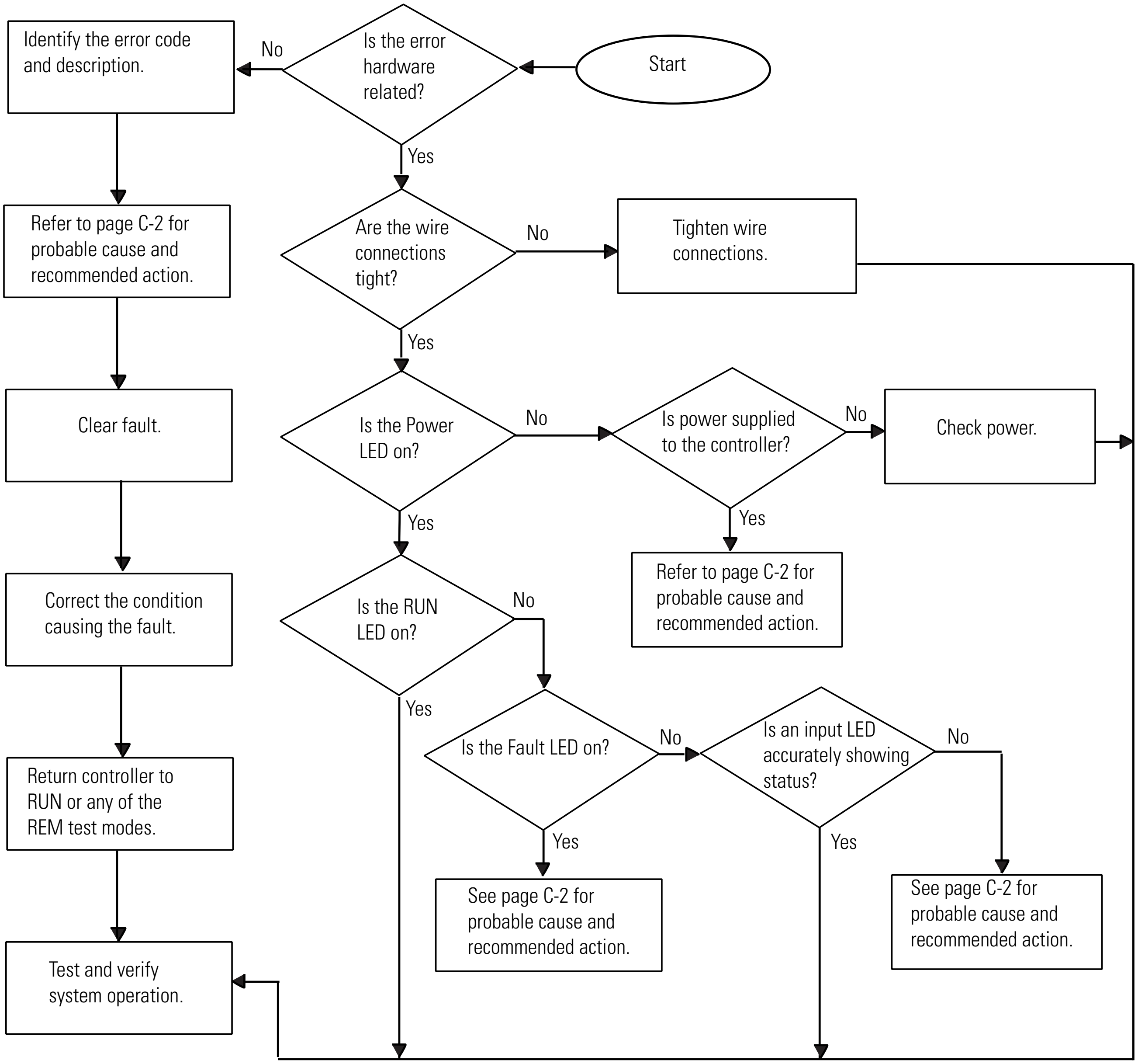
When an Error Exists

If an error exists within the controller, the controller LEDs operate as described in the following tables.

If the LEDS indicate:	**The Following Error Exists**	**Probable Cause**	**Recommended Action**
All LEDS off	No input power or power supply error	No Line Power	Verify proper line voltage and connections to the controller.
		Power Supply Overloaded	This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.
Power and FAULT LEDs on solid	Hardware faulted	Processor Hardware Error	Cycle power. Contact your local Rockwell Automation representative if the error persists.
		Loose Wiring	Verify connections to the controller.
Power LED on and FAULT LED flashing	Application fault	Hardware/Software Major Fault Detected	1. Monitor Status File Word S:6 for major error code. See page C-5 for more information. 2. Remove hardware/software condition causing fault. 3. Clear Major Error Halted flag, bit S2:1/13. 4. Attempt a controller Run mode entry. If unsuccessful, repeat recommended action steps above or contact your local Rockwell Automation distributor.

Controller Error Recovery Model

Use the following error recovery model to help you diagnose software and hardware problems in the micro controller. The model provides common questions you might ask to help troubleshoot your system. Refer to the recommended pages within the model for further help.



Identifying Controller Faults

While a program is executing, a fault may occur within the operating system or your program. When a fault occurs, you have various options to determine what the fault is and how to correct it. This section describes how to clear faults and provides a list of possible advisory messages with recommended corrective actions.

Automatically Clearing Faults

You can automatically clear a fault by cycling power to the controller when the Fault Override at Power-up bit (S:1/8) is set in the status file.

You can also configure the controller to clear faults and go to RUN every time the controller is power cycled. This is a feature that OEMs can build into their equipment to allow end users to reset the controller. If the controller faults, it can be reset by simply cycling power to the machine. To accomplish this, set the following bits in the status file:

- S2:1/8 - Fault Override at Power-up
- S2:1/12 - Mode Behavior

If the fault condition still exists after cycling power, the controller re-enters the fault mode. For more information on status bits, refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference Manual,* publication 1762-RM001.

TIP

You can declare your own application-specific major fault by writing your own unique value to S:6 and then setting bit S:1/13 to prevent reusing system defined codes. The recommended values for user defined faults are FF00 to FF0F.

Manually Clearing Faults Using the Fault Routine

The occurrence of recoverable or non-recoverable user faults can cause the user fault subroutine to be executed. If the fault is recoverable, the subroutine can be used to correct the problem and clear the fault bit S:1/13. The controller then continues in the Run or test mode.

The subroutine does not execute for non-user faults. Refer to the *MicroLogix 1200 and MicroLogix 1500 Instruction Set Reference*

Manual, publication 1762-RM001, for information on creating a user fault subroutine.

Fault Messages

Refer to the *MicroLogix 1200 and 1500 Instruction Set Reference Manual,* publication 1762-RM001, for the controller fault messages that can occur during operation of the MicroLogix 1500 programmable controllers. Each fault message includes the error code description, the probable cause, and the recommended corrective action.

Calling Rockwell Automation for Assistance

If you need to contact Rockwell Automation or local distributor for assistance, it is helpful to obtain the following (prior to calling):

- controller type, series letter, and revision letter of the base unit
- series letter, revision letter, and firmware (FRN) number of the processor (on bottom side of processor unit)
- controller LED status
- controller error codes (found in S2:6 of status file).

Appendix D

Upgrading Your Operating System

The operating system (OS) can be upgraded through the communication port on the controller. In order to download a new operating system, you must have the following:

- ControlFLASH™ Upgrade Kit containing the new OS
- a Windows® 95, Windows® 98, Windows NT™, or Windows® 2000 based computer to run the download software.

The ControlFLASH™ Upgrade Kit includes:

- the operating system upgrade to be downloaded
- the ControlFLASH programming tool, along with its support drivers and on-line help
- a readme first file explaining how to upgrade the operating system

Preparing for Upgrade

Before upgrading the controller's operating system, you must:

- Obtain the operating system upgrade from *http://www.ab.com/micrologix* or from your local Allen-Bradley distributor

IMPORTANT Installing a new operating system deletes the controller's user program.

- Install the ControlFlash Software. Double click the processor catalog number/firmware revision number to install the operating system upgrade.
- The controller must be configured for default communications (use communications toggle push button; DCOMM LED on) and be in the Program mode to allow the download of a new operating system.

Performing the Upgrade

The following steps occur during the upgrade process.

1. Controller mode and communications parameters are checked.
2. Download begins.
3. During the download, the Force, Battery, and Comms LEDs perform a walking bit pattern.
4. When the download is complete, the integrity of the new OS is checked. If the new OS is corrupt, the controller sends an error message to the computer and flashes the Missing or Corrupt OS LED pattern. See Missing/Corrupt OS LED Pattern below.
5. Following a successful transfer, the Power, Force, and Battery LEDs flash on and remain on for five seconds. Then the controller resets.

Missing/Corrupt OS LED Pattern

When an operating system download is not successful or if the controller does not contain a valid operating system, the controller flashes the Run, Force, and Fault LEDS on and off.

Understanding Communication Protocols

Use the information in this appendix to understand the differences in communication protocols. The following protocols are supported from the RS-232 communication channel:

- DF1 Full-Duplex
- DF1 Half-Duplex Slave
- DH-485
- Modbus RTU Slave (1764-LSP and 1764-LRP Series B Processors only)
- ASCII (1764-LSP and 1764-LRP Series B Processors only)

See Chapter 4 for information about required network devices and accessories.

RS-232 Communication Interface

The communications port on the MicroLogix 1500 utilizes an RS-232 interface. RS-232 is an Electronics Industries Association (EIA) standard that specifies the electrical characteristics for serial binary communication. It provides you with a variety of system configuration possibilities. (RS-232 defines electrical characteristics; it is *not* a protocol.)

One of the biggest benefits of an RS-232 interface is that it lets you easily integrate telephone and radio modems into your control system.

DF1 Full-Duplex Protocol

DF1 Full-Duplex protocol is an open protocol developed by Allen-Bradley. It provides a point-to-point connection between two devices. DF1 Full-Duplex protocol combines data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1) and 2-way simultaneous transmission with embedded responses (subcategory F1). Refer to *DF1 Protocol and Command Set Reference Manual*, publication 1770-6.5.16, for more information.

DF1 Full-Duplex protocol (also referred to as DF1 point-to-point protocol) is useful where RS-232 point-to-point communication is required. DF1 protocol controls message flow, detects and signals errors, and retries if errors are detected.

MicroLogix 1500 controllers support the DF1 Full-Duplex protocol via RS-232 connection to external devices such as computers, controllers, and other interface devices that support DF1 Full-Duplex.

For information about required network connecting equipment and examples of DF1 Full-Duplex connections, see Chapter 4.

DF1 Half-Duplex Protocol

DF1 Half-Duplex protocol is a multi-drop single master/multiple slave network. DF1 Half-Duplex protocol supports data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1). In contrast to DF1 Full-Duplex, communication takes place in one direction at a time. With an active Half-Duplex Master, you can use the RS-232 port on the MicroLogix 1500 as a Half-Duplex programming port and a Half-Duplex peer-to-peer messaging port.

DF1 Half-Duplex Operation

A DF1 Half-Duplex master device initiates all communication by “polling” each slave device. The slave device may only transmit when it is polled by the master. It is the master’s responsibility to poll each slave on a regular and sequential basis to allow slave devices an opportunity to communicate.

An additional feature of the DF1 Half-Duplex protocol is that it is possible for a slave device to enable a MSG write or read to/from another slave. When the initiating slave is polled, the MSG is sent to the master. The master recognizes that the message is not intended for it, but for another slave, so the master immediately forwards the message to the intended slave. The master does this automatically; you do not need to program the master to move data between slave nodes. This slave-to-slave transfer can also be used by programming software to allow slave-to-slave upload and download of programs to processors (including the master) on the DF1 Half-Duplex link.

The MicroLogix 1500 can only act as a slave device. A device that can act as a master is required to “run” the network. Several Allen-Bradley products support DF1 Half-Duplex master protocol. They include the SLC 5/03™ and higher processors, enhanced PLC-5® processors, and Rockwell Software RSLinx (version 2.x and higher).

DF1 Half-Duplex supports up to 255 devices (address 0 to 254) with address 255 reserved for master broadcasts. The MicroLogix 1500 supports broadcast reception.

Considerations When Communicating as a DF1 Slave on a Multi-drop Link

When communication is between either your programming software and a MicroLogix Programmable Controller or between two MicroLogix 1500 Programmable Controllers via slave-to-slave communication on a larger multi-drop link, the devices depend on a DF1 Half-Duplex Master to give each of them access in a timely manner. As the number of slave devices increase, the time between when slave devices are polled also increases. This increase in time may also be large if you are using low baud rates. As these time periods grow, you may need to increase the poll timeout and reply timeout values for slave devices.

IMPORTANT If a program download is started when using DF1 Half-Duplex, but then is interrupted due to electromagnetic interference or other events, discontinue communications to the controller for the *ownership timeout* period and then restart the program download. The *ownership timeout* period is 60 seconds. After the timeout, you can re-establish communications with the processor and try the program download again. The only other way to remove program ownership is to cycle power on the processor.

Using Modems with MicroLogix 1500 Programmable Controllers

The types of modems that you can use with MicroLogix 1500 controllers include dial-up phone modems, leased-line modems, radio modems and line drivers.

For point-to-point Full-Duplex modem connections that do not require any modem handshaking signals to operate, use DF1 Full-Duplex protocol with no handshaking. For point-to-point Full-Duplex modem connections that require RTS/CTS handshaking, use DF1 Full-Duplex protocol with handshaking.

For multi-drop modem connections, or for point-to-point modem connections that require RTS/CTS handshaking, use DF1 Half-Duplex slave protocol.

IMPORTANT Never attempt to use DH-485 protocol through modems under any circumstance.

TIP All MicroLogix controllers support RTS/CTS modem handshaking when configured for DF1 Full-Duplex protocol with the control line parameter set to Full-Duplex Modem Handshaking or DF1 Half-Duplex slave protocol with the control line parameter set to “Half-Duplex Modem”. No other modem handshaking lines (i.e. Data Set Ready, Carrier Detect and Data Terminal Ready) are supported by any MicroLogix 1500 controllers. MicroLogix 1500 1764-LRP processors also support DCD (Data Carrier Detect)

Dial-Up Phone Modems

Some dial-up phone line modems support point-to-point Full-Duplex communications. A MicroLogix 1500 controller, on the receiving end of the dial-up connection, can be configured for DF1 Full-Duplex protocol with or without handshaking. The modem connected to the MicroLogix controller should support auto-answer. The MicroLogix 1500 Series B processors (1764-LSP and 1764-LRP) support ASCII out communications. There fore, they can cause the modem to initiate or disconnect a phone call.

Leased-Line Modems

Leased-line modems are used with dedicated phone lines that are typically leased from the local phone company. The dedicated lines may be in a point-to-point topology supporting Full-Duplex communications between two modems or in a multi-drop topology supporting Half-Duplex communications between three or more modems.

Radio Modems

Radio modems may be implemented in a point-to-point topology supporting either Half-Duplex or Full-Duplex communications, or in a multi-drop topology supporting Half-Duplex communications between three or more modems.

Line Drivers

Line drivers, also called short-haul "modems", do not actually modulate the serial data, but rather condition the electrical signals to operate reliably over long transmission distances (up to several miles). Line drivers are available in Full- and Half-Duplex models. Allen-Bradley's AIC+ Advanced Interface Converter is a Half-Duplex line driver that converts an RS-232 electrical signal into an RS-485 electrical signal, increasing the signal transmission distance from 50 to 4000 feet (8000 feet when bridged).

DH-485 Communication Protocol

The information in this section describes DH-485 network functions, network architecture, and performance characteristics. It will also help you plan and operate the MicroLogix controllers on a DH-485 network.

DH-485 Network Description

The DH-485 protocol defines the communication between multiple devices that coexist on a single pair of wires. DH-485 protocol uses RS-485 Half-Duplex as its physical interface. (RS-485 is a definition of electrical characteristics; it is *not* a protocol.) RS-485 uses devices that are capable of co-existing on a common data circuit, thus allowing data to be easily shared between devices.

The DH-485 network offers:

- interconnection of 32 devices
- multi-master (peer-to-peer) capability
- token passing access control
- the ability to add or remove nodes without disrupting the network
- maximum network segment of 1219 m (4000 ft)

The DH-485 protocol supports two classes of devices: initiators and responders. All initiators on the network get a chance to initiate message transfers. To determine which initiator has the right to transmit, a token passing algorithm is used.

The following section describes the protocol used to control message transfers on the DH-485 network.

DH-485 Token Rotation

A node holding the token can send a message onto the network. Each node is allowed a fixed number of transmissions (based on the Token Hold Factor) each time it receives the token. After a node sends a message, it passes the token to the next device.

The allowable range of node addresses is 1 to 31. There must be at least one initiator on the network (such as a MicroLogix controller, or an SLC 5/02™ or higher processor).

DH-485 Configuration Parameters

When MicroLogix communications are configured for DH-485, the following parameters can be changed:

Table E.1 DF1 Full-Duplex Configuration Parameters

Parameter	Options
Baud Rate	9600, 19.2K
Node Address	1 to 31 decimal
Token Hold Factor	1 to 4

See Software Considerations on page E-10 for tips on setting the parameters listed above.

Devices that Use the DH-485 Network

In addition to the MicroLogix 1500 controllers, the devices shown in the following table also support the DH-485 network.

Table E.2 Allen-Bradley Devices that Support DH-485 Communication

Catalog Number	Description	Installation	Function	Publication
Bulletin 1761 Controllers	MicroLogix 1000	Series C or higher	These controllers support DH-485 communications.	1761-6.3
Bulletin 1762	MicroLogix 1200	Series A or higher	These controllers support DH-485 communications.	1762-UM001
Bulletin 1747 Processors	SLC 500 Processors	SLC Chassis	These processors support a variety of I/O requirements and functionality.	1747-6.2
1746-BAS	BASIC Module	SLC Chassis	Provides an interface for SLC 500 devices to foreign devices. Program in BASIC to interface the 3 channels (2 RS232 and 1 DH-485) to printers, modems, or the DH-485 network for data collection.	1746-6.1 1746-6.2 1746-6.3
1785-KA5	DH+™/ DH-485 Gateway	(1771) PLC Chassis	Provides communication between stations on the PLC-5® (DH+) and SLC 500 (DH-485) networks. Enables communication and data transfer from PLC® to SLC 500 on DH-485 network. Also enables programming software programming or data acquisition across DH+ to DH-485.	1785-6.5.5 1785-1.21
2760-RB	Flexible Interface Module	(1771) PLC Chassis	Provides an interface for SLC 500 (using protocol cartridge 2760-SFC3) to other A-B PLCs and devices. Three configurable channels are available to interface with Bar Code, Vision, RF, Dataliner™, and PLC systems.	1747-KE 2760-ND001
1784-KTX, -KTXD	PC DH-485 IM	IBM XT/AT Computer Bus	Provides DH-485 using RSLinx.	1784-6.5.22
1784-PCMK	PCMCIA IM	PCMCIA slot in computer and Interchange	Provides DH-485 using RSLinx.	1784-6.5.19

Table E.2 Allen-Bradley Devices that Support DH-485 Communication

Catalog Number	Description	Installation	Function	Publication
1747-PT1	Hand-Held Terminal	NA	Provides hand-held programming, monitoring, configuring, and troubleshooting capabilities for SLC 500 processors.	1747-NP002
1747-DTAM, 2707-L8P1, -L8P2, -L40P1, -L40P2, -V40P1, -V40P2, -V40P2N, -M232P3, and -M485P3	DTAM, DTAM Plus, and DTAM Micro Operator Interfaces	Panel Mount	Provides electronic operator interface for SLC 500 processors.	1747-ND013 2707-800, 2707-803
2711-K5A2, -B5A2, -K5A5, -B5A5, -K5A1, -B5A1, -K9A2, -T9A2, -K9A5, -T9A5, -K9A1, and -T9A1	PanelView 550 and PanelView 900 Operator Terminals	Panel Mount	Provides electronic operator interface for SLC 500 processors.	2711-802, 2711-816

NA = Not Applicable

Important DH-485 Network Planning Considerations

Carefully plan your network configuration before installing any hardware. Listed below are some of the factors that can affect system performance:

- amount of electrical noise, temperature, and humidity in the network environment
- number of devices on the network
- connection and grounding quality in installation
- amount of communication traffic on the network
- type of process being controlled
- network configuration

The major hardware and software issues you need to resolve before installing a network are discussed in the following sections.

Hardware Considerations

You need to decide the length of the communication cable, where you route it, and how to protect it from the environment where it will be installed.

When the communication cable is installed, you need to know how many devices are to be connected during installation and how many devices will be added in the future. The following sections will help you understand and plan the network.

Number of Devices and Length of Communication Cable

The maximum length of the communication cable is 1219m (4000 ft). This is the total cable distance from the first node to the last node in a segment. However, two segments can be used to extend the DH-485 network to 2438m (8000 ft). for additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual*, publication 1761-6.4.

Planning Cable Routes

Follow these guidelines to help protect the communication cable from electrical interference:

- Keep the communication cable at least 1.52m (5 ft) from any electric motors, transformers, rectifiers, generators, arc welders, induction furnaces, or sources of microwave radiation.
- If you must run the cable across power feed lines, run the cable at right angles to the lines.
- If you do not run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.15m (6 in.) from ac power lines of less than 20A, 0.30m (1 ft) from lines greater than 20A, but only up to 100 kVA, and 0.60m (2 ft) from lines of 100 kVA or more.
- If you run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.08m (3 in.) from ac power lines of less than 20A, 0.15m (6 in.) from lines greater than 20A, but only up to 100 kVA, and 0.30m (1 ft) from lines of 100 kVA or more.

  Running the communication cable through conduit provides extra protection from physical damage and electrical interference. If you route the cable through conduit, follow these additional recommendations:

- Use ferromagnetic conduit near critical sources of electrical interference. You can use aluminum conduit in non-critical areas.
- Use plastic connectors to couple between aluminum and ferromagnetic conduit. Make an electrical connection around the plastic connector (use pipe clamps and the heavy gauge wire or wire braid) to hold both sections at the same potential.
- Ground the entire length of conduit by attaching it to the building earth ground.
- Do not let the conduit touch the plug on the cable.
- Arrange the cables loosely within the conduit. The conduit should contain only serial communication cables.
- Install the conduit so that it meets all applicable codes and environmental specifications.

For more information on planning cable routes, see *Industrial Automation Wiring and Grounding Guidelines*, publication 1770-4.1.

Software Considerations

Software considerations include the configuration of the network and the parameters that can be set to the specific requirements of the network. The following are major configuration factors that have a significant effect on network performance:

- number of nodes on the network
- addresses of those nodes
- baud rate

The following sections explain network considerations and describe ways to select parameters for optimum network performance (speed). See your programming software's user manual for more information.

Number of Nodes

The number of nodes on the network directly affects the data transfer time between nodes. Unnecessary nodes (such as a second programming terminal that is not being used) slow the data transfer rate. The maximum number of nodes on the network is 32.

Setting Node Addresses

The best network performance occurs when node addresses are assigned in sequential order. Initiators, such as personal computers, should be assigned the lowest numbered addresses to minimize the time required to initialize the network. The valid range for the MicroLogix 1500 controllers is 1-31 (controllers cannot be node 0). The default setting is 1. The node address is stored in the controller Communications Status file (CS0:5/0 to CS0:5/7).

Setting Controller Baud Rate

The best network performance occurs at the highest baud rate, which is 19200. This is the default baud rate for a MicroLogix 1500 device on the DH-485 network. All devices must be at the same baud rate. This rate is stored in the controller Communications Status file (CS0:5/8 to CS0:5/15).

Setting Maximum Node Address

Once you have an established network set up and are confident that you will not be adding more devices, you may enhance performance by adjusting the maximum node address of your controllers. It should be set to the highest node address being used.

IMPORTANT All devices should be set to the same maximum node address.

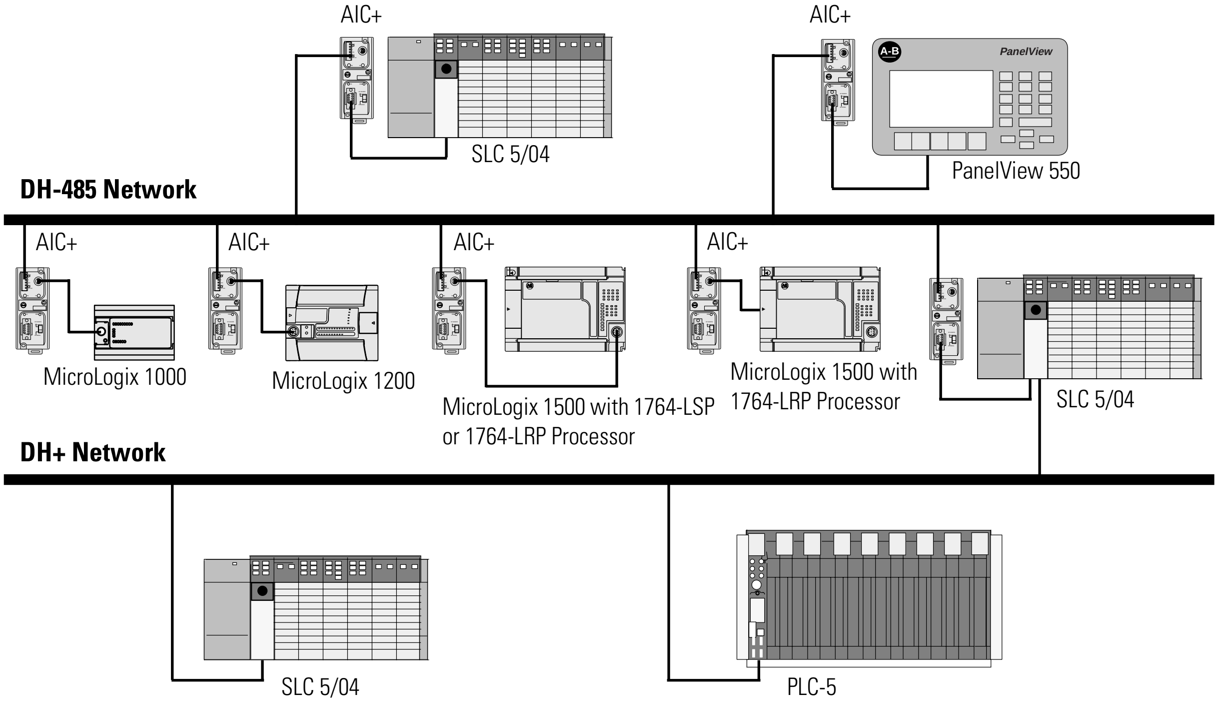
MicroLogix Remote Packet Support

MicroLogix 1500 controllers can respond and initiate with device’s communications (or commands) that do not originate on the local DH-485 network. This is useful in installations where communication is needed between the DH-485 and DH+ networks.

The example below shows how to send messages from a PLC device or a PC on the DH+ network to a MicroLogix controller on the DH-485 network. This method uses an SLC 5/04 processor bridge connection.

When using this method (as shown in the following illustration):

- PLC-5 devices can send read and write commands to MicroLogix 1500 controllers.
- MicroLogix 1500 controllers can respond to MSG instructions received.
- The MicroLogix 1500 controllers can initiate MSG instructions to devices on the DH+ network.
- PC can send read and write commands to MicroLogix 1500 controllers.
- PC can do remote programming of MicroLogix 1500 controllers.



Modbus RTU Slave Communication Protocol (MicroLogix 1764-LSP and 1764-LRP Series B and later processors only)

Modbus RTU Slave is a Half-Duplex, master-slave communications protocol. The Modbus network master initiates and controls all communications on the network. Modbus protocol allows a single master to communicate with a maximum of 255 slave devices.

When a MicroLogix 1200 or 1500 Communications port is configured for Modbus RTU Slave operation, the user must define where Modbus data (coils, contacts, and registers) is mapped into the MicroLogix data space.

The Modbus address space is comprised of seven distinct memory ranges. Four of these ranges can be mapped into MicroLogix data files. Three Modbus ranges are fixed to MicroLogix file 2, the Status file. The table below illustrates Modbus to MicroLogix mappings.

Table E.3 Modbus to MicroLogix Memory Map

Modbus Addressing	Description	Valid MicroLogix Addressing		
		File Type	Data File Number	Address
0001 to 4096	Read/Write Modbus Coil Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
10001 to 14096	Read-Only Modbus Contact Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
30001 to 30256	Read-Only Modbus Input Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
30501 to 30532	Modbus Communication Parameters	Communication Status Files	2	words 0 to 31
31501 to 31566	Read-Only System Status File space	Status (S)	2	words 32 to 65
40001 to 40256	Read/Write Modbus Holding Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
41501 to 41566	Read/Write System Status File space	Status (S)	2	words 0 to 65

For more information on the MicroLogix 1500 configuration parameters for Modbus Slave RTU (Remote Terminal Unit transmission mode) protocol, refer to the MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual, publication 1762-RM001. For more information about the Modbus Slave protocol, see the Modbus Protocol Specifications (available from http://www.modicon.com/techpubs/).

ASCII Protocol (MicroLogix 1500 1764-LSP and 1764-LRP Series B and later Processors only)

ASCII protocol provides connection to other ASCII devices, such as bar code readers, weigh scales, serial printers, and other intelligent devices.

You can use ASCII protocol by configuring the RS-232 port, channel 0 for ASCII driver (*For the 1764-LRP only, you can select either Channel 0 or Channel 1*).

Refer to the *MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001 for detailed configuration information.

When the driver is set to ASCII, the following parameters can be changed:

Table E.4 ASCII Channel Configuration Parameters

Parameter	Description	Programming Software Default
Baud Rate	Toggles between the communication rate of 300, 600, 1200, 2400, 4800, 9600, 19.2K, and 38.4K.	1200
Parity	Toggles between None, Odd, and Even.	None
Termination 1	Specifies the first termination character. The termination character defines the one or two character sequence used to specify the end of an ASCII line received. Setting the first ASCII termination character to undefined (\ff) indicates no ASCII receiver line termination is used.	\d
Termination 2	Specifies the second termination character. The termination character defines the one or two character sequence used to specify the end of an ASCII line received. Setting the second ASCII Termination character to undefined (\ff) and the first ASCII Termination character to a defined value (\d) indicates a single character termination sequence.	\ff
Control Line	Toggles between No Handshaking, Half-Duplex Modem, and Full-Duplex Modem	No Handshaking
Delete Mode	The Delete Mode allows you to select the mode of the “delete” character. Toggles between Ignore, CRT, and Printer. Delete Mode affects the characters echoed back to the remote device. When Delete Mode is enabled, the previous character is removed from the receive buffer. • In CRT mode, when a delete character is encountered, the controller echos three characters to the device: backspace, space, and backspace. This erases the previous character on the terminal. • In Printer Mode, when a delete character is encountered, the controller echos the slash character, then the deleted character. Enable the Echo parameter to use Delete Mode.	Ignore
Echo	When Echo Mode is enabled, all of the characters received are echoed back to the remote device. This allows you to view characters on a terminal connected to the controller. Toggles between Enabled and Disabled.	Disabled
XON/XOFF	Allows you to Enable or Disable XON/ XOFF software handshaking. XON/XOFF software handshaking involves the XON and XOFF control characters in the ASCII character set. When the receiver receives the XOFF character, the transmitter stops transmitting until the receiver receives the XON character. If the receiver does not receive an XON character after 60 seconds, the transmitter automatically resumes sending characters. Also, when the receive buffer is more than 80% full, an XOFF character is sent to the remote device to pause the transmission. Then, when the receive buffer drops to less than 80% full, an XON character is sent to the remote device to resume the transmission.	Disabled
RTS Off Delay (x20 ms)	Allows you to select the delay between when a transmission is ended and when RTS is dropped. Specify the RTS Off Delay value in increments of 20 ms. Valid range is 0 to 65535.	0
RTS Send Delay (x20 ms)	Allows you to select the delay between when RTS is raised and the transmission is initiated. Specify the RTS Send Delay value in increments of 20 ms. Valid range is 0 to 65535.	0

System Loading and Heat Dissipation

System Loading Limitations

When you connect MicroLogix accessories and expansion I/O, an electrical load is placed on the base unit power supply. This section shows how to calculate the load and validate that the system will not exceed the capacity of the base unit power supply or expansion power supply.

The following example is provided to illustrate system loading validation. The system validation procedure accounts for the amount of 5V dc and 24V dc current consumed by controller, expansion I/O, and user supplied equipment.

Current consumed by the Base Units, Memory Modules, Real Time Clock Modules, and the End Cap Terminators (for systems utilizing Compact I/O expansion) has already been factored into the calculations. A system is valid if the current and power requirements are satisfied.

TIP An End Cap Terminator (catalog number 1769-ECR or -ECL) is needed for any system using Compact expansion I/O.

IMPORTANT In a MicroLogix 1500 system, a maximum of one 1769 expansion cable can be used, allowing for two banks of I/O modules. One bank is connected directly to the controller and the other is connected via the expansion cable. The bank connected to the controller uses the controller's embedded power supply. The bank connected via the cable requires its own power supply.

System Expansion Calculations

A download is also available for system validation. On the Internet, go to http://www.ab.com/micrologix and navigate to MicroLogix 1500.

The procedure in this publication consists of:

- Selecting System Devices
- Verifying the System Loading

Selecting System Devices

1. Use Table F.1 to select the processor and optional communications or display devices. Enter a 1 in the “Select Devices” column.

2. Enter the current draw values in the “Calculated Current for System” columns. If an external power supply will be used to power communication devices, do not include their current draw values in this calculation. Add up the current draw values to determine the “SUBTOTAL1” values.

Table F.1 Selecting Hardware: Base Unit and Communications/Display Devices

Catalog Number	Select Device(s)	Bus Current Draw Specification		Calculated Current for System	
		at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
Choose a Processor, LSP or LRP:					
1764-LSP		300	0		
1764-LRP		380	0		
1764-DAT[1] optional		350	0		
Communications/Display Devices, optional, one only maximum:					
1761-NET-AIC[1]		0	120[2]		
1761-NET-ENI[1]		0	100[2]		
2707-MVH232 or 2707-MVP232[1]		0	80[2]		
			SUBTOTAL1	**(A1)**	**(B1)**

(1) These are optional accessories. Current is consumed only if the accessory is installed.

(2) Current for the AIC+ and ENI may be supplied by controller communications port or from an external 24V dc source. No current is consumed from the controller when a user-supplied, external source is used. If an external source is to be used, do not select the device here. The current for a 2707-MVH232 or 2707-MVP232 MicroView Operator Interface is supplied from the controller communication port, when directly connected.

3. Use Table F.2 to select the I/O modules. Enter the number of modules in either the “Base Unit Expansion” or the “Bank 1” column.

IMPORTANT When planning the system layout, keep in mind that each module has a “Power Supply Distance Rating”. This is the maximum distance an I/O module may be located from the power supply. For most modules, the rating is 8. For the 1769-HSC and 1769-SDN, the rating is 4.

Depending on its configuration, the 1769-SDN may transfer large amounts of data into and out of the controller I/O image tables. Care should be taken when using more than three of these modules to verify that they are optimally configured. This will ensure that the maximum available 4K data table size will not be exceeded. Refer to the 1769-SDN User Manual for more details.

4. Enter the current draw values in the “Calculated Current” columns. Add up the current draw values to determine the “SUBTOTAL2” values.

5. Verify that the total number of modules does not exceed the system limits using the maximum values for the base unit and Table F.5 for the expansion power supply, if used.

Table F.2 Selecting Hardware: Expansion I/O

Select I/O Modules for Each Bank:			**Bus Current Draw Specification (mA)**		*Calculate Current Draw:*			
Expansion I/O Modules	**Base Unit Expansion (1)**	**Bank 1(2)**			**Calculated Current for Base Unit Expansion (mA)**		**Calculated Current for Bank 1 Power Supply (mA)(3)**	
					2250 mA max	**400 mA max**		
Catalog Number	**n1**	**n2**	**X**	**Y**	**n1 x X**	**n1 x Y**	**n2 x X**	**n2 x Y**
	Number of Modules(4)		**at 5V dc**	**at 24V dc**	**at 5V dc**	**at 24V dc**	**at 5V dc**	**at 24V dc**
1769-HSC(5)			425	0				
1769-IA16			115	0				
1769-IA8I			90	0				
1769-IF4 (Series A)			120	150				
1769-IF4 (Series B)			120	60				
1769-IF4XOF2			120	160				
1769-IM12			100	0				
1769-IQ16			115	0				
1769-IQ6XOW4			105	50				
1769-IR6			100	45				
1769-IT6			100	40				
1769-OA8			145	0				
1769-OA16			225	0				
1769-OB16			200	0				
1769-OB16P			160	0				
1769-OF2 (Series A)			120	200				
1769-OF2 (Series B)			120	120				
1769-OV16			200	0				
1769-OW8			125	100				
1769-OW8I			125	100				
1769-OW16			205	180				
1769-SDN			440	0				
TOTAL MODULES:			**SUBTOTAL2:**		**(A2)**	**(B2)**	**(C)**	**(D)**

(1) May not exceed 8 I/O modules.

(2) No more than 8 I/O modules on either side of the power supply.

(3) Maximum value depends on the power supply chosen.

(4) Up to 16 modules may be used in a MicroLogix 1500 system when using a Series B Base Unit and Series C processor (up to 8 for Series A Base Units).
A maximum of 8 modules can be connected directly to the Base Unit.
A maximum of 8 modules can be connected to each side of the Expansion Power Supply.

(5) No more than 4 I/O modules may be connected to the base unit or to either side of the expansion power supply when the 1769-HSC or 1769-SDN are used in the system.

Verifying the System Loading

To have a valid system, both current and power requirements must be satisfied.

Verifying the Base Unit Loading

1. Enter the SUBTOTAL values from Tables F.1 and F.2. Add the total current draw for the Base Unit. Verify the values are within the maximum limits.

Table F.3 Base Unit Power Supply Loading - Verify the Current Limits

Current from:	**Calculated Current for System**	
	at 5V dc (mA)	**at 24V dc (mA)**
For 1764-24BWA only, enter sum of any User 24V dc Sensor Current		(E)
MAXIMUM LIMIT	**n/a**	**400 mA User 24V dc**
Values from SUBTOTAL1 (Table F.1)	(A1)	(B1)
Values from SUBTOTAL2 (Table F.2)	(A2)	(B2)
TOTAL BASE UNIT CURRENT LOADING	**(F)**	**(G)**
MAXIMUM LIMIT	**2250 mA at 5V dc**	**400 mA at 24V dc**

2. Using the table below, verify that the MAXIMUM POWER LIMIT is not exceeded.

Table F.4 Base Unit Power Supply Loading - Verify the Required Power

Catalog Number:	**1764-24AWA, 1764-28BXB Base Units**			**1764-24BWA Base Unit**		
5V Power Calculation	(F)	x 5V	= W	(F)	x 5V	= W
24V Power Calculation	(G)	x 24V	= W	(G)	x 24V	= W
				(E)	x 24V	= W
Add up Total Watts	**W**			**W**		
MAXIMUM POWER LIMIT	**16W**			**22W**		

Verifying the Expansion Power Supply Loading

Using the values from SUBTOTAL2, verify that the system loading and I/O distribution are within the limits shown in Table F.5. Consider future expansion when selecting a power supply.

Table F.5 Bank 1 Power Supply Loading - Verify the Current Limits

Specification	Catalog Number	Calculated Current for System		24V dc User Output Capacity
		at 5V dc (mA)	at 24V dc (mA)	
Values from SUBTOTAL2 (Table F.2):		(C)	(D)	
MAXIMUM CURRENT LIMIT	**1769-PA2**	**2000**	**800**	**250 mA**
	1769-PA4	**4000**	**2000**	n/a
	1769-PB2	**2000**	**800**	
	1769-PB4	**4000**	**2000**	
I/O Distribution - Distribute I/O modules such that the current consumed from either the left side or the right side of the power supply never exceeds the following values:	1769-PA2	2000	800	**250 mA**
	1769-PA4	2000	1000	n/a
	1769-PB2	2000	800	
	1769-PB4	2000	1000	

System Using a 1769-PA2

To validate your system, the total 5V dc current and 24V dc current consumed must be considered. The I/O modules must be distributed, such that the current consumed from the left *or* right side of the power supply never exceeds 2A at 5V dc and 1.0A at 24V dc. Use the current graphs below to determine if the power supply loading in your system is within the allowable range.

Figure F.1 1769-PA2 Current with +24V dc User Load = 0A

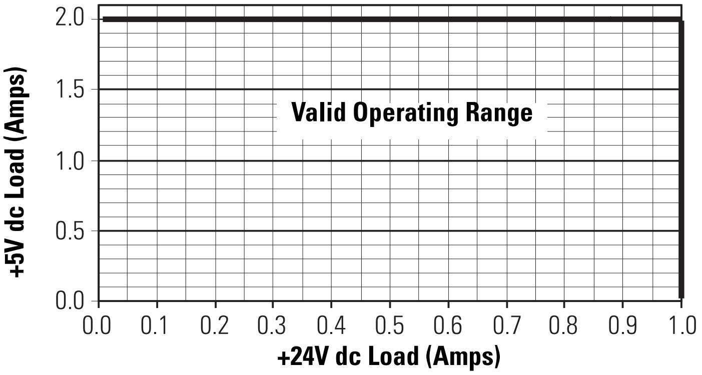


Figure F.2 1769-PA2 Current with +24V dc User Load = 0.2A

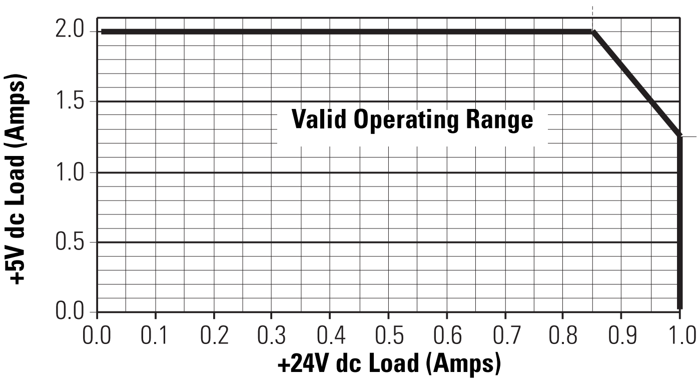
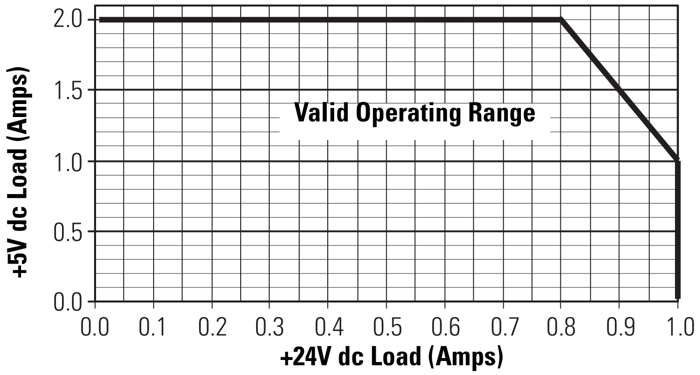


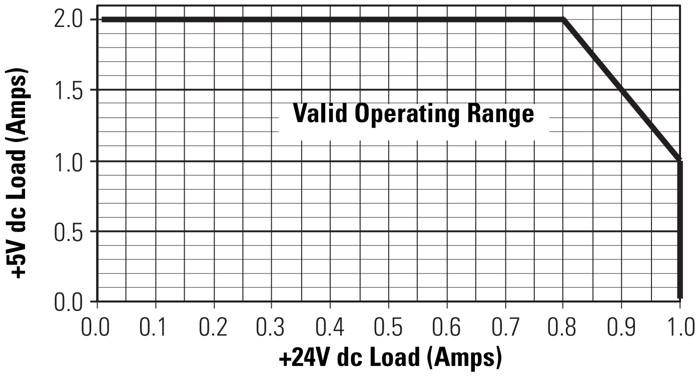
Figure F.3 1769-PA2 Current with +24V dc User Load = 0.25A



System Using a 1769-PB2

To validate your system, the total 5V dc current and 24V dc current consumed must be considered. The I/O modules must be distributed, such that the current consumed from the left *or* right side of the power supply never exceeds 2A at 5V dc and 1.0A at 24V dc. Use the current graph below to determine if the power supply loading in your system is within the allowable range.

Figure F.4 1769-PB2 Current

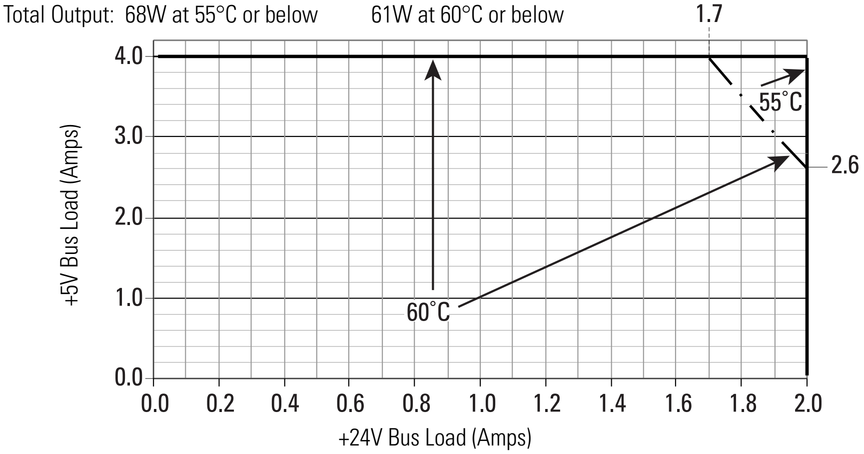


System Using a 1769-PA4

To validate your system, the total 5V dc current and 24V dc current consumed must be considered. The I/O modules connected to the PB2 should be distributed, such that the current consumed from the left and right side of the power supply never exceeds 2A at 5V and 0.8A at 24V dc with an ambient temperature of 0 to 55°C. Use the current graph below to determine if the power supply loading in your system is:

- within the allowable range for special load conditions
- above 55° to 60°C.

Figure 7 1769-PA4 5V and 24V dc Current

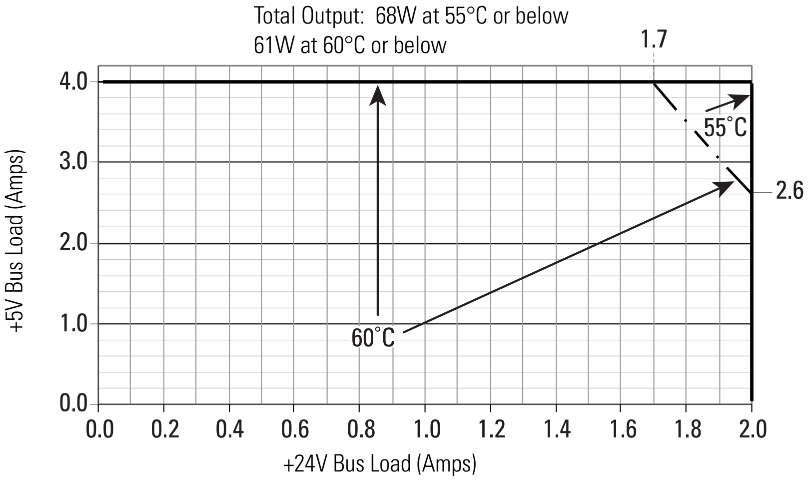


System Using a 1769-PB4

To validate your system, the total 5V dc current and 24V dc current consumed must be considered. The I/O modules connected to the PB2 should be distributed, such that the current consumed from the left and right side of the power supply never exceeds 2A at 5V and 0.8A at 24V dc with an ambient temperature of 0 to 55°C. Use the current graph below to determine if the power supply loading in your system is:

- within the allowable range for special load conditions
- above 55° to 60°C.

Figure 8 1769-PB4 5V and 24V dc Current



Calculating Heat Dissipation

Use this procedure when you need to determine the heat dissipation for installation in an enclosure. Use the following table.

Catalog Number	**Heat Dissipation**		
	Equation or Constant	**Calculation**	**Subtotal**
1764-24AWA	18W + (0.3 x System Loading)	18W + (0.3 x _______ W)	
1764-24BWA	20W + (0.3 x System Loading)	20W + (0.3 x _______ W)	
1764-28BXB	20W + (0.3 x System Loading)	20W + (0.3 x _______ W)	
1764-DAT	1.75W		
1769-HSC	6.21W x number of modules	6.21W x ___________	
1769-IA16	3.30W x number of modules	3.30W x ___________	
1769-IA8I	1.81W x number of modules	1.81W x ___________	
1769-IF4 (Series A)	3.99W x number of modules	3.99W x ___________	
1769-IF4 (Series B)	2.63W x number of modules	2.63W x ___________	
1769-IF4XOF2	3.03W x number of modules	3.03W x ___________	
1769-IM12	3.65W x number of modules	3.65W x ___________	
1769-IQ16	3.55W x number of modules	3.55W x ___________	
1769-IQ6XOW4	2.75W x number of modules	2.75W x ___________	
1769-IR6	1.50W x number of modules	1.50W x ___________	
1769-IT6	1.50W x number of modules	1.50W x ___________	
1764-LSP	1.5W		
1764-LRP	1.9W		
1764-MM1, -RTC, -MM1/RTC	0		
1769-OA8	2.12W x number of modules	2.12W x ___________	
1769-OA16	4.9W x number of modules	4.9W x ___________	
1769-OB16	2.11W x number of modules	2.11W x ___________	
1769-OB16P	2.69W x number of modules	2.69W x ___________	
1769-OF2 (Series A)	4.77W x number of modules	4.77W x ___________	
1769-OF2 (Series B)	2.52W x number of modules	2.52W x ___________	
1769-OV16	2.06W x number of modules	2.06W x ___________	
1769-OW8	2.83W x number of modules	2.83W x ___________	
1769-OW8I	2.83W x number of modules	2.83W x ___________	
1769-OW16	4.75W x number of modules	4.75W x ___________	
1769-SDN	3.8W x number of modules	3.8W x ___________	
		Add Subtotals to determine Heat Dissipation	

The following terms are used throughout this manual. Refer to the *Allen-Bradley Industrial Automation Glossary*, Publication Number AG-7.1, for a complete guide to Allen-Bradley technical terms.

address

A character string that uniquely identifies a memory location. For example, I:1/0 is the memory address for data located in Input file word 1, bit 0.

AIC+ Advanced Interface Converter

A device that provides RS-232 isolation to an RS-485 Half-Duplex communication link. (Catalog Number 1761-NET-AIC.)

application

1) A machine or process monitored and controlled by a controller.
2) The use of computer- or processor-based routines for specific purposes.

baud rate

The speed of communication between devices. Baud rate is typically displayed in *K baud*. For example, 19.2K baud = 19,200 bits per second.

bit

The smallest unit of memory used in discrete or binary logic, where the value 1 represents ON and 0 represents OFF.

block diagrams

A method used to illustrate logic components or a sequence of events.

Boolean operators

Logical operators such as AND, OR, NAND, NOR, NOT, and Exclusive-OR that can be used singularly or in combination to form logic statements or circuits. Can have an output response of T or F.

branch

A parallel logic path within a rung of a ladder program. Its primary use is to build OR logic.

communication scan

A part of the controller's operating cycle. Communication with devices (such as other controllers and operator interface devices) takes place during this period.

control program

User logic (the application) that defines the controller's operation.

controller

A device, such as a programmable controller, used to control output devices.

controller overhead

A portion of the operating cycle used for housekeeping purposes (memory checks, tests, communications, etc.).

counter

A device that counts the occurrence of an event.

CPU (Central Processing Unit)

The decision-making and data storage section of a programmable controller.

data table

The part of processor memory that contains I/O status and files where user data (such as bit, integer, timers, and counters) is monitored, manipulated, and changed for control purposes.

DIN rail

Manufactured according to Deutsche Industrie Normenausshus (DIN) standards, a metal railing designed to ease installation and mounting of your devices.

download

The transfer of program or data files to a device.

DCD

Data Carrier Detect. A signal generated by a modem that represents traffic (activity) on a communications network.

DTE

Data Terminal Equipment

EMI

Electromagnetic interference.

embedded I/O

Embedded I/O is the controller's on-board I/O. For MicroLogix controllers, embedded I/O is all I/O residing at slot 0.

expansion I/O

Expansion I/O is I/O that is connected to the controller via a bus or cable. MicroLogix 1200 controllers use Bulletin 1762 expansion I/O. MicroLogix 1500 controllers use Bulletin 1769 expansion I/O. For MicroLogix controllers, expansion I/O is all I/O residing at slot 1 and higher.

encoder

A device that detects position, and transmits a signal representing that position.

executing mode

Any run, remote run, or test mode.

false

The status of an instruction that does not provide a continuous logical path on a ladder rung.

FIFO (First-In-First-Out)

The order that data is stored and retrieved from a file.

file

A collection of data or logic organized into groups.

full-duplex

A mode of communication where data may be transmitted and received simultaneously (contrast with half-duplex).

half-duplex

A mode of communication where data transmission is limited to one direction at a time.

hard disk

A storage device in a personal computer.

high byte

Bits 8 to 15 of a word.

housekeeping

The portion of the scan when the controller performs internal checks and services communications.

input device

A device, such as a push button or a switch, that supplies an electrical signal to the controller.

input scan

The controller reads all input devices connected to the input terminals.

inrush current

The temporary surge of current produced when a device or circuit is initially energized.

instruction

A mnemonic defining an operation to be performed by the processor. A rung in a program consists of a set of input and output instructions. The input instructions are evaluated by the controller as being true or false. In turn, the controller sets the output instructions to true or false.

instruction set

The set of instructions available within a controller.

I/O

Input and Output

jump

Changes the normal sequence of program execution. In ladder programs a JUMP (JMP) instruction causes execution to jump to a specific rung in the user program.

ladder logic

A graphical programming format resembling a ladder-like diagram. The ladder logic programing language is the most common programmable controller language.

least significant bit (LSB)

The element (or bit) in a binary word that carries the smallest value of weight.

LED (Light Emitting Diode)

Used as status indicator for processor functions and inputs and outputs.

LIFO (Last-In-First-Out)

The order that data is stored and retrieved from a file.

low byte

Bits 0 to 7 of a word.

logic

A general term for digital circuits or programmed instructions to perform required decision making and computational functions.

Master Control Relay (MCR)

A hard-wired relay that can be de-energized by any series-connected emergency stop switch.

mnemonic

A simple and easy to remember term that is used to represent a complex or lengthy set of information.

Modbus™ RTU Slave

A serial communication protocol.

modem

Modulator/demodulator. Equipment that connects data terminal equipment to a communication line.

modes

Selected methods of operation. Example: run, test, or program.

negative logic

The use of binary logic in such a way that “0” represents the desired voltage level.

network

A series of stations (nodes) connected by some type of communication medium. A network may be made up of a single link or multiple links.

nominal input current

The typical amount of current seen at nominal input voltage.

normally closed

Contacts on a relay or switch that are closed when the relay is de-energized or deactivated. They are open when the relay is energized or the switch is activated.

normally open

Contacts on a relay or switch that are open when the relay is de-energized or the switch is deactivated. They are closed when the relay is energized or the switch is activated.

off-delay time

The OFF delay time is a measure of the time required for the controller logic to recognize that a signal has been removed from the input terminal of the controller. The time is determined by circuit component delays and by any applied filter.

offline

When a device is not scanning/controlling or when a programming device is not communicating with the controller.

offset

A continuous deviation of a controlled variable from a fixed point.

off-state leakage current

When a mechanical switch is opened (off-state), no current flows through the switch. Semiconductor switches and transient suppression components which are sometimes used to protect switches, have a small current flow when they are in the off state. This current is referred to as the off-state leakage current. To ensure reliable operation, the off-state leakage current rating must be less than the minimum operating current rating of the device that is connected.

on-delay time

The ON delay time is a measure of the time required for the controller logic to recognize that a signal has been presented at the input terminal of the controller.

one shot

A programming technique that sets a bit ON or OFF for one program scan.

online

When a device is scanning/controlling or when a programming device is communicating with the controller.

operating voltage

For inputs, the voltage range needed for the input to be in the On state. For outputs, the allowable range of user-supplied voltage.

output device

A device, such as a pilot light or a motor starter coil, that receives a signal or command from the controller.

output scan

The controller turns on, off, or modifies the devices connected to the output terminals.

PCCC

Programmable Controller Communications Commands

processor

A Central Processing Unit. (See CPU.)

processor files

The set of program and data files resident in the controller.

program file

Areas within a processor that contain the logic programs. MicroLogix controllers support multiple program files.

program mode

When the controller is not scanning the control program.

program scan

A part of the controller’s operating cycle. During the program scan, the logic program is processed and the Output Image is updated.

programming device

Programming package used to develop ladder logic diagrams.

protocol

The rules of data exchange via communications.

read

To acquire data. For example, the processor reads information from other devices via a read message.

relay

An electrically operated device that mechanically switches electrical circuits.

relay logic

A representation of binary or discrete logic.

restore

To transfer a program from a device to a controller.

reserved bit

A location reserved for internal use.

retentive data

Information (data) that is preserved through power cycles.

RS-232

An EIA standard that specifies electrical, mechanical, and functional characteristics for serial binary communication circuits.

run mode

An executing mode during which the controller scans or executes the logic program.

rung

A rung contains input and output instructions. During Run mode, the inputs on a rung are evaluated to be true or false. If a path of true logic exists, the outputs are made true (energized). If all paths are false, the outputs are made false (de-energized).

RTU

Remote Terminal Unit

save

To save a program to a computer hard disk.

scan

The scan is made up of four elements: input scan, program scan, output scan, and housekeeping.

scan time

The time required for the controller to complete one scan.

sinking

A term used to describe current flow between two devices. A sinking device provides a direct path to ground.

sourcing

A term used to describe current flow between two devices. A sourcing device or circuit provides a power.

status

The condition of a circuit or system.

terminal

A point on an I/O module that external devices, such as a push button or pilot light, are wired to.

throughput

The time between when an input turns on and a corresponding output turns on or off. Throughput consists of input delays, program scan, output delays, and overhead.

true

The status of an instruction that provides a continuous logical path on a ladder rung.

upload

Data is transferred from the controller to a programming or storage device.

watchdog timer

A timer that monitors a cyclical process and is cleared at the conclusion of each cycle. If the watchdog runs past its programmed time period, it causes a fault.

write

To send data to another device. For example, the processor writes data to another device with a message write instruction.

www.rockwellautomation.com

Corporate Headquarters
Rockwell Automation, 777 East Wisconsin Avenue, Suite 1400, Milwaukee, WI, 53202-5302 USA, Tel: (1) 414.212.5200, Fax: (1) 414.212.5201

Headquarters for Allen-Bradley Products, Rockwell Software Products and Global Manufacturing Solutions
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe: Rockwell Automation SA/NV, Vorstlaan/Boulevard du Souverain 36-BP 3A/B, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Headquarters for Dodge and Reliance Electric Products
Americas: Rockwell Automation, 6040 Ponders Court, Greenville, SC 29615-4617 USA, Tel: (1) 864.297.4800, Fax: (1) 864.281.2433
Europe: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 17741
Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 351 6723, Fax: (65) 355 1733

Publication 1764-UM001B-EN-P - April 2002 PN 40072-091-01(2)
Supersedes Publication 1764-UM001A-US-P - April 2000

BWF B5V

ITEM # 65

One Gang Weatherproof Outlet Boxes - Die Cast Metal

BWF PRODUCT BENEFITS & FEATURES

- Rugged, seamless, die-cast construction that prevents moisture entry.
- Reinforced connector outlets provide a secure mechanical installation.
- State of the art powder coat finish for maximum durability.
- Closure plugs, ground screw and mounting lugs included.
- Complete installation instructions included with each product.

COMPLIANCES

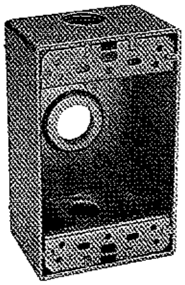
- UL Listed and CSA Certified

APPLICATIONS

- For use in branch circuit wiring in wet, damp or dry locations.
- May be used as a weatherproof junction box, or as a housing for receptacles, switches and GFCI's.

ONE GANG OUTLET BOX WITH 3 THREADED OUTLETS

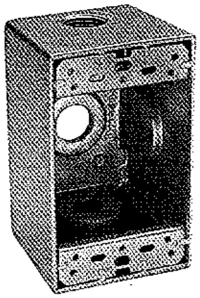
$4\frac{9}{16}''$ x $2\frac{13}{16}''$ x $2''$, closure plugs, ground screw and mounting lugs included



PACKAGE TYPE	BWF No.	Unit UPC 0-87115-	Unit Cubic	Description Outlets	Description Color	Case QTY	Case WT
SHOW PAK	**B-5V**	18021-6	18.3"	3 - 1/2"	Grey	20	11.6
	B-5AV	18520-4	18.3"	3 - 1/2"	Bronze	20	11.6
	B-5WV	18720-8	18.3"	3 - 1/2"	White	20	11.6
	B-75V	18031-5	18.3"	3 - 3/4"	Grey	20	11.4
	B-75AV	52886-5	18.3"	3 - 3/4"	Bronze	20	11.4
	B-75WV	52885-8	18.3"	3 - 3/4"	White	20	11.4
	B-100V	27100-6	18.3"	3 - 1"	Grey	20	11.2
BLISTER CARDED	**1503**	01503-7	97.3"	3 - 1/2"	Grey	6	3.9
	1503AB	18523-5	97.3"	3 - 1/2"	Bronze	6	3.9
	1503W	50000-7	97.3"	3 - 1/2"	White	6	3.9
	1753	01753-6	97.3"	3 - 3/4"	Grey	6	3.9
	1753AB	18533-4	97.3"	3 - 3/4"	Bronze	6	3.9
	1753W	50005-2	97.3"	3 - 3/4	White	6	3.9

DEEP, ONE GANG OUTLET BOX WITH 3 THREADED OUTLETS

$4\frac{9}{16}''$ x $2\frac{13}{16}''$ x $2\frac{5}{8}''$, closure plugs, ground screw and mounting lugs included



PACKAGE TYPE	BWF No.	Unit UPC 0-87115-	Unit Cubic	Description Outlets	Description Color	Case QTY	Case WT
SHOW PAK	**DB-5V**	38006-7	23.8	3 - 1/2"	Grey	12	10
	DB-5AV	27103-7	23.8	3 - 1/2"	Bronze	12	10
	DB-5WV	27104-4	23.8	3 - 1/2"	White	12	10
	DB-75V	27105-1	23.8	3 - 3/4"	Grey	12	10
	DB-100V	27108-2	23.8	3 - 1"	Grey	12	10

CGB114 | ITEM # 64

5F Cord and Cable Fittings

Straight Body Male Thread
Sizes 3/8″ – 3″

Cl. I, Div. 2*, Groups A,B,C,D
Cl. II, Div. 1, Groups E,F,G
Cl. II, Div. 2, Groups F,G
Cl. III

Wet Locations

Application:

CGB, CGD, CGE and CGK cord and cable fittings with neoprene bushing are for use with portable cords and Types MV (unarmored), PLTC, SE (round), TC and UF cables.
CGB, CGD, CGE and CGK cord and cable fittings are installed to:

- provide means for passing a cord, cable (unarmored) or flexible conduit into an enclosure, through a bulkhead or into a rigid conduit
- form a seal for cord or unarmored round cables
- form a secure connection or termination for flexible cord, cable (unarmored), or flexible conduit

Features:

- Rugged construction protects cord and cable from damage.
- Compact, permitting close grouping of several cords and/or cables
- Tightening one nut makes watertight seal
- Large range of NPT sizes for use with any conduit system
- Available for straight, 45° or 90° entrance
- Many combinations of gland nuts and bushings can be used to make up connectors, provided parts of the same form are used together

Standard Materials:

- CGB & CGK series – Form A through Form D bodies and gland nuts – steel. Form E & F bodies and gland nuts – *Feraloy*® iron alloy
- CGD & CGE series – all bodies are *Feraloy* iron alloy. Form A through Form D gland nuts – steel. Form E & F gland nuts – *Feraloy* iron alloy.
- Bushing – neoprene

Standard Finishes:

- Steel – zinc electroplate with chromate finish coat
- *Feraloy* – electrogalvanized and aluminum acrylic paint

Size Ranges:

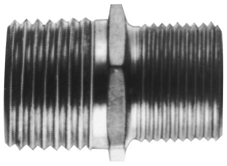
- Cable O.D. – .125″ to 2.625″
- NPT thread – ⅜″ to 3 ″

Certifications and Compliances:

- UL Standard: 514B
- NEC: Class I, Division 2*; Class II, Class III
- Wet locations
- CSA Standard: C22.2 No. 18, 25
- CEC: Class II, Division 1, Groups E,F,G; Class II, Division 2, Groups F,G; Class III

Complete with gland nut and Neoprene bushing

Body only



Neoprene bushing

CGB With Gland Nut and Tapered Neoprene Bushing‡

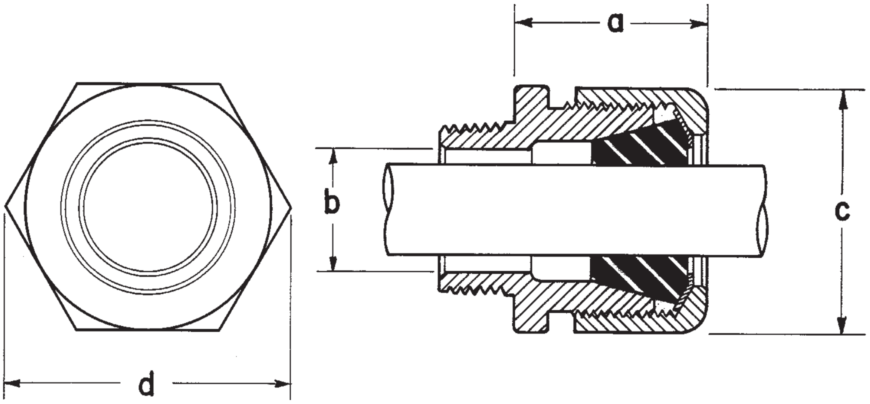
Male Thread NPT Trade Size	Form	Cord Range Dia.	Inside Body Dia.	Complete with Gland Nut & Neoprene Bushing ♦ Cat. #	Body Only Cat. #	Neoprene Bushing Cat. #
⅜	A	.125 to .250	.469	CGB3814	CGB:17123B	BUSH214
⅜	A	.250 to .375	.469	CGB3816	CGB:17123B	BUSH216
⅜	A	.375 to .437	.469	CGB3817	CGB:17123B	BUSH217
⅜	B	.125 to .250	.500	CGB3892	CGB:4315A	BUSH92
⅜	B	.250 to .375	.500	CGB3893	CGB:4315A	BUSH93
⅜	B	.375 to .500†	.500	CGB3894	CGB:4315A	BUSH94
½	A	.125 to .250	.469	CGB114§	CGB:17122B	BUSH214
½	A	.250 to .375	.469	CGB116§	CGB:17122B	BUSH216
½	A	.375 to .437	.469	CGB117§	CGB:17122B	BUSH217
½	B	.125 to .250	.625	CGB192§	CGB:0104355	BUSH92
½	B	.250 to .375	.625	CGB193§	CGB:0104355	BUSH93
½	B	.375 to .500	.625	CGB194§	CGB:0104355	BUSH94
½	B	.500 to .625	.625	CGB195§	CGB:0104355	BUSH05
½	C	.625 to .750†	.625	CGB196§	CGB:1702A	BUSH96
½	C	.750 to .875†	.625	CGB197§	CGB:1702A	BUSH97
¾	B	.125 to .250	.688	CGB292§	CGB:0104438§	BUSH92
¾	B	.250 to .375	.688	CGB293§	CGB:0104438§	BUSH93
¾	B	.375 to .500	.688	CGB294§	CGB:0104438§	BUSH94
¾	B	.500 to .625	.688	CGB295§	CGB:0104438§	BUSH05
¾	C	.625 to .750†	.750	CGB296§	CGB:4318A	BUSH96
¾	C	.750 to .875†	.750	CGB297§	CGB:4318A	BUSH97
¾	D	.875 to 1.000†	.813	CGB298§	CGB:4320A	BUSH98

Continued on page 67.

Dimensions

* §†‡ ♦ For description of symbols, see page 67.

CGB Series



COOPER Crouse-Hinds

876-N5

ITEM # 61

AdaptaHorn® Grille Type Vibrating Horn

Weatherproof, NEMA Type 4X

876 & 877 Series

FEATURES

- PLC compatible models
- Convenient plug-in assembly
- Corrosion resistant finish
- Completely assembled
- Volume adjustable
- NEMA 4X enclosure

AGENCY APPROVALS

- UL Listed
- FM Approved

SPECIFICATIONS

- Operating range: -20% to +10% of nominal voltage

876 AC Series

- Adjustable output: 78 to 103 dB
- 400 hour rating at 50% duty cycle

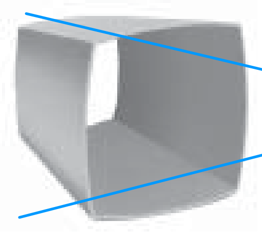
~~877 DC Series~~

- ~~Adjustable output: 78 to 101 dB~~
- ~~200 hour rating~~

The Edwards 876 AC & ~~877 DC~~ Series are low-current, high decibel, vibrating horns for heavy-duty use and is UL listed to NEMA 4X enclosure requirements. The die-cast weatherproof box has a durable, corrosion resistant, electrostatic heat flowed powder epoxy gray finish. May be used for indoor applications.

Mount on conduit or to any flat surface. A hole on the top has been drilled and tapped for 3/4" (19mm) - 14 NPT conduit. Knockouts are located on the bottom and rear of the unit.

Used where a distinctive, urgent signal is required for outdoor or weatherproof requirements such as: timing scheduling, paging, general alarm, personnel warning, and emergency evacuations.



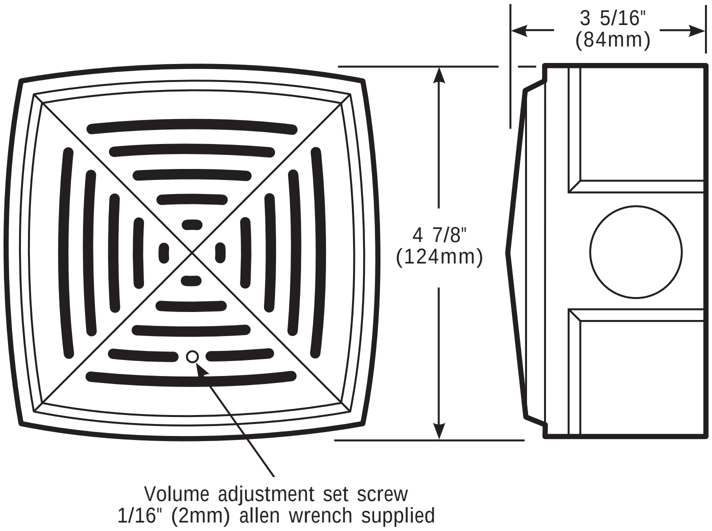
~~**872-PO Plastic Projector AdaptaHorn Accessory**~~

~~Plastic projector snaps onto any AdaptaHorn. Available as separate item.~~

D-002

EDWARDS SIGNALING

TECHNICAL INFORMATION



Volume adjustment set screw
1/16" (2mm) allen wrench supplied

Cat. No.	Volts	Amps	V A	DC coil Res. (Ohms)	dB at 10 Ft.
~~876-E5~~	~~12V AC~~	~~1.25~~	~~15~~	~~1.5~~	103
~~876-G5~~	~~24V AC~~	~~.63~~	~~15.1~~	~~5.2~~	
876-N5†	120V AC	.13	15.6	150	
~~876-R5~~	~~240V AC~~	~~.07~~	~~16.8~~	~~580~~	
877-E1	12V DC	.27	3.2	6	101
877-G1	24V DC	.16	3.8	24	
877-J1	32V DC	.13	4.2	40	
877-K1	48V DC	.07	3.5	96	
877-P1	125V DC	.025	3.1	600	

† Diode polarized version available in red. Order 886D-N5

PLC COMPATIBILITY - SIGNAL INPUT LOAD CHARACTERISTICS*

Cat. No.	Operating voltage Volts	Max. off state leakage current mA	Continuous on current mA	Surge (inrush/duration) Amps/milliseconds
876-N5	120V AC	25	120	1.02/.000026
~~877-G1~~	~~24V DC~~	~~25~~	~~150~~	~~1.7/.000042~~

*This device is PLC compatible and may be operated by PLCs with output characteristics that match the input load requirements of this signal.

Electromechanical devices can produce transient spikes and should only be used on PLC output cards that have inherent transient spike suppression. Consult the PLC manufacturer prior to connecting 24V DC electromechanical devices to PLCs.

Ferraz Shawmut

USCC & USM 24, 48 & 600 VOLT / ULTRASAFE™ FUSEHOLDERS

HIGHLIGHTS:

- Finger Safe
- Optional Indicator Lights
- DIN Rail Mount
- Compact Footprint
- Quick, Easy Fuse Change

APPLICATIONS:

- All circuits up to 600 volts for motors, control circuits, transformers, etc.
- Non-load disconnect
- 12, 24 and 48 volt DC circuits

RECOMMENDED FUSE USAGE

USCC . . . . .use with **ATDR*, ATMR, ATQR**

USM . . . . .use with **ATQ, ATM*, A6Y-2B, A25Z-2, TRM, OTM, A13X-2, GFN, GGU, A60Q-2**

*** Recommended for DC Applications**

ULTRASAFE MODULAR FUSE HOLDERS

Ferraz Shawmut ULTRASAFE™ modular 24, 48 and 600 volt Fuse Holders introduce a new level of safety for Class CC (USCC) and Midget 1-1/2” x 13/32” (USM) as well as DC rated fuses up to 30 amperes. ULTRASAFE holders qualify as “finger safe” under IEC and DIN standards to an IP2 grade of protection, including fuse changing (with the flick of a finger). ULTRASAFE holders are available in 1, 2, 3 or 4 poles, with or without blown-fuse indicators in each pole. AC indicators are orange and DC are red. The multi-pole units can also be made up by ordering pin-tie handles for field assembly. ULTRASAFE holders save up to 15% mounting space and any combination can be snapped onto 35mm DIN rail for extra savings in panel building time. ULTRASAFE holders with Class CC fuses chosen for Type “2” protection give one of the safest protection packages in the industry. Ultrasafe body material is tough and durable polyamide, with exceptional insulating properties.

Ratings

- 600VAC, 30A
  Min. voltage to operate indicator light:
  90VAC
  [Less than 0.7 mA leakage current at 600V]
- 24VDC, 30A
- 48VDC, 30A
- Withstand rating:
  Class CC 200kA I.R.
  Midget Fuse 100kA I.R.

Approvals

- All Ultrasafe Fuse Holders meet the requirements of UL512
- UL Listed
  Class CC
  Guide IZLT, File E52283
- UL Recognized
  Component
  Midget
  Guide IZLT2, File E52283
- CSA Certified
  Class CC & Midget
  C22.2, Class 6225
  File 32169

USCC & USM 24, 48 & 600 VOLT / ULTRASAFE™ FUSEHOLDERS

For use with Class CC Fuses

CATALOG NO.	DESCRIPTION
USCC1	1 pole
USCC1I	1 pole with indicator
USCC2	2 pole
USCC2I	2 pole with indicators
USCC3	3 pole
USCC3I	3 pole with indicators
USCC3IN	3 pole with indicators and a 4th neutral pole
USCC3N	3 pole with a 4th neutral pole
USCC4	4 pole
USCC4I	4 pole with indicators

For use with Midget (1-1/2” x 13/32”) Fuses

USM1	1 pole
USM1I	1 pole with indicator
USM2	2 pole
USM2I	2 pole with indicators
USM3	3 pole
USM3I	3 pole with indicators
USM3IN	3 pole with indicators and a 4th neutral pole
USM3N	3 pole with a 4th neutral pole
USM4	4 pole
USM4I	4 pole with indicators

Neutral Link Pole

USN	1 Pole with Integral Neutral Link

Accessories

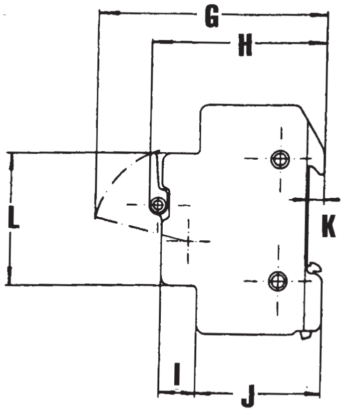
USPTH2	Pin-tie handle for 2 poles
USPTH3	Pin-tie handle for 3 poles
USPTH4	Pin-tie handle for 4 poles

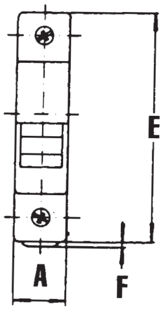
For use with DC rated Class CC & Midget Fuses

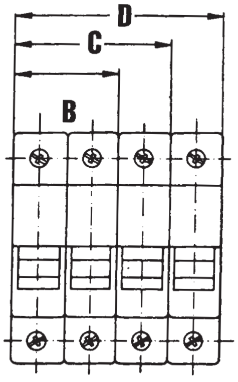
PART NUMBER	INDICATOR TYPE	OPERATING VOLTAGE	LEAKAGE CURRENT
USM1I-DC24	LED	12 to 24 VDC	10mA max.(@24vdc)
USM1I-DC24P	LED	20 to 24 VDC	1mA max.(@24vdc)
USM1I-DC48	LED	35 to 48 VDC	10mA max.(@48vdc)
USCC1I-DC24	LED	12 to 24 VDC	10mA max.(@24vdc)
USCC1I-DC48	LED	35 to 48 VDC	10mA max.(@48vdc)

Dimensions

DIMENSION	mm	In
A	17.5	0.69
B	35.0	1.38
C	52.5	2.07
D	70.0	2.76
E	78.0	3.07
F	2.5	0.10
G	78.0	3.07
H	59.0	2.32
I	12.5	0.49
J	42.5	1.67
K	5.0	0.20
L	45.0	1.77







Terminal screws: Phillips/slot head
Suggested screw torque: 14.75 in-lbs.
Connector type: Pressure plate
Wire range: #6 to #14 (solid/stranded Cu)
Load-break disconnect: No

GDL3
GDL5
GDL2

ITEM # 53,
54, & 55

Ferraz Shawmut

ELECTRONIC / GLASS FUSES

GSA / GSA-V

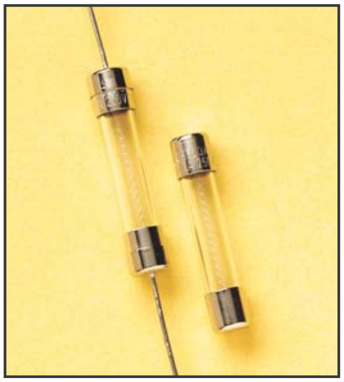
Ceramic Body
Time Delay
1/4” x 1-1/4”
1-1/2” Axial Leads Optional

1/4A through 10A, 250VAC - UL Listed, 12A through 20A UL Recognized
1/4A through 20A, 250VAC - CSA Certified
25A and 30A, 125VAC - CSA Certified, UL Recognized

Standard Fuse Ampere Ratings

CATALOG NUMBER	AXIAL LEAD CAT. NO	AMPERE RATING	VOLTS	I.R.
GSA1/100	GSA-V1/100	1/100A	250V	1
GSA1/32	GSA-V1/32	1/32A	250V	1
GSA1/16	GSA-V1/16	1/16A	250V	1
GSA1/10	GSA-V1/10	1/10A	250V	1
GSA1/8	GSA-V1/8	1/8A	250V	1
GSA15/100	GSA-V15/100	15/100A	250V	1
GSA175/1000	GSA-V175/1000	175/100A	250V	1
GSA3/16	GSA-V3/16	3/16A	250V	1
GSA2/10	GSA-V2/10	2/10A	250V	1
GSA1/4	GSA-V1/4	1/4A	250V	2
GSA3/10	GSA-V3/10	3/10A	250V	2
GSA3/8	GSA-V3/8	3/8A	250V	2
GSA4/10	GSA-V4/10	4/10A	250V	2
GSA1/2	GSA-V1/2	1/2A	250V	2
GSA6/10	GSA-V6/10	6/10A	250V	2
GSA7/10	GSA-V7/10	7/10A	250V	2
GSA3/4	GSA-V3/4	3/4A	250V	2
GSA8/10	GSA-V8/10	8/10A	250V	2
GSA1	GSA-V1	1A	250V	2
GSA1-2/10	GSA-V1-2/10	1-2/10A	250V	2
GSA1-1/4	GSA-V1-1/4	1-1/4A	250V	2
GSA1-1/2	GSA-V1-1/2	1-1/2A	250V	2
GSA1-6/10	GSA-V1-6/10	1-6/10A	250V	2
GSA2	GSA-V2	2A	250V	2
GSA2-1/4	GSA-V2-1/4	2-1/4A	250V	2
GSA2-1/2	GSA-V2-1/2	2-1/2A	250V	2
GSA2-8/10	GSA-V2-8/10	2-8/10A	250V	2
GSA3	GSA-V3	3A	250V	2
GSA3-2/10	GSA-V3-2/10	3-2/10A	250V	2
GSA3-1/2	GSA-V3-1/2	3-1/2A	250V	2
GSA4	GSA-V4	4A	250V	3
GSA5	GSA-V5	5A	250V	3
GSA6	GSA-V6	6A	250V	4
GSA6-1/4	GSA-V6-1/4	6-1/4A	250V	3
GSA7	GSA-V7	7A	250V	3
GSA8	GSA-V8	8A	250V	3
GSA10	GSA-V10	10A	250V	3
GSA12	GSA-V12	12A	250V	3
GSA15	GSA-V15	15A	250V	3
GSA20	GSA-V20	20A	250V	3
GSA25	GSA-V25	25A	125V	5
GSA30	GSA-V30	30A	125V	5

1. 250VAC @ 35A I.R./125VAC @ 10kA I.R.
2. 250VAC @ 100A I.R./125VAC @ 10kA I.R.
3. 250VAC @ 400A I.R./125VAC @ 10kA I.R.
4. 250VAC @ 200A I.R./125VAC @ 10kA I.R.
5. 125VAC @ 400A I.R.



GDL / GDL-V

Glass Body
Time Delay
1/4” x 1-1/4”

1/100A through 8A, 250VAC - UL Listed and CSA Certified
10A through 15A, 125VAC - UL Listed and CSA Certified
20A through 30A, 32VAC - UL Recognized

Standard Fuse Ampere Ratings

CATALOG NUMBER	AXIAL LEAD CAT. NO	AMPERE RATING	VOLTS	I.R.
GDL1/100	GDL-V1/100	1/100A	250V	1
GDL1/32	GDL-V1/32	1/32A	250V	1
GDL4/100	GDL-V4/100	4/100A	250V	1
GDL1/16	GDL-V1/16	1/16A	250V	1
GDL1/10	GDL-V1/10	1/10A	250V	1
GDL1/8	GDL-V1/8	1/8A	250V	1
GDL15/100	GDL-V15/100	15/100A	250V	1
GDL175/1000	GDL-V175/1000	175/1000A	250V	1
GDL3/16	GDL-V3/16	3/16A	250V	1
GDL2/10	GDL-V2/10	2/10A	250V	1
GDL1/4	GDL-V1/4	1/4A	250V	1
GDL3/10	GDL-V3/10	3/10A	250V	1
GDL3/8	GDL-V3/8	3/8A	250V	1
GDL4/10	GDL-V4/10	4/10A	250V	1
GDL1/2	GDL-V1/2	1/2A	250V	1
GDL6/10	GDL-V6/10	6/10A	250V	1
GDL7/10	GDL-V7/10	7/10A	250V	1
GDL3/4	GDL-V3/4	3/4A	250V	1
GDL8/10	GDL-V8/10	8/10A	250V	1
GDL1	GDL-V1	1A	250V	1
GDL1-2/10	GDL-V1-2/10	1-2/10A	250V	2
GDL1-1/4	GDL-V1-1/4	1-1/4A	250V	2
GDL1-1/2	GDL-V1-1/2	1-1/2A	250V	2
GDL1-6/10	GDL-V1-6/10	1-6/10A	250V	2
GDL1-8/10	GDL-V1-8/10	1-8/10A	250V	2
GDL2	GDL-V2	2A	250V	2
GDL2-1/4	GDL-V2-1/4	2-1/4A	250V	2
GDL2-1/2	GDL-V2-1/2	2-1/2A	250V	2
GDL2-8/10	GDL-V2-8/10	2-8/10A	250V	2
GDL3	GDL-V3	3A	250V	2
GDL3-2/10	GDL-V3-2/10	3-2/10A	250V	2
GDL4	GDL-V4	4A	250V	3
GDL5	GDL-V5	5A	250V	3
GDL6	GDL-V6	6A	250V	3
GDL6-1/4	GDL-V6-1/4	6-1/4A	250V	3
GLD7	GDL-V7	7A	250V	3
GLD8	GDL-V8	8A	250V	3
GLD10	GDL-V10	10A	125V	4
GDL12	GDL-V12	12A	125V	4
GDL15	GDL-V15	15A	125V	4
GDL20	GDL-V20	20A	32V	5
GDL25	GDL-V25	25A	32V	5
GDL30	GDL-V30	30A	32V	5

1. 250VAC @ 35A I.R./125VAC @ 10kA I.R.
2. 250VAC @ 100A I.R./125VAC @ 10kA I.R.
3. 250VAC @ 200A I.R./125VAC @ 10kA I.R.
4. 125VAC @ 10kA I.R.
5. 32VAC @ 300A I.R.

ATDR6
ATDR3

ITEM # 25 & 26

AMP-TRAP 2000®

ATDR

TIME DELAY / CLASS CC

THE BEST PROTECTION FOR TODAY'S SMALL MOTORS.

Amp-trap 2000® ATDR small-dimension fuses can provide IEC Type 2 "no damage" protection to your facility's increasingly sensitive branch circuit components and small motors – minimizing the risk of fault-related damage. ATDR Class CC fuses deliver the best time delay characteristics in their class with excellent cycling ability for small motor loads.

Features/Benefits

- **Time delay** for motor starting inrush currents *without* nuisance opening
- **Highly current limiting** for low peak let-thru current
- **Improved cycling ability** for frequent motor starts/stops without nuisance fuse opening
- **Rejection-style design** prevents replacement errors (when used with recommended fuse blocks)
- **High-visibility orange label** ensures instant recognition, simplifies replacement
- **Metal-embossed date and catalog number** for traceability and lasting identification
- **Fiberglass body** provides dimensional stability in harsh industrial settings
- **High-grade silica filler** ensures fast arc quenching and optimum current limitation

HIGHLIGHTS:

- Time Delay
- Best Choice for Small Motor Protection
- Highly Current-Limiting
- AC & DC Rated

APPLICATIONS:

- Small Motors
- Contactors
- Lighting, Heating & General Loads
- Branch Circuit Protector

Ratings

- **AC:** 1/4 to 30A
  600VAC, 200kA I.R.

  DC: 1/4 to 30A
  300VDC, 100kA I.R.

Approvals

- UL Listed to Standard 248-4
- CSA Certified to Standard C22.2 No. 248.4
- DC Listed to UL Standard 198L

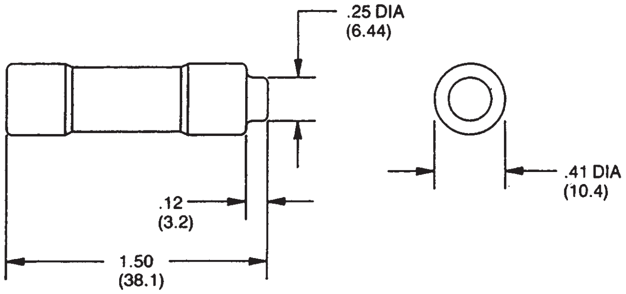
TIME DELAY / CLASS CC FUSES

ATDR

Standard Fuse Ampere Ratings, Catalog Numbers

AMPERE RATING	CATALOG NUMBER	AMPERE RATING	CATALOG NUMBER	AMPERE RATING	CATALOG NUMBER	AMPERE RATING	CATALOG NUMBER	AMPERE RATING	CATALOG NUMBER
1/4	ATDR1/4	1-1/2	ATDR1-1/2	➡ 3	ATDR3	➡ 6	ATDR6	12	ATDR12
1/2	ATDR1/2	1-6/10	ATDR1-6/10	3-2/10	ATDR3-2/10	6-1/4	ATDR6-1/4	15	ATDR15
8/10	ATDR8/10	1-8/10	ATDR1-8/10	3-1/2	ATDR3-1/2	7	ATDR7	17-1/2	ATDR17-1/2
1	ATDR1	2	ATDR2	4	ATDR4	7-1/2	ATDR7-1/2	20	ATDR20
1-1/8	ATDR1-1/8	2-1/4	ATDR2-1/4	4-1/2	ATDR4-1/2	8	ATDR8	25	ATDR25
1-1/4	ATDR1-1/4	2-1/2	ATDR2-1/2	5	ATDR5	9	ATDR9	30	ATDR30
1-4/10	ATDR1-4/10	2-8/10	ATDR2-8/10	5-6/10	ATDR5-6/10	10	ATDR10		

Dimensions



Small Motor Fuse Protection, 600 Volts AC or Less

MOTOR FULL LOAD AMPERES	ATDR RATING*	
	MINIMUM DUTY	NORMAL DUTY
.71 - .89	1-1/4	1-6/10
.90 - 1.19	1-6/10	2
1.20 - 1.34	2	2-1/2
1.35 - 1.79	2-1/2	3
1.80 - 2.25	3	4
2.26 - 2.69	4	5
2.70 - 2.90	4	6
2.91 - 3.20	5	6
3.21 - 3.75	5	7
3.76 - 4.50	6	8
4.51 - 5.34	8	10
5.35 - 5.69	10	12
5.70 - 6.70	12	12
6.71 - 7.79	12	15
7.80 - 8.88	15	17-1/2
8.89 - 11.1	17-1/2	20
11.2 - 13.3	20	25
13.4 - 15.2	25	30

* The 1996 National Electrical Code allows time-delay Class CC fuses to be sized at up to 400% (maximum) of motor FLA, if needed.

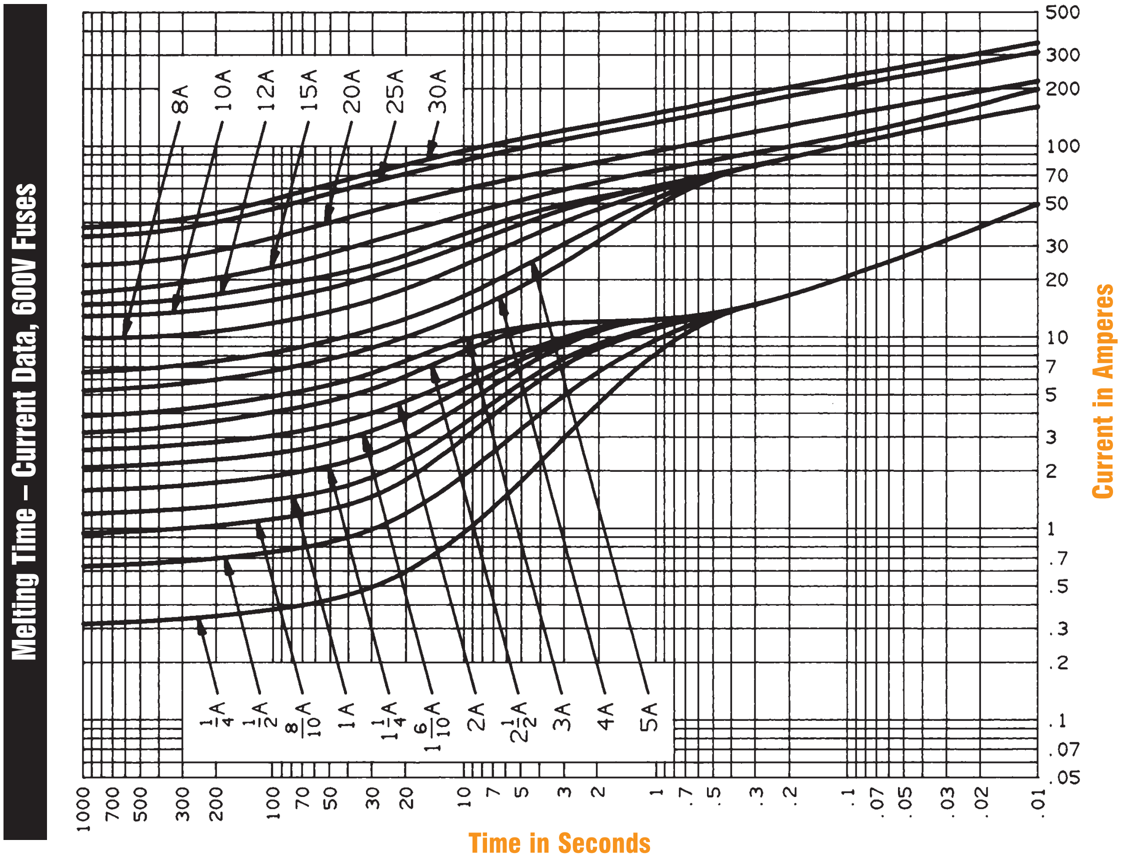
Recommended Fuse Blocks for Class CC Fuses

Number of Poles	CATALOG NUMBER			
	ULTRASAFE™ Indicating Fuse Holder	Screw Connector w/ Double Quick Connects	Pressure Plate Connector w/ Double Quick Connects	Copper Box Connector
ADDER		30310R	30320R	30350R
1	USCC1I	30311R	30321R	30351R
2	USCC2I	30312R	30322R	30352R
3	USCC3I	30313R	30323R	30353R

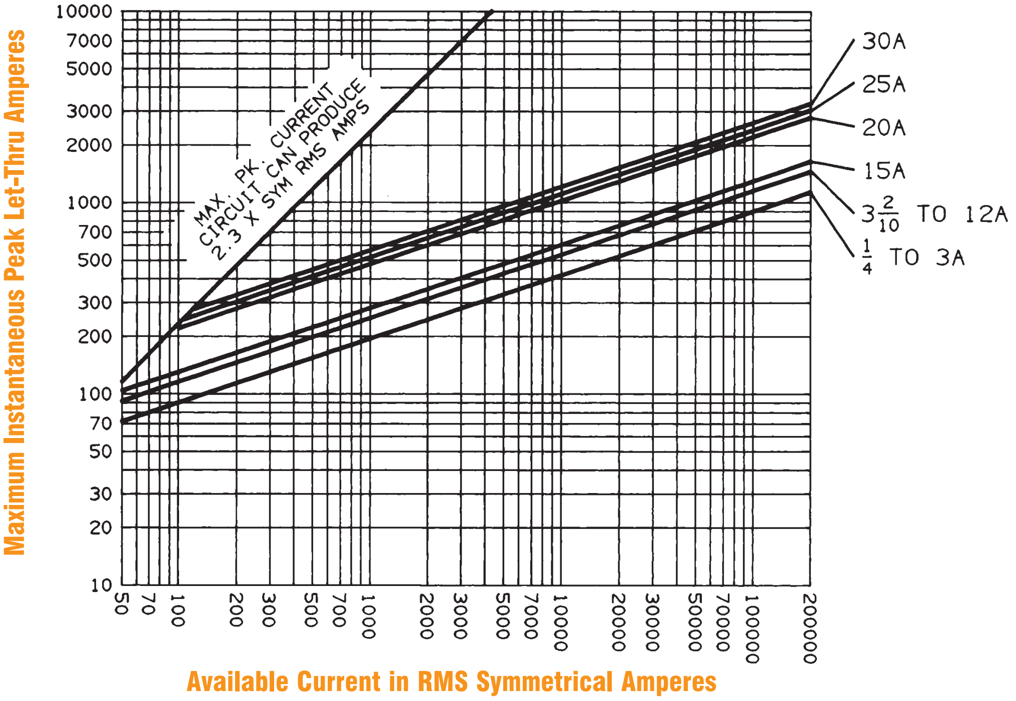
TIME DELAY / CLASS CC FUSES

ATDR

ATDR1/4 to 30



Peak Let-Thru Current Data – ATDR1/4 to 30, 600 Volts AC



AJT80 ITEM # 24

SMARTSPOT INDICATOR AMP-TRAP 2000®

AJT

Ferraz Shawmut

TIME DELAY / CLASS J

HIGHLIGHTS:

- Smart Spot Indicator
- Time Delay
- Highly Current Limiting
- DC Ratings
- Optional Mechanical Indicator (70 to 600A fuses)

APPLICATIONS:

- Motor Circuits
- Mains
- Feeders
- Branch Circuits
- Lighting, Heating & General Loads
- Transformers
- Control Panels
- Circuit Breaker Back-up
- Bus Duct
- Load Centers

SMARTSPOT™ WITH *MAXIMUM* CIRCUIT PROTECTION

Amp-trap 2000® SmartSpot™ AJT fuses now provide a visual open fuse indicator. With advanced material technology added to the existing product line the AJT fuse provides IEC Type "2" (No Damage) protection to main, feeder, and branch circuits, for all types of loads — yet, they require only half the mounting space needed for 600VAC Class RK fuses. AJT's time delay characteristics for handling harmless in-rush currents, its current limiting ability (the most current limiting UL fuse class!), and wide range of ratings (from 1 to 600 Amperes) — give excellent protection for all your applications.

Features/Benefits

- **Solid State SmartSpot Indicator**
- **Time delay** for motor starting and transformer inrush
- **300kA interrupting rating** - self-certified, UL witnessed tests
- **Extremely current limiting** for low peak let-thru current
- **Most current limiting UL class fuse**
- **Small footprint** requires less mounting space and allows smaller, more economical fuse blocks
- **Easy 2-to-1 selectivity** for prevention of nuisance shutdowns
- **Unique Class J dimensions** prevent replacement errors
- **High-visibility orange label** gives instant recognition
- **Metal-embossed date and catalog number** for traceability and lasting identification
- **Fiberglass body** provides dimensional stability in harsh industrial settings
- **High-grade silica filler** ensures fast arc quenching
- **Optional EI Indicator/Switch mount** for AJT70 to 600 open fuse indication

Ratings

- **AC:** 1 to 600A 600VAC, 200kA I.R. (self certified for 600VAC, 300kA I.R., UL witnessed)

DC: 1 to 600A 500VDC, 100kA I.R.

Approvals

AJT (1-600):

- UL Listed to Standard 248-8
- DC Listed to UL Standard 198L
- CSA Certified to Standard C22.2 No. 248.8
- IEC 269-2-1

AJT (70-600) EI:

- UL Component Recognized
- DC Tested to UL Standard 198L

TIME DELAY / CLASS J FUSES AJT

Standard Fuse Ampere Ratings, Catalog Numbers

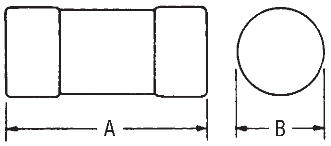
AMPERE RATING	CATALOG NUMBER	AMPERE RATING	CATALOG NUMBER	AMPERE RATING	CATALOG NUMBER	AMPERE RATING	CATALOG NUMBER
1	AJT1	4-1/2	AJT4-1/2	25	AJT25	125	AJT125
1-1/4	AJT1-1/4	5	AJT5	30	AJT30	150	AJT150
1-1/2	AJT1-1/2	5-6/10	AJT5-6/10	35	AJT35	175	AJT175
1-6/10	AJT1-6/10	6	AJT6	40	AJT40	200	AJT200
1-8/10	AJT1-8/10	6-1/4	AJT6-1/4	45	AJT45	225	AJT225
2	AJT2	7	AJT7	50	AJT50	250	AJT250
2-1/4	AJT2-1/4	8	AJT8	60	AJT60	300	AJT300
2-1/2	AJT2-1/2	9	AJT9	70	AJT70	350	AJT350
2-8/10	AJT2-8/10	10	AJT10	80	AJT80	400	AJT400
3	AJT3	12	AJT12	90	AJT90	450	AJT450
3-2/10	AJT3-2/10	15	AJT15	100	AJT100	500	AJT500
3-1/2	AJT3-1/2	17-1/2	AJT17-1/2	110	AJT110	600	AJT600
4	AJT4	20	AJT20				

Note: Indicator Not availible (1-7a)

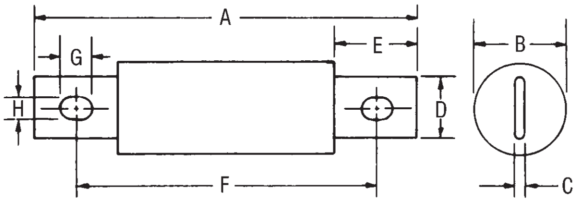
Recommended Fuse Blocks With Box Connectors for Amp-trap® Class J Fuses

Fuse Ampere Rating	Catalog Number 600V OR LESS	
	1 Pole	3 pole
0-30	US3J1I	US3J3I
31-60	US6J1I	US6J3I
61-100	61036J	61038J
101-200	62001J	62003J
201-400	64031J	64033J
401-600	6631J	6633J

A variety of pole configurations and termination provisions is available.



1-60A

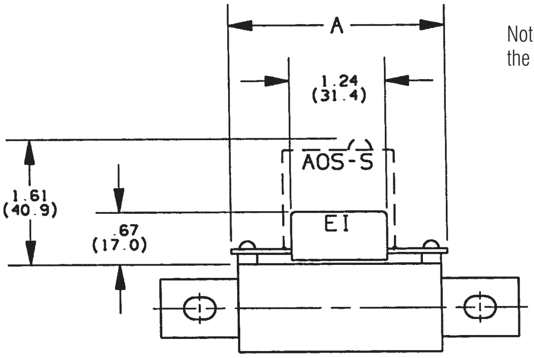


70-600A

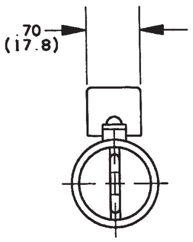
Dimensions

AMPERE RATING	A		B		C		D		E		F		G		H	
	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm
1-30	2-1/4	57	13/16	21	-	-	-	-	-	-	-	-	-	-	-	-
31-60	2-3/8	60	1-1/16	27	-	-	-	-	-	-	-	-	-	-	-	-
61-100	4-5/8	117	1-1/16	27	1/8	3.2	3/4	19	1	25	3-5/8	92	3/8	10	9/32	7
101-200	5-3/4	146	1-5/8	41	3/16	4.8	1-1/8	29	1-3/8	35	4-3/8	111	3/8	10	9/32	7
201-400	7-1/8	181	2-1/8	54	1/4	6.3	1-5/8	41	1-7/8	48	5-1/4	133	17/32	14	13/32	10
401-600	8	203	2-1/2	64	3/8	9.5	2	51	2-1/8	54	6	152	11/16	18	17/32	13

Optional Indicator/Microswitch Mount (EI) dimensions:



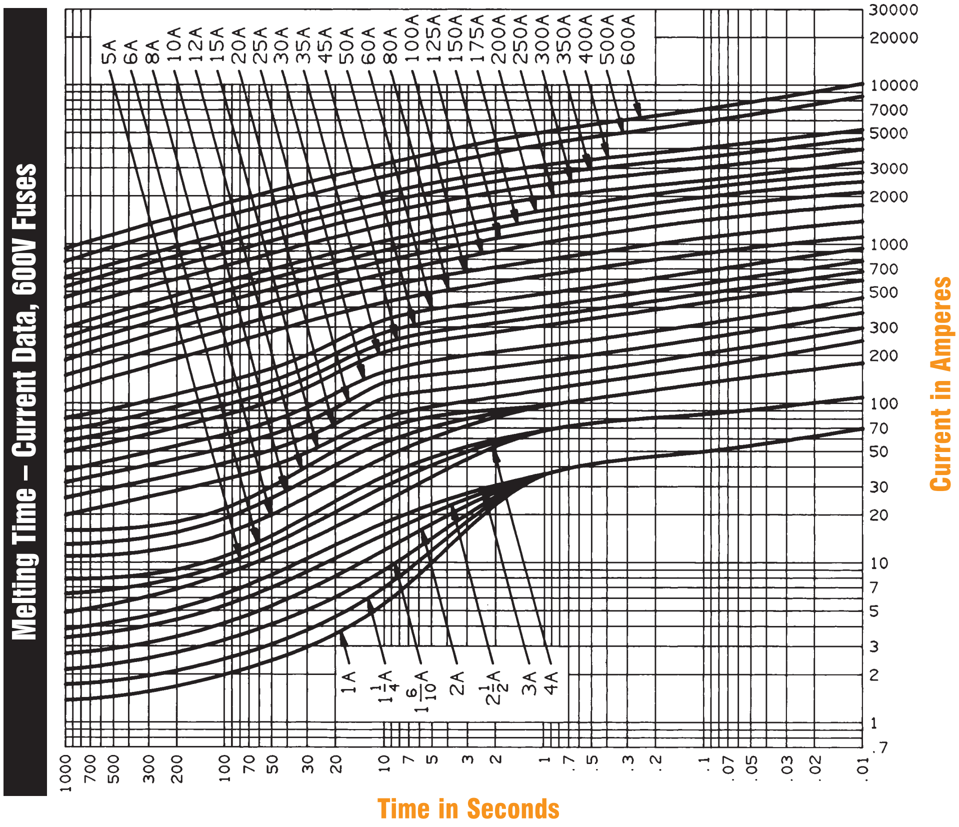
Note: Fuses with the EI option will receive the AOS-S or AOS-Q Add-On-Switch



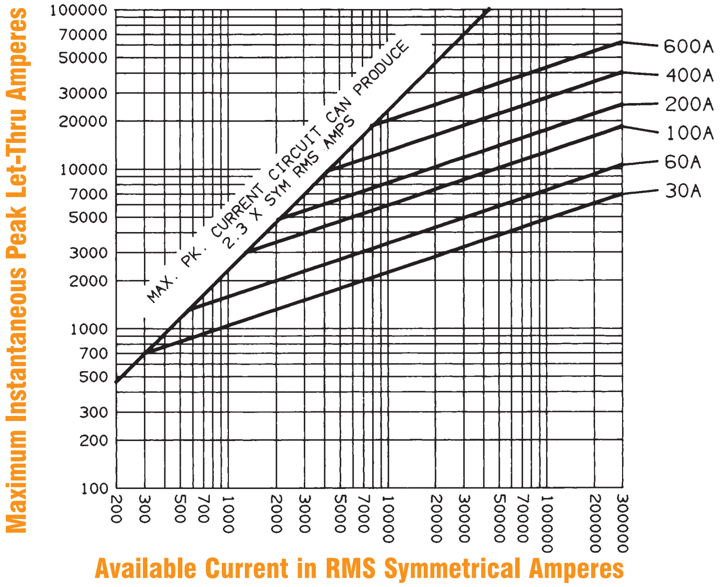
CATALOG NUMBER	A
AJT(70-100)-EI	2.80 (71.0)
AJT(110-200)-EI	3.22 (81.8)
AJT(225-400)-EI	3.24 (82.2)
AJT(450-600)-EI	3.61 (91.8)

TIME DELAY / CLASS J FUSES

AJT1 to 600



Peak Let-Thru Current Data – AJT30 to 600, 600 Volts AC



Note: See Application Tables page L9 for Three Phase Class J AJT Fuses.

CLASS J

600 VOLT / FUSE BLOCKS

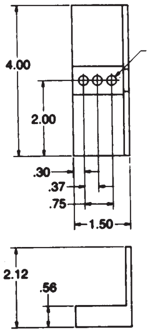


Figure 1

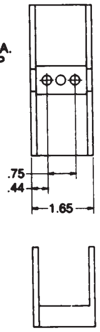


Figure 2

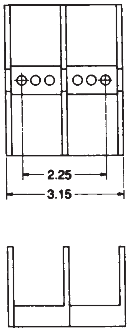


Figure 3

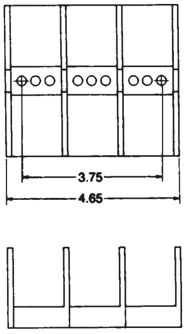


Figure 4

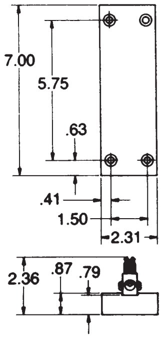


Figure 5

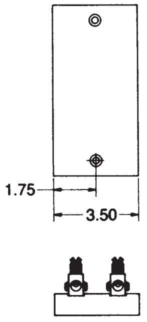


Figure 6

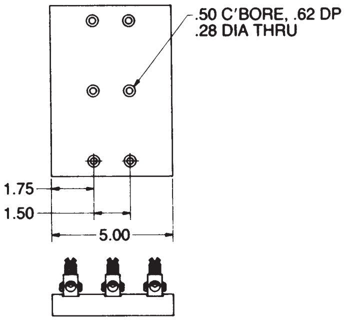


Figure 7

30A and 100A figures are standard dimension fuse blocks. See also 30 A and 100A space-saving "SJ" Series.

Recommended mounting screws for all 30A, 60A and 100A fuse blocks: 1/4" (.250" dia.)

600 Volt, 30, 60 & 100 Ampere Class J Fuse Blocks

AMPERE RATING	POLES	CONNECTOR		CATALOG NUMBER		FIG.	CONNECTOR TORQUE In - lb
				TYPE OF CLIP			
		TYPE	WIRE RANGE	NON-SPRING REINFORCED	SPRING REINFORCED		
30 GFPC INSULATOR	ADDER 1 2 3	BOX	Al/Cu #2-14	60300J 60301J 60302J 60303J	60305J 60306J 60307J 60308J	1 2 3 4	35
	ADDER 1 2 3	SCREW	Cu #10-14	60310J 60311J 60312J 60313J	60315J 60316J 60317J 60318J	1 2 3 4	20
	ADDER 1 2 3	PRESSURE PLATE	Cu #10-14	60320J 60321J 60322J 60323J	60325J 60326J 60327J 60328J	1 2 3 4	20
	ADDER 1 2 3	BOX	Cu* #4-14	- - - -	60355J 60356J 60357J 60358J	1 2 3 4	35
60 GFPC INSULATOR	ADDER 1 2 3	BOX	Al/Cu #2-14	60600J 60601J 60602J 60603J	60605J 60606J 60607J 60608J	1 2 3 4	45
	ADDER 1 2 3	BOX	Cu* #4-14	- - - -	60655J 60656J 60657J 60658J	1 2 3 4	45
100 PHENOLIC INSULATOR	1 2 3	BOX	Al/Cu 2/0-#6	- - -	61036J 61037J 61038J	5 6 7	120
	1 2 3	BOX	Cu* 2/0-#12	- - -	61006J 61007J 61008J	5 6 7	50

Note: To convert 30A or 60A adder pole to single pole, use end barrier #U09617.

* Fuse blocks have copper box connectors and clips and are for copper wires only. These are specifically designed with the same coefficient of expansion as copper wire for improved heat cycling and meet or exceed OEM "no aluminum" specifications.

WS625118SS ITEM # 1

Hoffman®
A Pentair Company

Rev. A June 2003

Watershed™ Free-Standing Enclosures

Application

The Hoffman Watershed™ stainless steel free-standing enclosure, with its unique design and Type 4X rating, is a perfect fit for mounting electrical or high-tech electronic equipment in a variety of indoor and outdoor settings. Its unique features are specifically designed for use in sanitary washdown production environments like food, beverage, or pharmaceutical processing. However, these same features also are useful in petrochemical plants, pulp and paper facilities, and wastewater treatment plants.

Patent pending.

Construction

- Manufactured from 12 gauge Type 304 stainless steel with 10 gauge Type 304 stainless steel back
- Seams continuously welded and ground smooth
- Smooth Type 304 stainless steel lift-off bullet-style hinges
- Hinges are shielded by cover edges
- Hinged side of cover has provisions to allow direct flushing of hinge area
- 20-degree sloped top facilitates runoff of water and cleaning solutions and prohibits the placement of objects on the top of the enclosure
- 170-degree door opening
- Door edges are sloped 20 degrees at top and bottom edges to facilitate runoff
- Slanted flange trough collar prohibits pooling of fluids along the top edge of the enclosure opening
- Three-point latching operated by Type 316 padlocking stainless steel handles; disconnect handles include integral defeater insert
- Seamless foam-in-place one-piece gasket provides oil-tight and dust-tight seal against contaminants
- Bonding provision on door and ground stud on body
- Panel studs fit optional NEMA size panels
- Mounting holes in bottom of enclosure for direct mounting or for optional sanitary legs and stainless steel floor stands
- Furnished hardware kit consists of panel mounting nuts, grounding hardware, and hole seals for mounting holes

Finish

Stainless steel enclosures are unpainted. External surfaces have a #4 brushed finish.

Industry Standards

NSF Criteria C-2
UL 508A, 508, File Number E61997: Type 4, Type 4X, Type 12
cUL C22.2 No. 26, File Number E61997: Type 4, Type 4X, Type 12
NEMA/EEMAC Type 4, Type 4X, Type 12
IEC 60529, IP66

Accessories

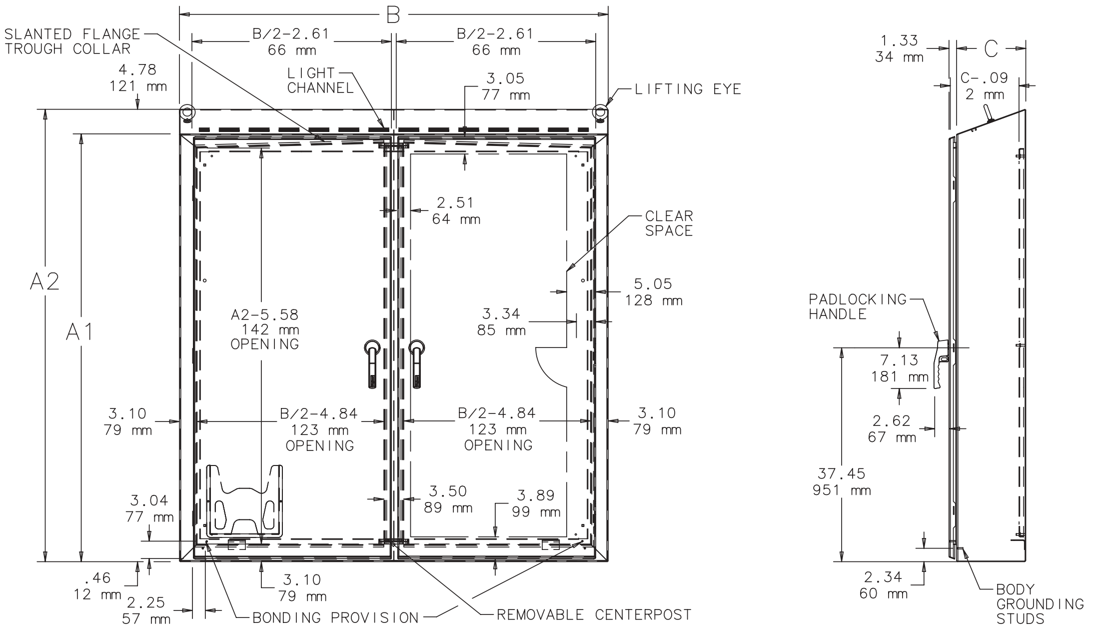
See Chapter 12, General Accessories.

Floor-Stand Kit
Panels
Sanitary Leg Kit

Standard Sizes **Watershed™ Free-Standing Enclosures**

Catalog Number	Includes Disconnect Cutout	Nominal Dimensions A x B x C		A1=Front			A2=Back		B=Width		C=Depth	* Panel Catalog Number
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	
WS625112SS	No	62 x 51 x 12	1575 x 1295 x 305	62.81	1595	67.20	1707	51.09	1298	12.12	308	**A60P48**
WS625118SS	No	62 x 51 x 18	1575 x 1295 x 457	62.81	1595	67.20	1707	51.09	1298	18.12	460	**A60P48**
WS626312SS	No	62 x 63 x 12	1575 x 1600 x 305	62.81	1595	67.20	1707	63.09	1707	12.12	308	**A60P60**
WS626318SS	No	62 x 63 x18	1575 x 1600 x 457	62.81	1595	67.20	1707	63.09	1602	18.12	460	**A60P60**
WS746312SS	No	74 x 63 x 12	1880 x 1600 x 305	74.81	1900	79.20	2012	63.09	1602	12.12	308	**A72P60**
WS746318SS	No	74 x 63 x 18	1880 x 1600 x 457	74.81	1900	81.38	2067	63.09	1602	18.12	460	**A72P60**
WS747512SS	No	74 x 75 x 12	1880 x 1905 x 305	74.81	1900	79.20	2012	75.09	1907	12.12	308	**A72P72**
WS747518SS	No	74 x 75 x 18	1880 x 1905 x 457	74.81	1900	81.38	2067	75.09	1907	18.12	460	**A72P72**
WS747524SS	No	74 x 75 x 24	1880 x 1905 x 610	74.81	1900	83.57	2123	75.09	1907	24.12	613	**A72P72**

* Panels must be ordered separately. See General Accessories.

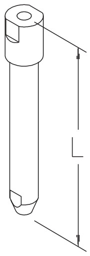


87574582

Accessories

Sanitary Leg Kits

Sanitary leg kits provide space between the enclosure and the floor for better washdown accessibility. Available with fixed or independently adjustable legs. Adjustable leg shown. Four legs per kit. Maintains UL/cUL Type 4X rating when properly installed on a Hoffman Type 4X enclosure.



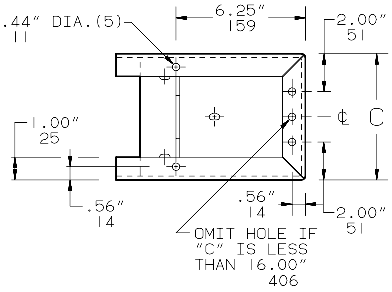
87574583

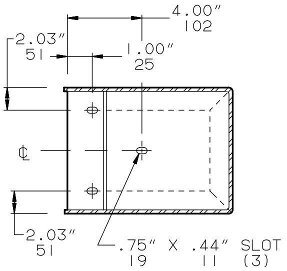
Catalog Number	Description	Size in.	mm
WSASLKSS	Adj. Sanitary Leg Kit	11.50-12.50	292-318
WSFSLKSS	Fixed Sanitary Leg Kit	12.00	305

Floor-Stand Kit

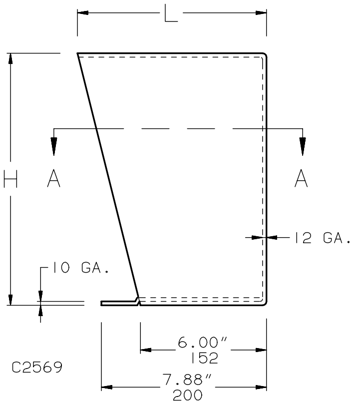
Use to raise free-standing enclosure. To install, drill holes in the bottom of the enclosure and bolt the floor stands to the enclosure. Each kit includes two stands. Type 304 stainless steel. Maintains UL/cUL Type 4X rating when properly installed on a Hoffman Type 4X enclosure.

Catalog Number	H in.	H mm	C in.	C mm	L in.	L mm
AFK1218SS	12.00	305	18.06	459	9.09	231
AFK1224SS	12.00	305	24.06	611	9.09	231





Section A-A



C2569

Hoffman®
A Pentair Company

Electric Heaters

Rev A December 2001

Application

Designed to protect sensitive mechanical, electrical, and electronic equipment from the harmful effects of condensation, corrosion, and low temperatures. Thermostatically controlled fan-driven heater units maintain a stable temperature within enclosures so critical components can perform more reliably over a longer period of time.

Construction

- Attractive and durable housing is anodized aluminum
- Thermostat, standard on all units, is adjustable from 0°F to 100°F (-18°C to 38°C)
- Fan draws cool air from the bottom of the enclosure and passes this air across the thermostat and heating elements before being released into enclosure cavity
- Heated air is discharged through the top of the heater unit
- Four 10-32 x self-tapping screws are included with each heater
- Ball bearing fan runs continuously for even temperature distribution
- Terminal strip with clamp connector that accepts both solid and stranded wire

Finish

Anodized aluminum.

Industry Standards

UL Component Recognized
CSA Listed
CE

Installation

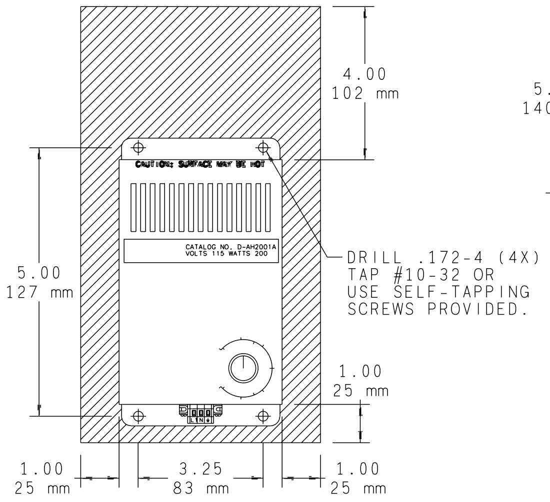
Hoffman electric heaters should be centered as low as possible on an interior enclosure panel. This permits the unit to heat the cool air located at the bottom of the enclosure. For maximum efficiency, the heater should be mounted in a vertical position with the terminal block to the bottom and the air outlet openings at the top. However, the unit will also effectively distribute heat if turned 90 degrees with the terminal block out the bottom and the air outlet at the side. Although enclosure panels are preferable, heaters may be installed on any flat sheet metal surface. Do not install heaters on wood panels.

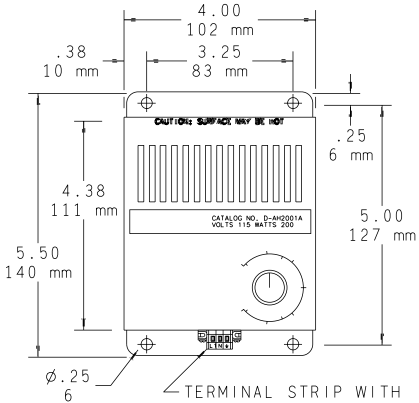
Heat sensitive components should not be placed near the heater discharge area since this air can be quite warm. The clearance range defines the space that must be kept free of these components for proper and safe operation of the heater.

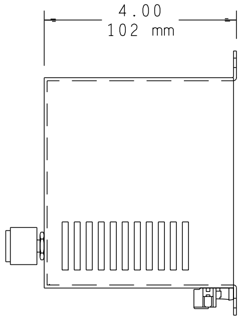
Standard Sizes Electric Heaters

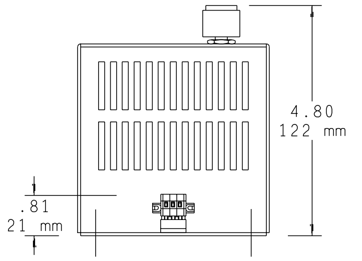
Catalog Number	Watts	Voltage	Hz	Amps	Weight lb.	(kg.)
D-AH1001A	100	115	50/60	0.9	4.00	(1.81)
D-AH1002A	100	230	50/60	0.6	4.00	(1.81)
D-AH2001A	200	115	50/60	1.7	4.00	(1.81)
D-AH2002A	200	230	50/60	0.9	4.00	(1.81)
D-AH4001B	400	115	50/60	3.3	6.00	(2.72)
D-AH4002B	400	230	50/60	1.7	6.00	(2.72)
D-AH8001B	800	115	50/60	6.5	6.00	(2.72)
D-AH8002B	800	230	50/60	3.3	6.00	(2.72)

Dimensions and Clearance Range for D-AH1001A, -2A and D-AH2001A, -2A



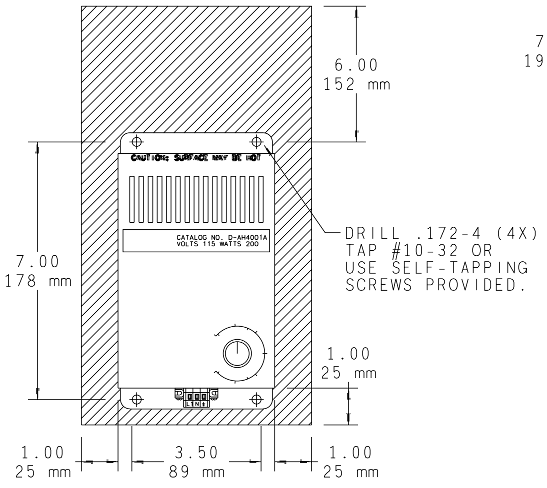


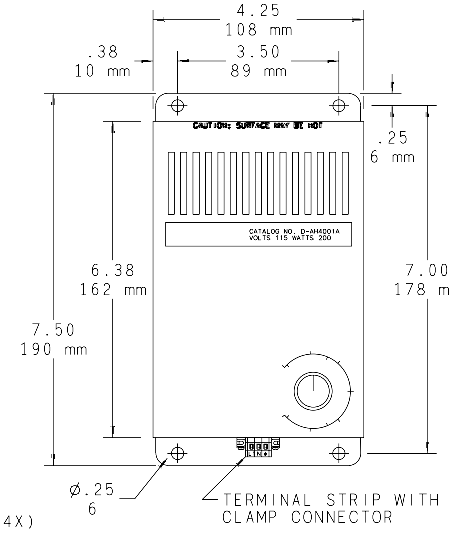


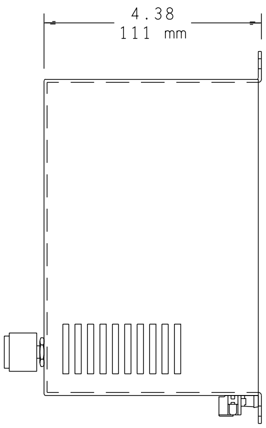


Inch
Millimeter

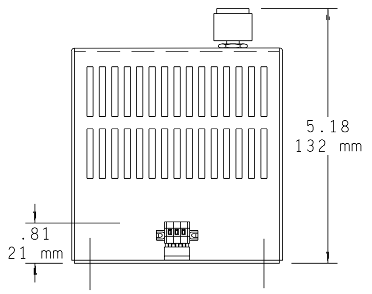
Dimensions and Clearance Range for D-AH4001B, -2B and D-AH8001B, -2B







87541412



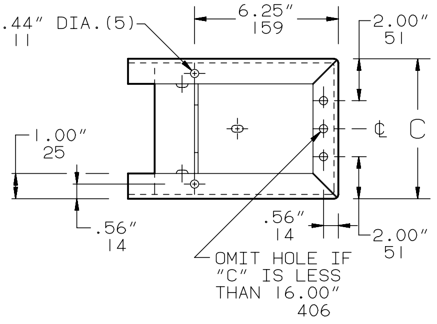
AFK1218SS | ITEM # 3

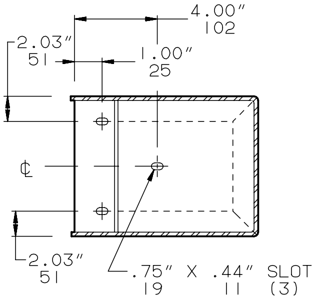
Steel Floor Stand (kit includes two stands)

Floor Stand Kit

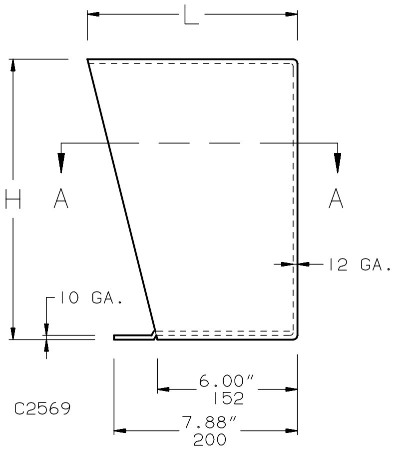
Kits are easily installed on most wall-mounted Hoffman enclosures. Can also be used to elevate Hoffman free-standing enclosures. To install, drill holes in the bottom of the enclosure and bolt the floor stands to the enclosure. It is not necessary to remove the wall-mounting brackets from the enclosure. Each kit includes two stands. 12 gauge steel floor stand has a ANSI 61gray polyester powder finish over phosphatized surfaces. Stainless steel floor stand is Type 304. Special heights, depths, materials, and finishes can be provided on custom order. Consult factory for information.

Product maintains UL/CSA Type 4 and Type 12 when properly installed on Hoffman Type 4 or Type 12 enclosures.





Section A-A



Steel Floor Stands

Catalog Number	Height H	Width C	L
AFK0608	6.00 (152)	8.06 (205)	7.06 (179)
AFK0610	6.00 (152)	10.06 (256)	7.06 (179)
AFK0612	6.00 (152)	12.06 (306)	7.06 (179)
AFK0618	6.00 (152)	18.06 (459)	7.06 (179)
AFK1208	12.00 (305)	8.06 (205)	8.12 (206)
AFK1210	12.00 (305)	10.06 (256)	8.12 (206)
AFK1212	12.00 (305)	12.06 (306)	8.12 (206)
AFK1216	12.00 (305)	16.06 (408)	8.12 (206)
AFK1218	12.00 (305)	18.13 (461)	8.12 (206)
AFK1220	12.00 (305)	20.06 (510)	8.12 (206)
AFK1808	18.00 (457)	8.06 (205)	9.17 (233)
AFK1810	18.00 (457)	10.06 (256)	9.17 (233)
AFK1812	18.00 (457)	12.06 (306)	9.17 (233)
AFK1816	18.00 (457)	16.06 (408)	9.17 (233)
AFK2408	24.00 (610)	8.06 (205)	10.23 (260)
AFK2410	24.00 (610)	10.06 (256)	10.23 (260)
AFK2412	24.00 (610)	12.06 (306)	10.23 (260)
AFK2416	24.00 (610)	16.06 (408)	10.23 (260)

Stainless Steel Floor Stands

Catalog Number	Height H	Width C	Depth L
AFK1208SS	12.00 (305)	8.06 (205)	9.09 (231)
AFK1210SS	12.00 (305)	10.06 (256)	9.09 (231)
AFK1212SS	12.00 (305)	12.06 (306)	9.09 (231)
AFK1216SS	12.00 (305)	16.06 (408)	9.09 (231)
AFK1218SS	12.00 (305)	18.06 (459)	9.09 (231)
AFK1224SS	12.00 (305)	24.06 (611)	9.09 (231)
AFK2410SS	24.00 (610)	10.06 (256)	9.09 (231)
AFK2412SS	24.00 (610)	12.06 (306)	9.09 (231)

Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.

A606CHNFSS

ITEM # 70

A Pentair Company

Stainless Steel Continuous Hinge Type 4X CHNFSS Junction Boxes

NEMA/EEMAC Type 3R, Type 4, Type 4X, Type 12, and Type 13
JIC standard EGP-1-1967
CSA File No. LL42184: Type 4, Type 4X, and Type 12
IEC 60529, IP66
Meets Type 3RX requirements

Accessories

See Chapter 12, General Accessories.

Corrosion Inhibitors
Fast Operating Junction Box Clamp
Lock Kit
Panels (see table)
Swing-Out Panel Kit
Terminal Block Kit Assembly
Window Kit

Application

Provides unmatched protection for housing electrical components in highly corrosive environments. This enclosure is used in indoor and outdoor settings that are frequently wet or have constant exposure to water, other liquids, or contaminants.

Construction

- 16 or 14 gauge Type 304 or Type 316L stainless steel
- Seams continuously welded and ground smooth, no holes or knockouts
- Seamless foam-in-place gasket assures watertight and dust-tight seal
- Stainless steel screws and clamps assure watertight seal
- Door removed by pulling stainless steel continuous hinge pin
- Weldnuts provided for mounting optional panels and terminal block kits

See Chapter 11, EMC Enclosures, for information on a related EMC-shielded product.

Finish

Enclosures are unpainted. Cover and sides of body have smooth #4 brushed finish. Optional stainless steel panels are unpainted. Optional steel panels are white

Industry Standards

UL 50, File No. E27567: Type 3R, Type 4, Type 4X, and Type 12 (see table)
UL 508A, 508, File No. E61997: Type 3R, Type 4, Type 4X and Type 12 (see table)

Modification Services Program

You can customize this product to your unique requirements by specifying from these options:

- Enclosure height, width, depth
- Holes and cutouts in body, doors, subpanels
- Tapped holes in subpanels
- Fasteners, mounting channel in enclosure and subpanel
- Mounting (adds and deletes)
- Doors
- Subpanels
- Windows
- Standard accessories

For details, see Modification Services at hoffmanonline.com.
To order, contact your local Hoffman sales representative.

For information about modifications outside the scope of the Modification Services program, contact your Hoffman sales representative.

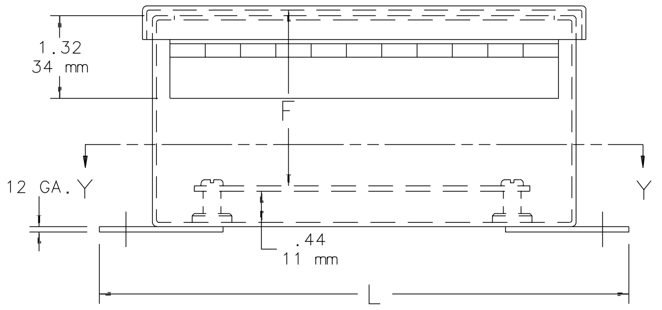
Standard Sizes Continuous Hinge Type 4X CHNFSS Junction Boxes

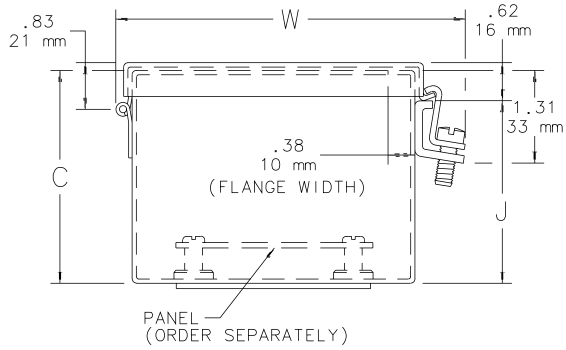
Box Catalog Number Type 304	Box Catalog Number Type 316L	Body Ga.	Cover Ga.	Box Size A x B x C	* Stainless Steel Panel Catalog Number	* Steel Panel Catalog Number	Panel Size D x E	Mounting G x H	Overall L x W	F	J	N	T	V	Y
■A6044CHNFSS	■ A6044CHNFSS6	16	16	6.00 x 4.00 x 4.00 (152 x 102 x 102)	A6P4SS	A6P4	4.88 x 2.88 (124 x 73)	6.75 x 2.00 (171 x 51)	7.50 x 4.94 (191 x 125)	3.50 (89)	3.62 (92)	2.38 (60)	3.00 (76)	0.31 (8)	0.56 (14)
☐ A606CHNFSS	☐ A606CHNFSS6	16	16	6.00 x 6.00 x 4.00 (152 x 152 x 102)	A6P6SS	A6P6	4.88 x 4.88 (124 x 124)	6.75 x 4.00 (171 x 102)	7.50 x 6.94 (191 x 176)	3.50 (89)	3.62 (92)	2.38 (60)	5.00 (127)	0.31 (8)	0.56 (14)
☐A8064CHNFSS	☐ A8064CHNFSS6	14	16	8.00 x 6.00 x 4.00 (203 x 152 x 102)	A8P6SS	A8P6	6.75 x 4.88 (171 x 124)	8.75 x 4.00 (222 x 102)	9.50 x 6.94 (241 x 176)	3.50 (89)	3.62 (92)	1.38 (35)	5.00 (127)	0.25 (6)	0.62 (16)
☐A1008CHNFSS	☐ A1008CHNFSS6	14	16	10.00 x 8.00 x 4.00 (254 x 203 x 102)	A10P8SS	A10P8	8.75 x 6.88 (222 x 175)	10.75 x 6.00 (273 x 152)	11.50 x 8.94 (292 x 227)	3.50 (89)	3.62 (92)	1.38 (35)	7.00 (178)	0.25 (6)	0.62 (16)
☐A12106CHNFSS	☐ A12106CHNFSS6	14	16	12.00 x 10.00 x 6.00 (305 x 254 x 152)	A12P10SS	A12P10	10.75 x 8.88 (273 x 225)	12.75 x 8.00 (324 x 203)	13.50 x 10.94 (343 x 278)	5.50 (140)	5.62 (143)	2.38 (60)	9.00 (229)	0.25 (6)	0.62 (16)
☐A1212CHNFSS	☐ A1212CHNFSS6	14	16	12.00 x 12.00 x 6.00 (305 x 305 x 152)	A12P12SS	A12P12	10.75 x 10.88 (273 x 276)	12.75 x 10.00 (324 x 254)	13.50 x 12.94 (343 x 329)	5.50 (140)	5.62 (143)	2.38 (60)	11.00 (279)	0.25 (6)	0.62 (16)
☐A1412CHNFSS	☐ A1412CHNFSS6	14	16	14.00 x 12.00 x 6.00 (356 x 305 x 152)	A14P12SS	A14P12	12.75 x 10.88 (324 x 276)	14.75 x 10.00 (375 x 254)	15.50 x 12.94 (394 x 329)	5.50 (140)	5.62 (143)	2.38 (60)	11.00 (279)	0.25 (6)	0.62 (16)
☐A1614CHNFSS	☐ A1614CHNFSS6	14	16	16.00 x 14.00 x 6.00 (406 x 356 x 152)	A16P14SS	A16P14	14.75 x 12.88 (375 x 327)	16.75 x 12.00 (425 x 305)	17.50 x 14.94 (445 x 379)	5.50 (140)	5.62 (143)	2.38 (60)	13.00 (330)	0.25 (6)	0.62 (16)

Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.

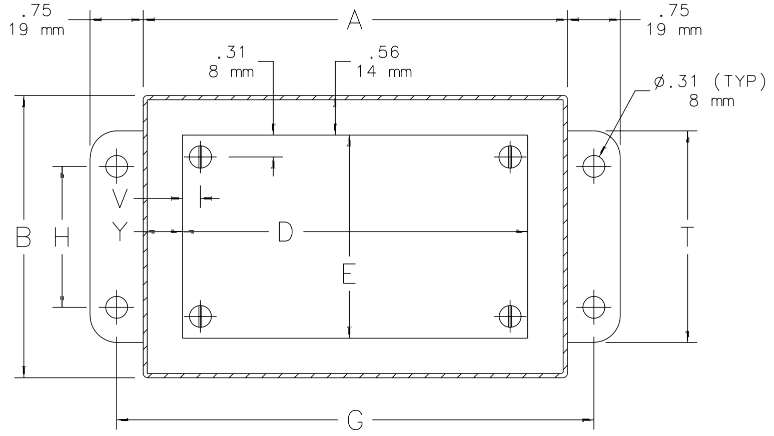
* Panels must be ordered separately. Optional aluminum, zinc-plated and composite panels are also available for most sizes. See General Accessories.

☐ UL 50 ■ UL 508A, 508



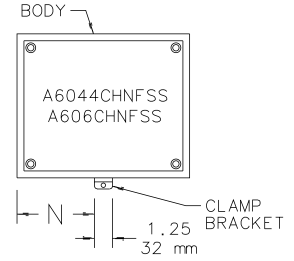


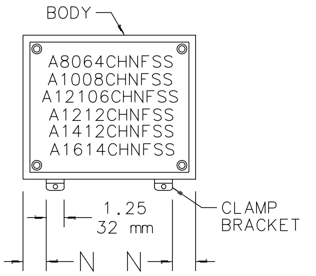
NOTE: 1. Optional panels are 14 gauge steel or stainless steel.
2. Panel screws are #10-32 pan head.



SECTION Y-Y

Clamp Bracket Locations





C2540

A60P48

ITEM # 2

Panels for Type 3R, 4, 4X, 12 and 13 Enclosures

Steel panels are 12 gauge and have a white finish. Larger panels have flanges on two sides or four sides (see table). Some larger steel panels are 10 gauge and include extra holes for panel lifting (see table). Aluminum panels are 5052-H32 aluminum alloy. Larger panels have flanges on four sides (see table). Aluminum panels are protected on one side with a plastic film. Stainless steel panels are Type 316 stainless steel. Panel mounting hardware is furnished with all enclosures which accept these panels.

Steel Panel Catalog Number	Zinc-Plated Panel Catalog Number	Panel Thickness (ga.) or Flange Thickness ("T")	Aluminum Panel Catalog Number	Panel Thickness ("T")	Stainless Steel Panel Catalog Number	Panel Thickness (ga.)	Panel Size D x E inch	(millimeter)	Number of Holes	Edge Flanges
A12DLP12		12 ga.	—	—	—	—	9.00 x 9.00	(229 x 229)	4	None
A16P12	**A16P12G**	12 ga.	**A16P12AL**	0.10 (3)	**A16P12SS6**	12 ga.	13.00 x 9.00	(330 x 229)	4	None
A20P12		12 ga.	—	—	—	—	17.00 x 9.00	(432 x 229)	4	None
A16P16		12 ga.	**A16P16AL**	0.10 (3)	**A16P16SS6**	12 ga.	13.00 x 13.00	(330 x 330)	4	None
A20P16	**A20P16G**	12 ga.	**A20P16AL**	0.10 (3)	**A20P16SS6**	12 ga.	17.00 x 13.00	(432 x 330)	4	None
A24P16		12 ga.	—	—	**A24P16SS6**	12 ga.	21.00 x 13.00	(533 x 330)	4	None
A30P16		0.75 (19)	—	—	—	—	27.00 x 13.00	(686 x 330)	4	2
A20P20		12 ga.	**A20P20AL**	0.75 (19)	**A20P20SS6**	12 ga.	17.00 x 17.00	(432 x 432)	4	None*
A24P20	**A24P20G**	0.75 (19)	**A24P20AL**	0.75 (19)	**A24P20SS6**	12 ga.	21.00 x 17.00	(533 x 432)	4	2*
A30P20		0.75 (19)	—	—	**A30P20SS6**	12 ga.	27.00 x 17.00	(686 x 432)	4	2
A12P24		12ga.	—	—	—	—	9.00 x 21.00	(229 x 533)	4	None
A24P24	**A24P24G**	0.75 (19)	**A24P24AL**	0.75 (19)	**A24P24SS6**	12 ga.	21.00 x 21.00	(533 x 533)	4	2*
A30P24	**A30P24G**	0.75 (19)	**A30P24AL**	0.75 (19)	**A30P24SS6**	12 ga.	27.00 x 21.00	(686 x 533)	4	2*
A36P24		0.75 (19)	**A36P24AL**	0.75 (19)	**A36P24SS6**	12 ga.	33.00 x 21.00	(838 x 533)	6	2*
A42P24		0.75 (19)	—	—	—	—	39.00 x 21.00	(991 x 533)	6	2
A48P24		0.75 (19)	—	—	—	—	45.00 x 21.00	(1143 x 533)	6	2
A30P30		0.75 (19)	—	—	**A30P30SS6**	12 ga.	27.00 x 27.00	(686 x 686)	4	4
A36P30	**A36P30G**	0.75 (19)	**A36P30AL**	0.75 (19)	**A36P30SS6**	12 ga.	33.00 x 27.00	(838 x 686)	6	4
A40P30	**A40P30G**	0.75 (19)	—	—	—	—	37.00 x 29.00	(940 x 737)	4***	4
A42P30		0.75 (19)	—	—	**A42P30SS6**	12 ga.	39.00 x 27.00	(991 x 686)	6	4
A48P30		0.75 (19)	—	—	—	—	45.00 x 27.00	(1143 x 686)	6	4
A60P30		0.75 (19)	—	—	—	—	57.00 x 27.00	(1448 x 686)	6	4
A36P36		0.75 (19)	—	—	**A36P36SS6**	12 ga.	33.00 x 33.00	(838 x 838)	8	4
A42P36		0.75 (19)	—	—	**A42P36SS6**	12 ga.	39.00 x 33.00	(991 x 838)	8	4
A48P36	**A48P36G**	0.75 (19)	**A48P36AL**	0.75 (19)	**A48P36SS6**	12 ga.	45.00 x 33.00	(1143 x 838)	8	4
A60P36	**A60P36G**	0.75 (19)	**A60P36AL**	0.75 (19)	**A60P36SS6**	12 ga.	57.00 x 33.00	(1448 x 838)	8	4
A72P36		0.75 (19)	—	—	—	—	69.00 x 33.00	(1753 x 838)	8	4
A42P42		0.75 (219)	—	—	—	—	39.00 x 39.00	(991 x 991)	8	4
A48P42		0.75 (19)	—	—	—	—	45.00 x 39.00	(1143 x 991)	8	4
A54P42		0.75 (19)	—	—	—	—	50.00 x 38.00	(1270 x 965)	8	4
† **A60BFP42**		0.88 (22)	—	—	—	—	56.00 x 38.00	(1422 x 965)	10**	4
† **A48P48**		0.88 (22)	—	—	—	—	44.00 x 44.00	(1118 x 1118)	8	4
A60P48		0.88 (22)	—	—	—	—	56.00 x 44.00	(1422 x 1118)	12**	4
† **A60P60**		0.88 (22)	—	—	—	—	56.00 x 56.00	(1422 x 1422)	10**	4
† **A72P60**		0.88 (22)	—	—	—	—	68.00 x 56.00	(1727 x 1422)	12**	4
† **A72P72**		0.88 (22)	—	—	—	—	68.00 x 68.00	(1727 x 1727)	10**	4

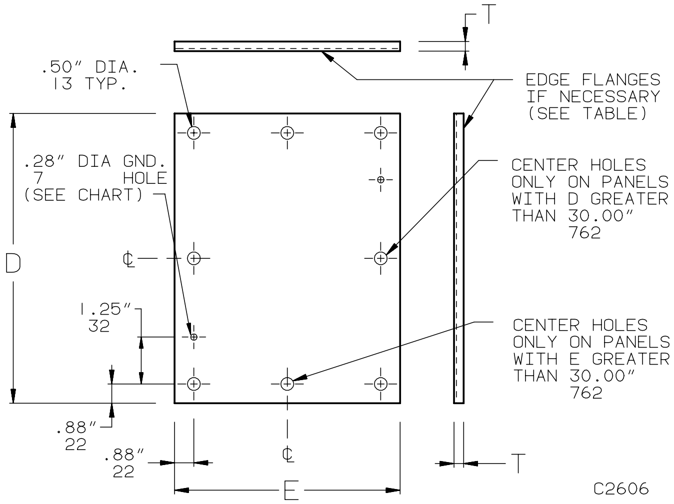
Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.

* Aluminum panels have four flanges.

** Extra holes are for panel lifting.

*** This panel is an exception to the illustration note regarding center holes on dimension "D".

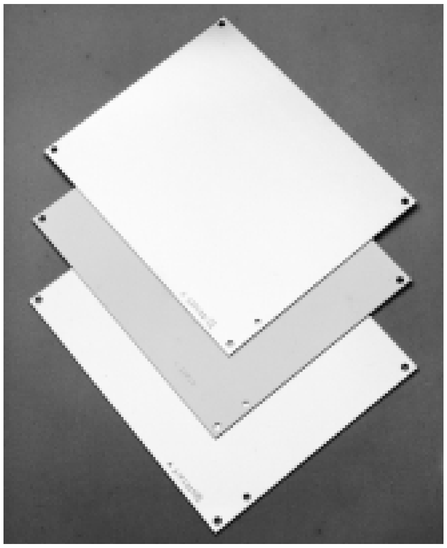
† Panels are 10 gauge steel.

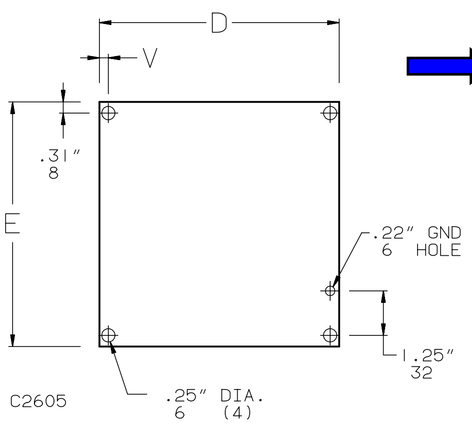


Additional panels are shown starting on page 12.63.

A12P10

ITEM #





Panels for Junction Boxes

Steel panels are 14 gauge with a white finish. Stainless steel panels are 14 gauge Type 304 and have a commercial #2B finish which is protected on one side with a plastic film. Aluminum panels are 5052-H32 aluminum alloy .080-inch (2mm) thick and protected on one side with a plastic film. Zinc-plated panels are 14 gauge steel protected on one side with a plastic film. Panel mounting hardware is furnished with all enclosures which accept these panels.

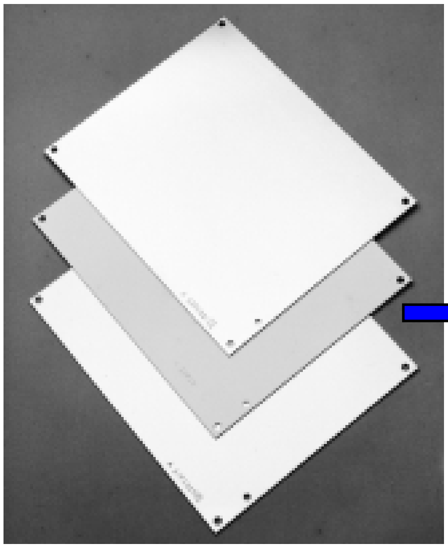
Catalog Number Steel	Catalog Number Stainless Steel	Catalog Number Aluminum	Catalog Number Zinc-Plated	Panel Size D x E	V
A6P4	A6P4SS	A6P4AL	A6P4G	4.88 x 2.88 (124 x 73)	0.31 (8)
A6P6	A6P6SS	A6P6AL	A6P6G	4.88 x 4.88 (124 x 124)	0.31 (8)
A8P6	A8P6SS	A8P6AL	A8P6G	6.75 x 4.88 (171 x 124)	0.25 (6)
A12P6	——	——	——	10.75 x 4.88 (273 x 124)	0.25 (6)
A8P8	——	——	——	6.75 x 6.88 (171 x 175)	0.25 (6)
A10P8	A10P8SS	A10P8AL	A10P8G	8.75 x 6.88 (222 x 175)	0.25 (6)
A14P8	——	——	——	12.75 x 6.88 (324 x 175)	0.25 (6)
A10P10	——	——	——	8.75 x 8.88 (222 x 226)	0.25 (6)
A12P10	A12P10SS	A12P10AL	A12P10G	10.75 x 8.88 (273 x 226)	0.25 (6)
A16P10	——	——	——	14.75 x 8.88 (375 x 226)	0.25 (6)
A12P12	A12P12SS	——	A12P12G	10.75 x 10.88 (273 x 276)	0.25 (6)
A14P12	A14P12SS	A14P12AL	A14P12G	12.75 x 10.88 (324 x 276)	0.25 (6)
A16P14	A16P14SS	A16P14AL	A16P14G	14.75 x 12.88 (375 x 327)	0.25 (6)
A18P16	A18P16SS	A18P16AL	A18P16G	16.75 x 14.88 (425 x 378)	0.25 (6)

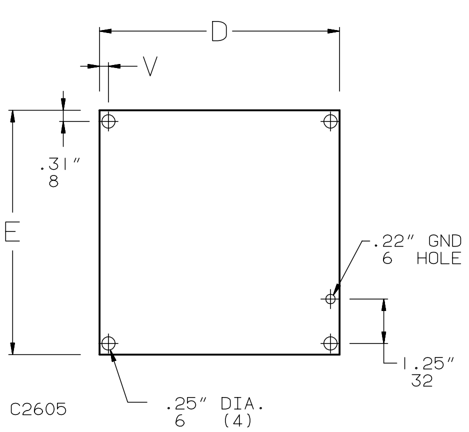
Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.

A6P6 ITEM # 71

Hoffman®
A Pentair Company

Panels





Panels for Junction Boxes

Steel panels are 14 gauge with a white finish. Stainless steel panels are 14 gauge Type 304 and have a commercial #2B finish which is protected on one side with a plastic film. Aluminum panels are 5052-H32 aluminum alloy .080-inch (2mm) thick and protected on one side with a plastic film. Zinc-plated panels are 14 gauge steel protected on one side with a plastic film. Panel mounting hardware is furnished with all enclosures which accept these panels.

Catalog Number Steel	Catalog Number Stainless Steel	Catalog Number Aluminum	Catalog Number Zinc-Plated	Panel Size D x E	V
A6P4	A6P4SS	A6P4AL	A6P4G	4.88 x 2.88 (124 x 73)	0.31 (8)
A6P6	A6P6SS	A6P6AL	A6P6G	4.88 x 4.88 (124 x 124)	0.31 (8)
A8P6	A8P6SS	A8P6AL	A8P6G	6.75 x 4.88 (171 x 124)	0.25 (6)
A12P6	——	——	——	10.75 x 4.88 (273 x 124)	0.25 (6)
A8P8	——	——	——	6.75 x 6.88 (171 x 175)	0.25 (6)
A10P8	A10P8SS	A10P8AL	A10P8G	8.75 x 6.88 (222 x 175)	0.25 (6)
A14P8	——	——	——	12.75 x 6.88 (324 x 175)	0.25 (6)
A10P10	——	——	——	8.75 x 8.88 (222 x 226)	0.25 (6)
A12P10	A12P10SS	A12P10AL	A12P10G	10.75 x 8.88 (273 x 226)	0.25 (6)
A16P10	——	——	——	14.75 x 8.88 (375 x 226)	0.25 (6)
A12P12	A12P12SS	——	A12P12G	10.75 x 10.88 (273 x 276)	0.25 (6)
A14P12	A14P12SS	A14P12AL	A14P12G	12.75 x 10.88 (324 x 276)	0.25 (6)
A16P14	A16P14SS	A16P14AL	A16P14G	14.75 x 12.88 (375 x 327)	0.25 (6)
A18P16	A18P16SS	A18P16AL	A18P16G	16.75 x 14.88 (425 x 378)	0.25 (6)

Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.

Intelligent Computer and Electronics Environmental Management Systems

Operation and Installation Manual

****IMPORTANT**** For safe and satisfactory operation, please read this manual and follow the instructions for installation and operation of this system. Keep this manual for future reference. Some information may not apply to your system.

Where To Find Information On

Introduction

Ice Qube computer and electronics enclosure cooling systems have been designed to provide a friendly environment for your equipment by cooling and dehumidifying the enclosure which houses your equipment in an efficient, modern, aesthetically pleasing package requiring minimal maintenance. Our closed-loop circulation design also protects your equipment from air-borne dust and contaminants, which may hinder your equipment operations and cause unnecessary downtime. **Ice Qube** offers models ranging in cooling capacity from 1,000 to 20,000 BTU per hour to provide cooling systems for many of your conditioning needs. **Ice Qube** also offers select models in enclosure top and side mount packages.

Basic Operation

The **Ice Qube** air conditioning system is actually three systems, which function simultaneously to maintain environmentally friendly conditions for your equipment within the enclosure. These are the closed-loop cold air system, the warm air system, and the vapor-compression refrigeration system.

The closed-loop cold air system circulates cold air from the **Ice Qube** cooling system to the electronics enclosure. This air then returns to the **Ice Qube** system bringing with it unwanted heat and humidity from within the enclosure. This heat and humidity is removed by a heat exchanger within the **Ice Qube** system. This heat exchanger is part of the vapor-compression refrigeration system.

At the heart of the vapor-compression refrigeration's system is a quiet, energy efficient rotary compressor, which circulates NON-CFC refrigerant to transfer heat from the heat exchanger (evaporator) located within the closed-loop air stream to a heat exchanger (condenser) located in the warm air system. In the warm air system, air is circulated from the ambient surrounding the enclosure, through a filter and across the warm air heat exchanger. Here, heat from the enclosure is transferred from the warm air heat exchanger to the warm air stream and dissipated to the ambient.

Unpacking Inspection

What to look for :

1. **Shipping container is banded to the pallet and arrows on the shipping container are pointing in the proper (upward) direction.** The **Ice Qube** system is position sensitive. **Ice Qube** recommends the unit to remain in the proper upright position, as indicated on the shipping container, for a minimum of 24 hours before initial operation to ensure the oil has returned to the compressor. Operation before the 24-hour time may cause compressor damage and shorten the life of the system. Operation before this 24-hour period will *void all warranties*.

2. Damage to the shipping container. If the shipping container has been damaged or marred in any way, carefully inspect the **Ice Qube** system for damage, which may have occurred during shipping. Check for scratches, dents, or rattles indicating loose components, presence of oil, or any other irregularities. Any evidence of damage should be recorded on the freight bill. The freight carrier's claim procedure should be followed. ***Ice Qube Inc. cannot accept responsibility for damages, which occur during shipping.***

Pre-Installation Test

Before installing the **Ice Qube** system on your enclosure, it is a good idea to operate the unit for a few minutes to ensure it is functioning properly. Although the **Ice Qube** system has been tested at the factory, internal damage may have occurred during shipping which may have not been apparent during the unpacking inspection. This procedure will also help to familiarize you with the **Ice Qube** system.

1. Place the system on a solid base such as a workbench or table. Be sure to allow for adequate space for airflow. There are two air streams, which must not be restricted, the cold air stream and the warm air stream. Top mount units must be elevated to provide adequate airflow for the cold air stream located on bottom of system. Check the Model # to determine whether it's a Top or Side mount air conditioner. **Top mount units can only be mounted on a flat horizontal surface and Side mount units can only be mounted on a flat vertical surface.**

2. Check that the warm air system filter is in place. (Location varies with model type)

   **Models with the optional rain or wash down hood do not have this filter and require regular condenser maintenance.*

3. Check the data tag for proper electrical requirements. The data tag will give the voltage and amperage requirements of the system. Be sure the electrical outlet where the system will be connected has the proper capacity. After noting the above, connect the power cord to a properly grounded electrical outlet. An extension cord is not recommended.

** If any unusual noise or vibration is present during the testing procedure, immediately disconnect the power cord and inspect the unit for the cause of the noise or vibration and contact Ice Qube immediately.

4. As soon as power is supplied to the system, the cold air evaporator blower will begin operation. The compressor and warm air condenser blower will not operate if the room air temperature is below 80' F. This is because the temperature controller has a factory set point of 80' F. (The digital display on the face of the controller will be displaying room temperature.) If the display is indicating 80' F or warmer, the cool status LED will flash for 3-1/2 minutes before the compressor and warm air condenser blower will operate.

If the display is indicating a temperature less than 80' F, you must change the set point to a temperature lower than the room temperature in order for the compressor and warm air condenser blower to operate. (Refer to the section on the Temperature Controller in this manual.)

5. With the compressors and both blowers operating, allow the unit to operate for 20 to 30 minutes. This will provide sufficient time for the vapor compression system to achieve operating balance. Measure the cold air outlet temperature with an accurate thermometer. This temperature should be at least 10' F colder than the inlet air temperature if the room temperature is warmer than 70' F. Inlet air temperature will be displayed on the temperature controller. (In areas where the humidity is high, the temperature difference may be less than 10' F.)

6. After completing these few simple checks, you are ready to prepare the electrical enclosure for installation of the **Ice Qube** system.

Preparing the Enclosure

Ice Qube air conditioning systems have been designed to be lighter in weight for easy installation. Our wall (vertical) mount units have been designed with a simple “two stud” alignment feature to make initial fastening to the enclosure quick and easy. A few modifications must be made to your enclosure to provide proper air flow, maintain enclosure integrity and assure secure installation. Required modifications will vary with air conditioner model.

1. Determine the location of the **Ice Qube** system on your enclosure.

****Caution****

With wall mount units, be sure the weight of the air conditioning system will not cause the enclosure to become unbalanced causing bodily harm or equipment damage. For units mounted on enclosure doors, be sure the hinges will support the weight of the **Ice Qube** system. Refer to system specifications for model weights.

2. Upon deciding the location of the **Ice Qube** system on the enclosure, attach the template which has been packaged with your system to the enclosure surface. (You can use the template to help you decide unit location.) Be sure that the **Ice Qube** system will be mounted level and that the inlet and outlet of the cold air stream will not be restricted by equipment or shelving within the enclosure. Also check that the air flow of the warm air stream will not be affected or restricted by surroundings.

3. Outline the modifications to be made to the enclosure using a marking pencil. Note the bolt holes, cutouts for the inlet and outlet air streams and the power cord. Units connecting to the ***ICENET*** network will require an additional opening for communication cables.

4. Make the holes for the studs, bolts and power cord using a drill. (bit size will vary with model) Be sure to protect any equipment located within the enclosure from debris produced during the installation procedure.

5. Drill a pilot hole for a saber saw to cut the inlet and outlet air passages. File all cuts to provide a uniform cutout.

6. Slide the mounting studs through the matching holes in the enclosure and check to see that all openings are aligned. (Top mount units do not have mounting studs.)

7. After checking that all opening and bolt holes are in alignment, apply the gasket material (provided with your system) to the **Ice Qube** air conditioning system cabinet to ensure an air tight NEMA integrity. *Caution* Be careful while removing the backing on the gasket material. The material may stretch and the holes will not align. ***Note* If the enclosure is not air tight or the air conditioning system operates with the enclosure door(s) open, a great deal of moisture will condense inside of the air conditioning system and possibly overflow the condensate management system.**

8. After all gasket material has been installed, mount the **Ice Qube** system onto the enclosure and fasten it using the nuts and bolts provided with your system. Check to be sure all fasteners have been tightened securely and the gasket material is in place to maintain enclosure integrity. You are now ready to operate your **Ice Qube** system.

****Note****

Near the bottom or on the side of the **Ice Qube** system cabinet, you will find a nipple which is for condensate overflow. Although all **Ice Qube** systems have a built-in condensate management systems, you may find it necessary to attach a hose to this nipple on enclosures which are located in extremely humid conditions, when enclosure doors are left open or the door seals are leaking. Top mount models do not have a built in condensate evaporation system.

Operating Your System

After installing the **Ice Qube** system onto your enclosure and attaching the power cord to a properly grounded electrical outlet with adequate voltage and current supply, you are ready to begin operation of the system. As soon as electrical power is supplied to the **Ice Qube** system, you should hear the cold air stream blower operating immediately. This blower operates continuously so that the temperature controller can constantly monitor your enclosure's internal temperature. Enclosure temperature will be displayed on the face of the controller.

If the enclosure temperature is above the factory cooling set point of 80 degrees Fahrenheit, you will see the cool status LED flashing. This indicates that the compressor's automatic off cycle timer is working. (The off cycle timer is factory set at 3-1/2 minutes.) At the end of 3-1/2 minutes, you should hear the compressor and the condenser air blower start. This signifies that the cooling system has begun operation to remove heat and humidity from within the enclosure. (It may take 20 to 30 minutes operating time to reach full capacity.)

If the heat load within the enclosure is less than the BTUH capacity of the of your Ice Qube system, you will notice the temperature on the digital display begin to decrease. When the temperature inside the enclosure decreases 7 degrees Fahrenheit below the cooling on set point, the compressor and the condenser blower should cycle off, but the cold air blower will continue to operate, circulating air within the enclosure. (The controller has a factory programmed temperature differential of 7 degrees Fahrenheit.)
Example: Cooling on @ 80 degrees F Cooling off @ 73 degrees F

Programming the Controller

The digital controller offers many features which you may or may not decide to use. However, the controller has been programmed at the factory with default settings for system operations which are satisfactory for many applications. Please review the following default settings to see if they are correct for your enclosure application.

1. Cooling system on temperature - 80 degrees Fahrenheit
2. Heating system on temperature - 50 degrees Fahrenheit (Optional)
3. High enclosure temperature alarm - 100 degrees Fahrenheit
4. Low enclosure temperature alarm - 40 degrees Fahrenheit
5. Audible and Visual alarm - On
6. Digital display in degrees Fahrenheit
7. Filter maintenance alarm - 30 Days
8. High condenser temperature alarm - 170 degrees Fahrenheit

If you wish to change the factory default settings, you must enter the programming code which is factory set at the sequence of : **Adjust-up (1)** arrow, **Adjust-down (2)** arrow, **Select (3)**, then **Exit (4)**. After pressing the above sequence and the code is accepted, the program LED should be on, and the digital display on the face of the controller should be flashing three alternating boxes. If no selection is made within one minute, the system returns to the normal operating mode. ***Note** Pressing the exit (4) button at any time while in the programming mode returns the controller to the normal operating mode.*

Press the **Select (3)** button to continue programming. The set temperature hi LED is on with the display indicating the cooling on set point. The compressor will begin operation at this temperature and remain operating until the enclosure temperature decreases approximately seven degrees Fahrenheit. (Four degrees Celsius) Press the **Adjust-up (1)** or **Adjust-down(2)** arrow until the desired set point is displayed within a range of 70 to 126 degrees Fahrenheit (21 to 52 degrees Celsius). When adjustment is complete, press the **Select (3)** button to continue.

The set temperature lo LED is on with the display indicating the (optional) heating on set point. The heating system will begin operation at this temperature and remain operating until the enclosure temperature increases approximately seven degrees Fahrenheit (Four degrees Celsius). Press the **Adjust-up (1)** or **Adjust-down (2)** arrow until the desired set point is displayed within a range of 40 to 63 degrees Fahrenheit (4.5 to 17 degrees Celsius).
*****Note** If you have changed the cool on or heat on set points, be sure to review the alarm settings.***

Press the **Select (3)** button to continue. The set alarm hi LED is on with the display indicating the high temperature alarm set point. The alarm will activate at this temperature and will automatically reset at 2 degrees Fahrenheit (1 degree Celsius) below this temperature. Press the **Adjust-up (1)** or **Adjust-down (2)** arrow to change the alarm set point in a range from 8 degrees Fahrenheit (4 degrees Celsius) above the set temperature hi set point, to 135 degrees Fahrenheit (57 degrees Celsius).

Press the **Select (3)** button to continue. The set alarm lo LED is on with the display indicating the low temperature alarm set point. The alarm will activate at this temperature and will automatically reset at 2 degrees Fahrenheit (1 degree Celsius) above this temperature. Press the **Adjust-up (1)** or **Adjust-down (2)** arrow to change the alarm set point in a range from 8 degrees Fahrenheit (4 degrees Celsius) below the set temperature lo set point, to 34 degrees Fahrenheit (1 degree Celsius).

Press the **Select (3)** button to continue. The alarm LED will flash and the display will show *ALL* indicating the all alarm on/off status. Press **Select (3)** and the display will show either *ON* or *OFF* indicating current alarm status. Press **Adjust-up (1)** or **Adjust-down (2)** to toggle the mode as desired. If the off mode is selected, no alarms will activate and the audible on/off select function is skipped.

Press the **Select (3)** button to continue. The audible LED will flash and the display will show *AUD* indicating the audible alarm on/off status. Press select and the display shows *ON* or *OFF* indicating the current audible alarm status. Press **Adjust-up (1)** or **Adjust-down (2)** to toggle the mode as desired.

Press the **Select (3)** button to continue. The C LED flashes and the display shows either *F* for degrees Fahrenheit or *C* for degrees Celsius. Press **Adjust-up (1)** or **Adjust-down (2)** to toggle the mode as desired.

Press the **Select (3)** button to continue. The code LED is on and the display shows *PIN*. To set a new user PIN code, press the **Adjust-up (1)** button. The display will flash *4*, prompting an entry of a four button sequence using the **Adjust –up (1), Adjust-down (2), Select (3)** and/or **Exit (4)** buttons. (Any sequence of the four buttons may be programmed as your code.) As the buttons are pressed, the display will show the number of buttons pressed. (After pressing a button, you will have approximately 5 seconds to press the next button. If you do not press the next button in the allotted time, the system will default to no PIN code indicated by 0 on the display.) Once the sequence is entered, the display will no longer flash, but will show *4*.

To program the no PIN code mode, press **Adjust-down (2)** and the display will show *0* indicating no PIN code. With no PIN code, pressing any button will permit access to the program.
****Caution** Always record the selection sequence (PIN code) and store in a secure place.**

Press the **Select (3)** button to continue. The filter LED flashes and the display shows *FIL* indicating the filter alarm days selection. Press the **Select (3)** button and the display will show the number of days that the alarm is set in one-half day increments.
(Example : *10.5* indicates the alarm will activate every ten and one-half days.) Press the **Adjust–up (1)** or **Adjust-down (2)** arrow to adjust the desired number of days. Programming 0 days will disable the alarm. **Note - The required number of days to set this alarm will be determined by your ambient air conditions. If rain or wash down hoods are installed on your system, no filter is supplied with your system and the filter alarm should be set to "0". This will disable the filter alarm.*

Press the **Select (3)** button to continue. (***Making adjustments to this setting is necessary only for installation of the ICENET communication network. Omit this otherwise.)***
The program LED will be lit and the display will show *Add*. This is where you will program the numerical address of the Ice Qube air condoning system for operation with the ICENET communication network. Press the **Adjust-up (1)** or **Adjust-down (2)** arrow until the desired numerical address for this Ice Qube air conditioning system is displayed. (Maximum range is .5 to 32 in .5 increments) Please make record of this numerical address and system location in order that it may be entered into the *ICENET Unit Description* folder on the *Options Screen*.

Programming of the microprocessor is now complete. Press the **Select** button to review the settings you have made. Press the **Exit** button to enter the selected settings and to return to the normal operating mode.

Alarm Operation

1. **The enclosure temperature is above or below the alarm set point.** The alarm LED will light, the display flashes, either the HI or LO LEDs flash with the display and the audible alarm sounds (if activated). The enclosure temperature must rise or fall two degrees Fahrenheit (one degree Celsius) before the alarm will reset.

2. **The condenser temperature is above the condenser alarm set point.** The alarm LED lights, the display flashes the condenser temperature, and the audible alarm sounds (if activated). The condenser temperature must fall four degrees Fahrenheit (two degrees Celsius) before the alarm will reset.

Note The above alarms can be manually reset by entering the PIN code into the system.

3. **The filter day timer has expired.** The alarm LED lights, the display flashes showing *FIL*, the filter LED flashes with the display and the audible alarm sounds (if activated). The filter alarm may be cleared by pressing **Exit (4)**.

Maintenance

The **Ice Qube** air conditioning system should provide many years of trouble-free operation with a minimal amount of maintenance. Primary maintenance consists of checking the condition of the ambient air filter and condensate management system.

1. Ambient Air Filter - It is recommended that the ambient air filter be checked and cleaned regularly, at least every 30 days, or more frequently depending on ambient conditions. In order to check the condition of the air filter, it is recommended to first remove electrical power from the Ice Qube system. Next, locate the filter cover and filter. (Location varies with model) Loosen the knurled knobs or screws which hold the filter cover in place and remove the cover from the system. Next, remove the filter and clean it by soaking it in warm soapy water and then rinsing in clean water. Use a shop-vac to remove excess water from the filter before returning it to the system. Replace the filter if it is showing signs of deterioration. Some units have slideout filters

****Note****

If rain or wash down hoods are installed on your system, no filter is supplied with your system and no filter maintenance is required. Systems equipped with rain or wash down hoods will require regular condensing section maintenance. **For systems equipped with filters, it is recommended to have a spare clean filter in stock in order to prevent prolonged cooling system downtime. The dirty filter may be cleaned at a more convenient time.**

2. Condensate Management System - The condensate management system should be checked periodically for scale, sludge and debris which may cause the system to fail. On open type enclosures, and in areas where the enclosure door is opened frequently in dirty or industrial environments, maintenance should be performed on a regular basis, at least every 30 days. On sealed enclosures, clean environments and where the door is not opened frequently, maintenance may be performed bi-annually. *Your environment will determine frequency of required maintenance.*

Maintenance of the condensate management system will require removal of electrical power from the Ice Qube system and removal of the cover. To remove the cover, use a screw driver to loosen the screws which attach the cover to the base. *Caution: Electrical wires are connected from the cover to the base.*

Upon removing the cover, you will see the primary condensate management pan located below the evaporator. Inspect the condensate pan and drain nipple for signs of scale, sludge or debris which may prevent water flow through the nipple. To clean the debris from the pan, use a clean absorbent cloth or a shop-vac. Nipples may be cleaned using a 1/4 inch tubing brush and then flushing with clean water.

Also inspect the neoprene tubing which is attached to the nipples on the condensate management system. If the tubing appears to have internal build up or is brittle, it should be replaced. It is recommended to replace the tubing at least every two years, pending your environmental conditions. *Note: If your system has a secondary condensate management pan, maintenance should be performed in the same manner as above.*

After all debris has been removed from the system, replace the cover onto the unit being careful not to pinch or damage the wiring connecting the cover to the base.

Another part of the system which may need cleaned occasionally is the cooling system cabinet. To clean the system cabinet, simply wipe it with a damp , lint free cloth. A mild soap solution may be used if necessary.

Trouble Shooting

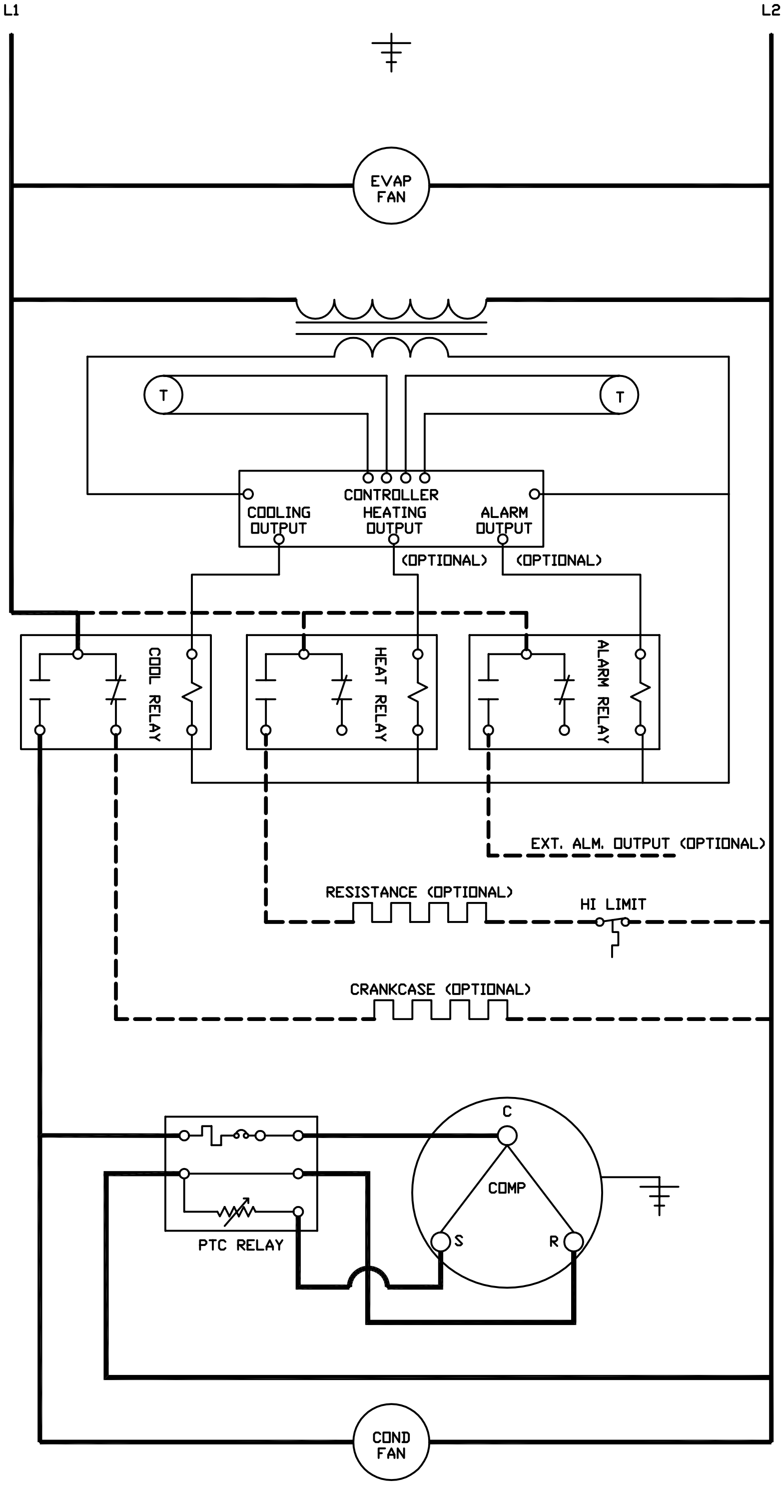
If your Ice Qube air conditioning system should fail to operate satisfactorily during the first year of operation, do not remove the cover without first notifying the factory. Removal of the cover will immediately void your warranty. If an operating problem should occur, please make the following simple checks before contacting Ice Qube Inc.

* Is electrical power available at the outlet ?
* Is the power cord plugged into the outlet ?
* Is the controller set point temperature above the enclosure temperature
* Is the evaporator (cold air stream) blower operating ?
* Is the compressor and condenser (warm air stream) blower operating ?
* Is the enclosure door closed tightly ?
* Are all gaskets in place ?
* Are there any unusual ambient conditions ?
* Has the warm air filter been cleaned or changed recently ?
* Is the system mounted level on the enclosure ?
* Is there adequate space within the enclosure for air flow ?
* Is there adequate space around the enclosure for air flow ?
- Have you recently added electronic equipment to the enclosure ?

If you are still experiencing operating difficulties after making these checks, please contact **Ice Qube** at **888-867-8234**.

PROPRIETARY DRAWING
THIS DRAWING IS THE PROPERTY OF ICE QUBE, INC. AND IS NOT TO BE DUPLICATED OR ALTERED WITHOUT AUTHORIZATION OF ICE QUBE, INC.

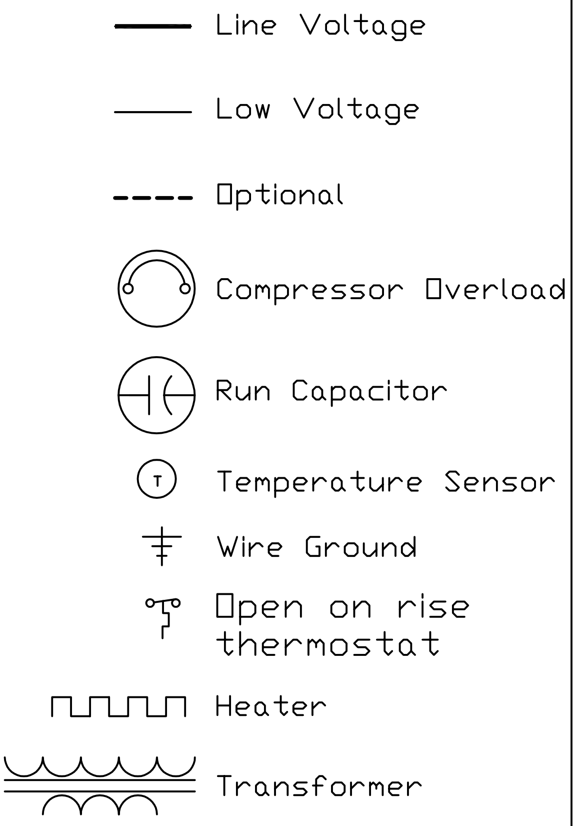
WIRING SCHEMATIC



MODELS

IQ1000V
IQ1200VS
IQ1500VS
IQ1800VS
IQ1200VXS
IQ1500VXS
IQ1800VXS
IQ2200VS
IQ3000VS
IQ2000VXS
IQ2400VXS
IQ2500V
IQ3500V
IQ1800TS
IQ2300TS
IQ2500TS
IQ4000TS
IQ2500T
IQ4000T

Legend



C Common
S Start
R Run

UNLESS OTHERWISE SPECIFIED
TOLERANCES:
.X ± .060" .XX ± .030"
.XXX ± .015"
FRACT ± 1/16" ANG ± 1/2°

INDUSTRIAL COOLING EQUIPMENT
141 WILSON AVENUE
GREENSBURG, PA 15601
724-837-2204 * 1-888-867-8234
FAX 724-837-3386

PART NAME
SCHEMATIC D

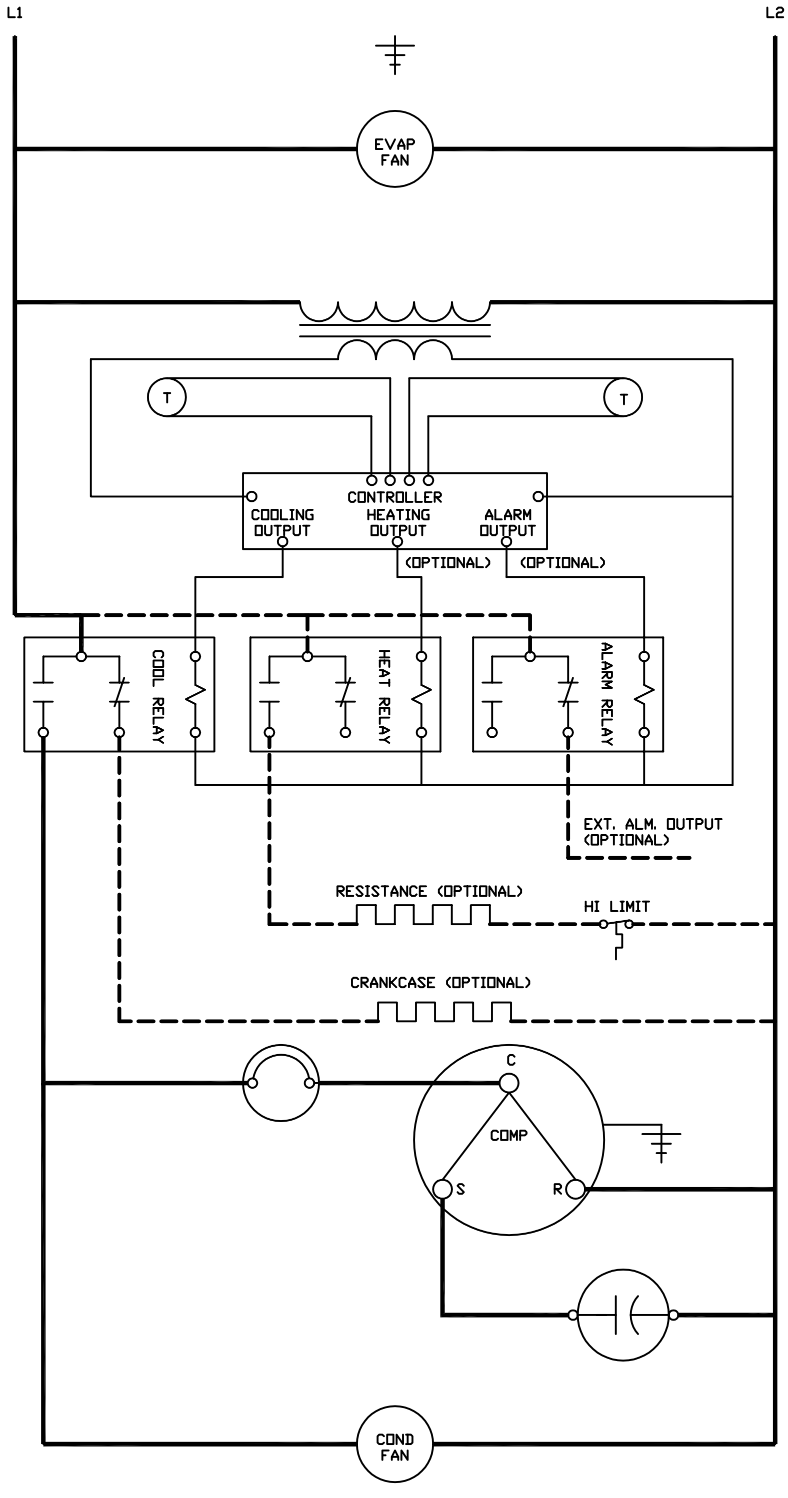
DATE 12-06-04
SHEET 1 OF 1
DWG NO IQ241206-D
REV 0

REVISIONS

REV	DESCRIPTION	DATE	CHECKED

PROPRIETARY DRAWING
THIS DRAWING IS THE PROPERTY OF ICE QUBE, INC. AND IS NOT TO BE DUPLICATED OR ALTERED WITHOUT AUTHORIZATION OF ICE QUBE, INC.

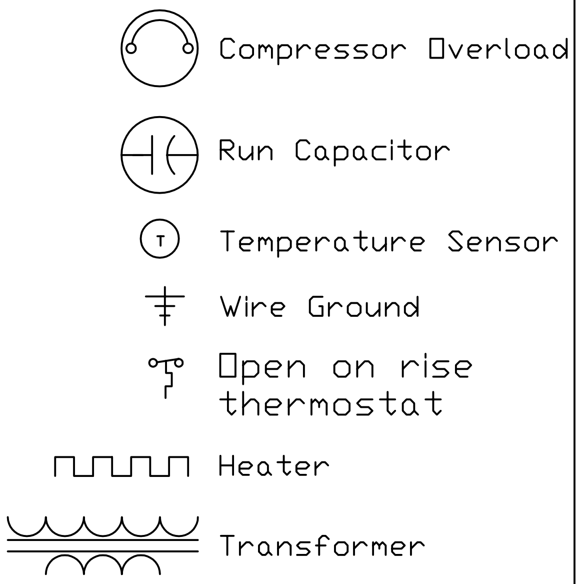
WIRING SCHEMATIC



MODELS

IQ4000V
IQ5000V
IQ5000V16
IQ6000V16
IQ4000V16HA
IQ3800VS
IQ5000T
IQ6000T

Legend



——— Line Voltage

——— Low Voltage

- - - - Optional

Compressor Overload

Run Capacitor

Temperature Sensor

Wire Ground

Open on rise thermostat

Heater

Transformer

C Common

S Start

R Run

UNLESS OTHERWISE SPECIFIED
TOLERANCES:
.X ± .060" .XX ± .030"
.XXX ± .015"
FRACT ± 1/16" ANG ± 1/2°

INDUSTRIAL COOLING EQUIPMENT
141 WILSON AVENUE
GREENSBURG, PA 15601
724-837-2204 * 1-888-867-8234
FAX 724-837-3386

PART NAME SCHEMATIC A

DATE 12-06-04
SHEET 1 OF 1
DWG NO IQ241206-A
REV 0

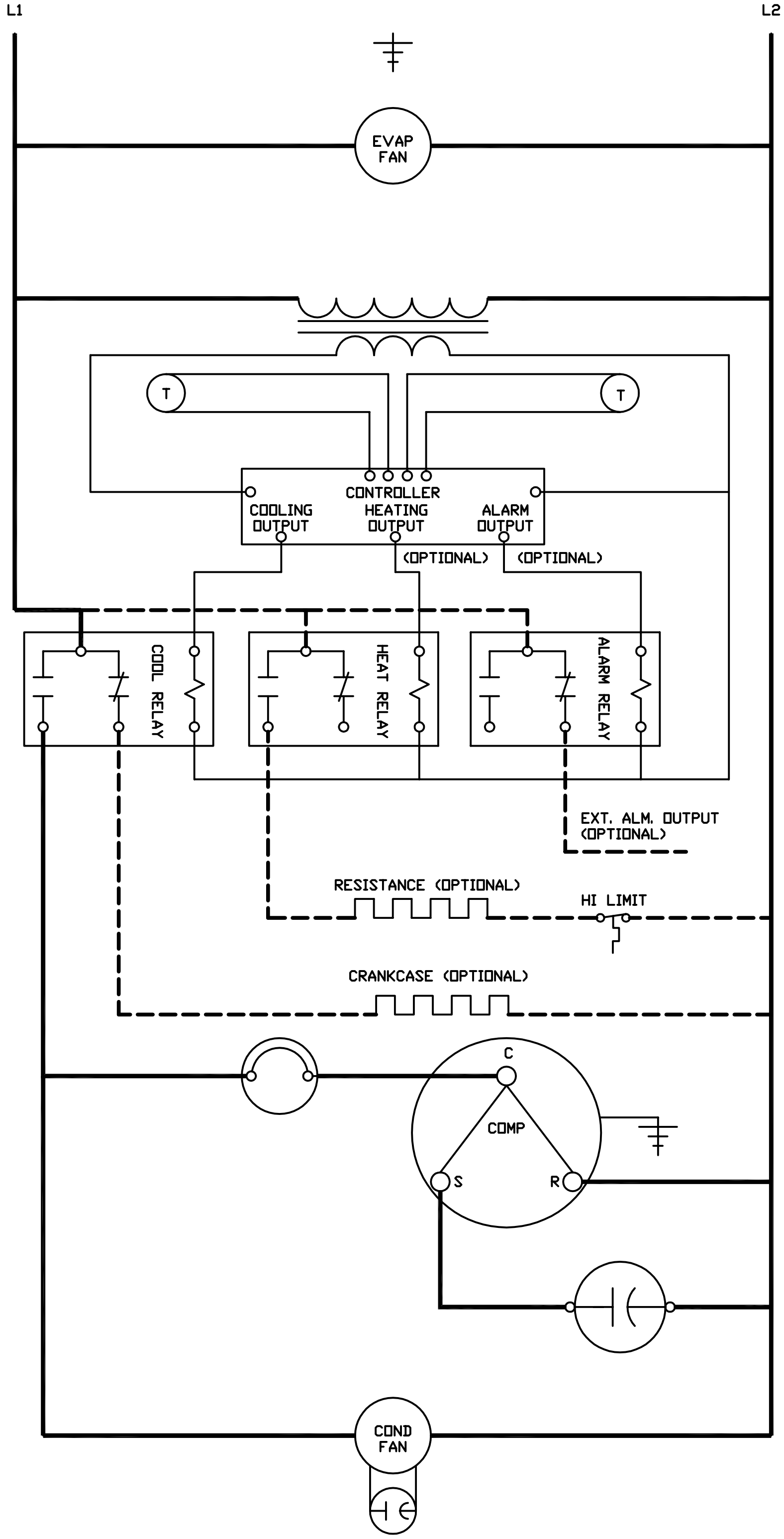
REVISIONS

REV	DESCRIPTION	DATE	CHECKED

WIRING SCHEMATIC

MODELS

IQ5000V16HA
IQ6000V16HA
IQ8000V16
IQ10000V
IQ12000V
IQ8000VHA



Legend

━━━ Line Voltage

─── Low Voltage

- - - - Optional

Compressor Overload

Run Capacitor

Ⓣ Temperature Sensor

⏚ Wire Ground

Open on rise thermostat

Heater

Transformer

C Common

S Start

R Run

UNLESS OTHERWISE SPECIFIED
TOLERANCES:
.X ± .060" .XX ± .030"
.XXX ± .015"
FRACT ± 1/16" ANG ± 1/2°

Ice Qube
INDUSTRIAL COOLING EQUIPMENT
141 WILSON AVENUE
GREENSBURG, PA 15601
724-837-2204 * 1-888-867-8234
FAX 724-837-3386

PART NAME
SCHEMATIC B

DATE 12-06-04
DWG NO IQ241206-B
REV 0
SHEET 1 OF 1

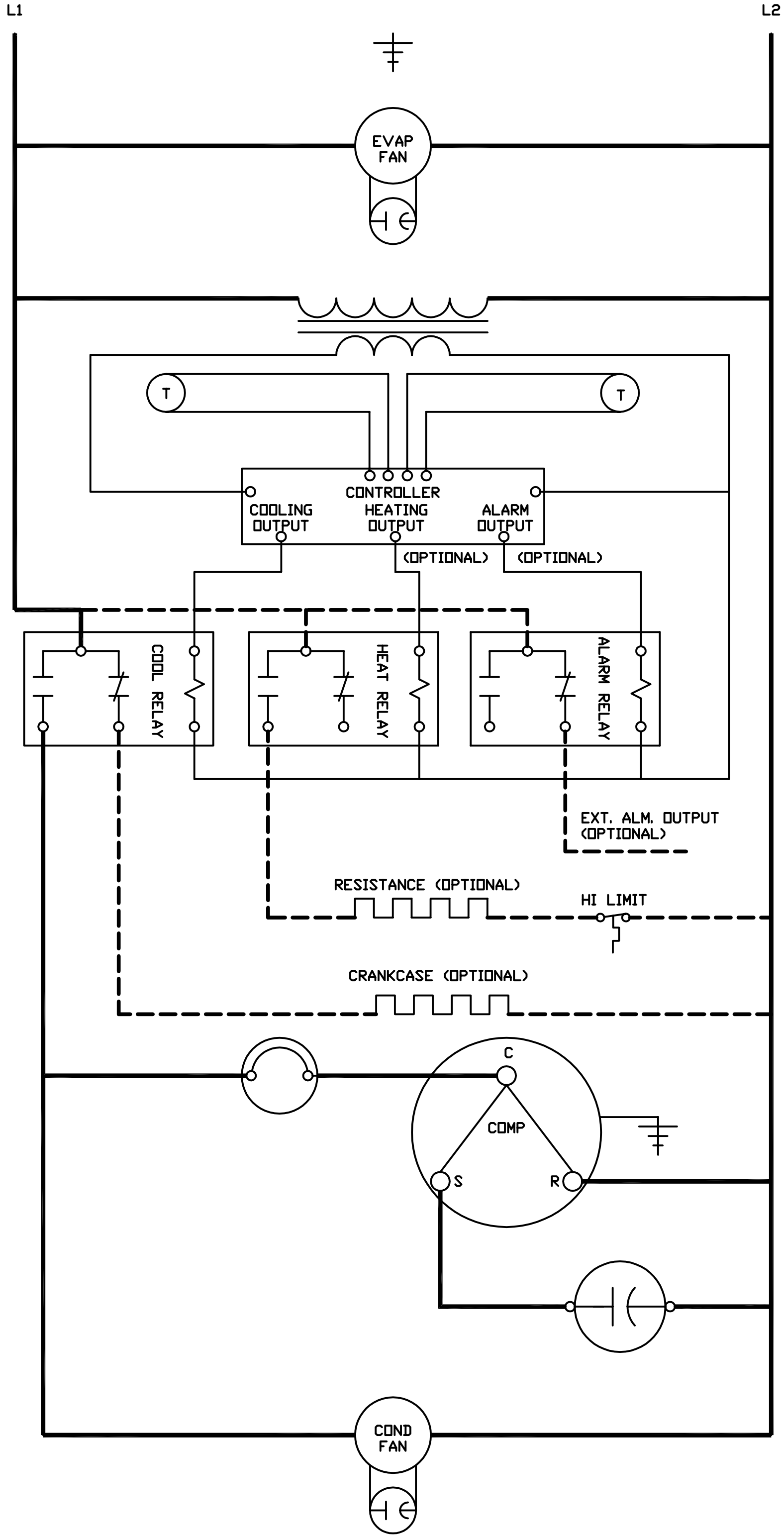
REVISIONS

REV	DESCRIPTION	DATE	CHECKED

MODELS

IQ14000V
IQ17000V
IQ20000V

WIRING SCHEMATIC



Legend

━━ Line Voltage

── Low Voltage

- - - Optional

Compressor Overload

Run Capacitor

Ⓣ Temperature Sensor

⏚ Wire Ground

Open on rise thermostat

⎍⎍⎍ Heater

Transformer

C Common

S Start

R Run

UNLESS OTHERWISE SPECIFIED
TOLERANCES:
.X ± .060" .XX ± .030"
.XXX ± .015"
FRACT ± 1/16" ANG ± 1/2°

Ice Qube

INDUSTRIAL COOLING EQUIPMENT
141 WILSON AVENUE
GREENSBURG, PA 15601
724-837-2204 * 1-888-867-8234
FAX 724-837-3386

PART NAME
SCHEMATIC C

DATE 12-06-04
SHEET 1 OF 1
DWG NO IQ241206-C
REV 0

REVISIONS

REV	DESCRIPTION	DATE	CHECKED

Warranty

The seller warrants to the original Buyer that the products manufactured by the seller are free from defects in material and workmanship. If the Buyer notifies the Seller within ONE YEAR of any such defects (the "Warranty Period"), and returns the products to Seller at Buyer's sole expense, Seller shall, at its option, repair the products, or replace them with products of comparable value. In either case, the Warranty Period for the repaired or replaced products shall extend after the date of repair or replacement for a time equal to the original warranty period. If the Buyer does not notify the seller of such defects, whether patent or latent, within the Warranty Period, Seller shall have no further liability or obligation to the Buyer. Therefore, in no event shall Seller's liability under this warranty exceed the original purchase price of the products which are the subject of a proper notice of defects.

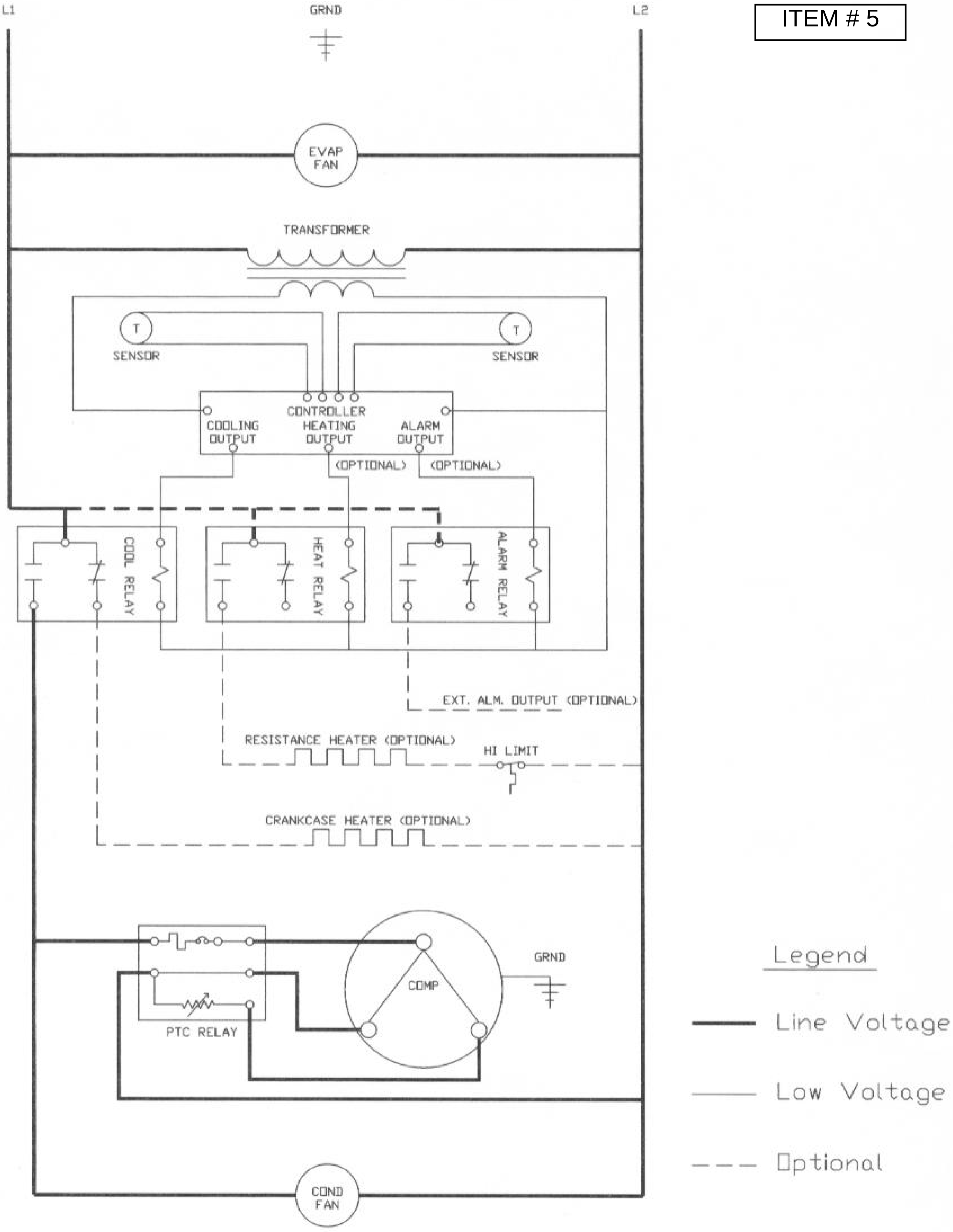
Excluded from this transaction are all implied warranties, including without limitation, the implied warranties of merchantability and fitness for a particular purpose or use. The express warranties set forth above are the only warranties given by Seller in this transaction.

In no event will seller be liable for any incidental or consequential damages of the buyer. The foregoing remedies are the sole and exclusive remedy of buyer for any breach of warranty in this transaction.

IQ1800VS-126-SS

ITEM # 5

Split Phase Compressor



PS5R-SG24 ITEM # 48

Features & Part Numbers

Key features of the PS5R Slim Line series include:

- Lightweight and Compact in size
- Wide Power Range: 30W – 240W
- Universal Input:
  30W to 90W:85-264V AC/100-370V DC
  120W and 240W:85-264V AC/100-350V DC
- Power Factor Correction (EN61000-3-2) for 60W to 240W
- Meets SEMI F47 Sag Immunity (120W & 240W)
- NEC Class 2 rated (30W & 60W)
- Approved for Class 1, Div. 2 Hazardous Locations
- Fused input
- Overcurrent protection, auto-reset
- Overvoltage protection, shut down
- Spring-up Screw Terminal type, IP20
- DIN rail or Panel Surface Mount
- Approvals:
  CE Marked
  TÜV
  c-UL, UL 508
  UL 1310 (PS5R-SC, -SD)
  UL 1604
  EN 50178:1997
  LVD: EN60950:2000
  EMC: Directive EN61204-3:2000
  (EMI: Class B, EMS: Industrial)

File # E234997

(SEMI F47 120W & 240W only)

Part Numbers

Part Number	Item	Watts	Rated Voltage	Rated Current
PS5R-SC12		30	12V DC	2.5A
PS5R-SC24			24V DC	1.3A
PS5R-SD24		60	24V DC	2.5A
PS5R-SE24		90	24V DC	3.75A
PS5R-SF24		120	24V DC	5A
➡ PS5R-SG24		240	24V DC	10A

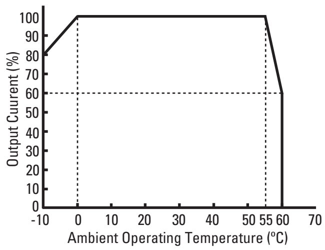
Specifications

Part Numbers		12VDC output	**PS5R-SC12**	–	–	–	
		24VDC output	**PS5R-SC24**	**PS5R-SD24**	**PS5R-SE24**	**PS5R-SF24**	**PS5R-SG24**
Output Capacity			30W	60W	90W	120W	240W
Input	**Input Voltage** (single-phase, 2-wire)		85 to 264 VAC, 100 to 370 VDC			85 to 264V AC, 100 to 350V DC	
	Input Current (typical)	100VAC	0.9A	1.7A	2.3A	1.8A	3.5A
		200VAC	0.6A	1.0A	1.4A	1.0A	1.7A
	Internal Fuse Rating		3.15A	3.15A	4A	4A	6.3A
	Inrush Current (cold start)		50A maximum (at 200V AC)				
	Leakage Current (at no load)		0.75mA maximum			1mA maximum	
	Typical Efficiency	12VDC	78%	–	–	–	–
		24VDC	80%	83%	82%	84%	
Output	**Output Current Ratings**	12VDC	2.5A	–	–	–	–
		24VDC	1.3A	2.5A	3.75A	5A	10A
	Voltage Adjustment		±10% (V. ADJ control on front)				
	Output Holding Time		20ms minimum (at rated input and output)				
	Starting Time		–	–	–	650ms maximum	500ms maximum
	Rise Time		100ms maximum (at rated input and output)			200ms maximum	
	Line Regulation		0.4% maximum				
	Load Regulation		1.5% maximum				0.8% max
	Temperature Regulation		0.05% degree C maximum				
	Ripple Voltage		2% peak to peak maximum (including noise)			1% peak to peak maximum (including noise)	
	Overcurrent Protection		105% or more, auto reset		103 to 110%, auto reset	105 to 130%, auto reset	
	Overvoltage Protection		120% min. SHUTDOWN				
Parallel Operation			No	No	No	No	No
Dielectric Strength			Between Input and Ground: 2000 VAC, 1 minute*				
Insulation Resistance			Between Input & Output Terminals: 100 MΩ Min				
Operating Temperature			-10 to 60°C (14 to 140°F)				
Storage Temperature			-25 to 75°C (-13 to +167°F)				
Operating Humidity			20 to 90% relative humidity (no condensation, no freezing)				
Vibration Resistance			Frequency 10 to 55Hz, Amplitude 0.375mm				
Shock Resistance			300m/s^2 3 times each in 6 axes				
Approvals			EMC: EN61204-3 (EMI: Class B, EMS: Industrial), LVD: EN60950, EN50178:1997, UL 1604, UL 508, UL1310 (PS5R-SC, -SD), c-UL (CSA 22.2 No. 14)				
			–			SEMI F47	
Harmonic Directive (EN61000-3-2)			N/A		EN61000-3-2 A14 class A		
Weight (approx.)			250g	285g	440g	630g	1000g
Terminal Screw			M3.5 slotted-Phillips head screw (screw terminal type)				
IP protection			IP20 fingersafe				
Dimensions H x W x D (mm)			95 x 36 x 108		115 x 46 x 121	115 x 50 x 129	125 x 80 x 149.5
Dimensions H x W x D (inches)			3.74 x 1.42 x 4.25		4.53 x 1.81 x 4.76	4.53 x 1.97 x 5.08	4.92 x 3.15 x 5.89

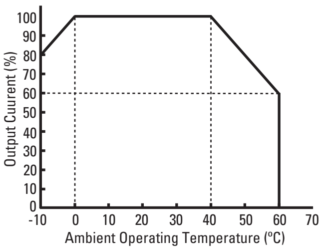
1. *For dimensional drawings, see page L-7.*
2. **Between input and output: 3000VAC, 1 minute; Between output and ground: 500VAC, 1 minute*

Temperature Derating Curves

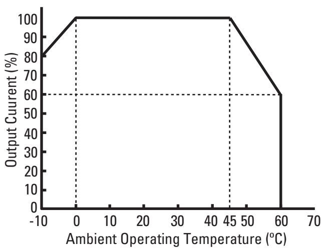
PS5R-SC



PS5R-SD, -SE, -SF



PS5R-SG



Condition Natural Air Cooling (Operating Temperature means temperature in surrounded PS5R.)

Make sure of convection in consideration of sufficient heat radiation. Do not block the opening of the switching power supply.

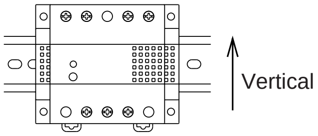
Keep at least 20mm clearance around the switching power supply, except for the opening.

All IDEC power supplies are listed to UL 508 which allows operation at 100% capacity inside a panel. This eliminates the need to use oversize power supplies or utilize two power supplies derated 50% of their rated output.

The charts above show that the PS5R Slim 30W/60W/90W (at 55ºC), 120W (at 40ºC), and 240W (at 45ºC) meet the ambient temperature required by the UL 508 and EN60950 standards to operate at an output current of 100%. The output current starts to derate beyond the required temperature.

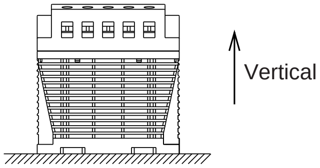
A Mounting

Mounting Style A
(standard)



B Mounting

Mounting Style B
(Facing upward)



Accessories

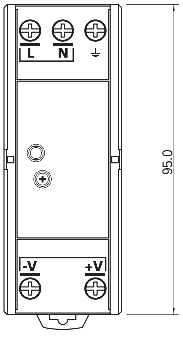
PS5R-S Accessories

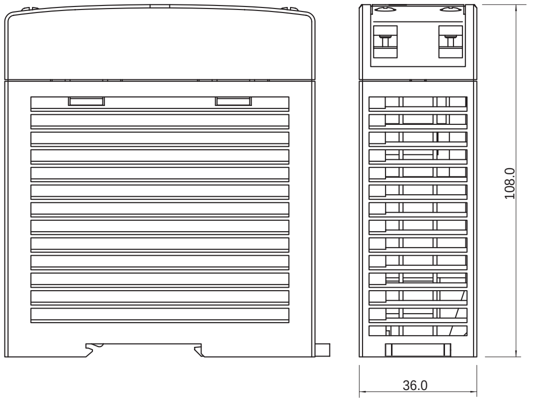
Appearance	Description	Part Number
	Panel Mounting Bracket for PS5R-SC and PS5R-SD	PS9Z-5R1C
	Panel Mounting Bracket for PS5R-SE	PS9Z-5R1E
	Panel Mounting Bracket for PS5R-SF & PS5R-SG	PS9Z-5R1G
	DIN rail (1000mm)	BNDN1000
	DIN rail end clip	BNL5

Dimensions

PS5R-SC12 (30W) & PS5R-SD24 (60W)

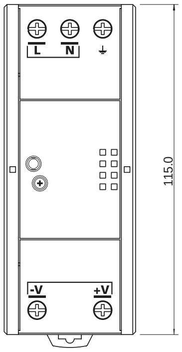
Height	95.0 mm
Width	36.0 mm
Depth	108.0 mm

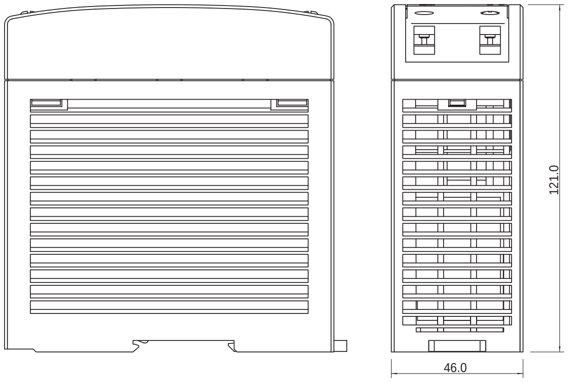




PS5R-SE24 (90W)

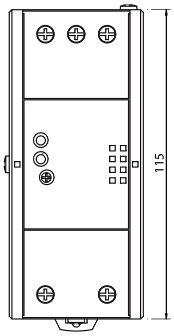
Height	115.0 mm
Width	46.0 mm
Depth	121.0 mm

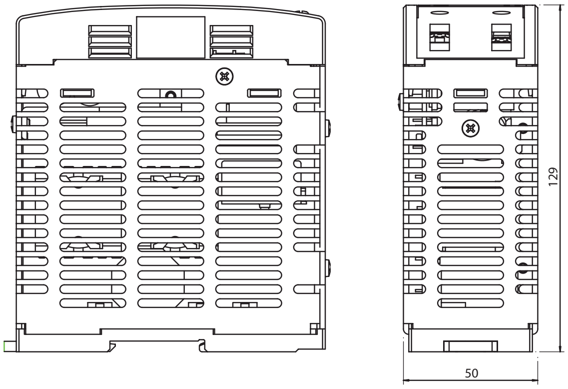




PS5R-SF24 (120W)

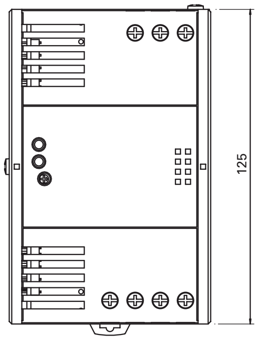
Height	115.0 mm
Width	50.0 mm
Depth	129.0 mm

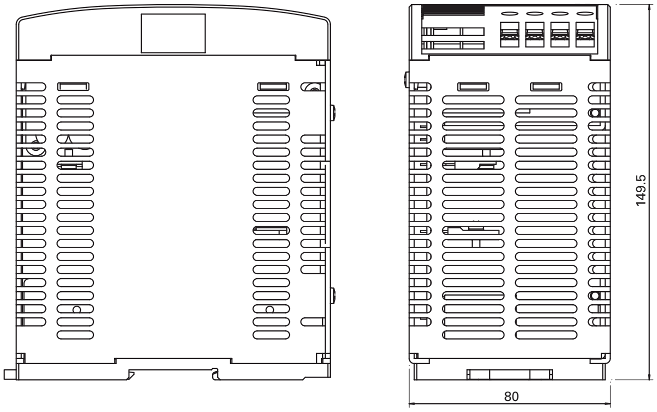




PS5R-SG24 (240W)

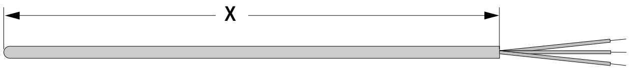
Height	125.0 mm
Width	80.0 mm
Depth	149.5 mm

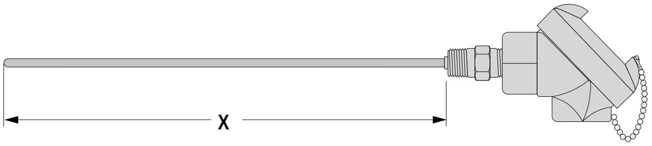


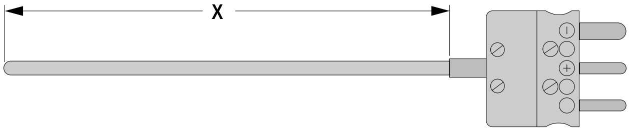


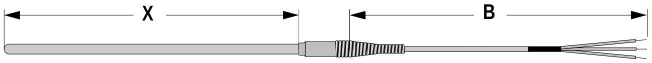
R1T185L483-006-00-13-T3J012-0 | ITEM # 66

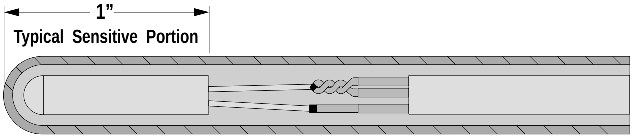
The single element RTDs illustrated and described on this and the following pages are designed to measure temperature in a variety of process and laboratory applications. These RTDs are specifically designed for use in two different process temperature ranges and they will provide accurate and repeatable temperature measurement through a broad range of -328° to 1112°F (-200° to 600°C). Low range wirewound RTDs -328° to 400°F (-200° to 204°C) and low range thin film RTDs -40° to 400°F (-40° to 204°C) are constructed using silver plated copper internal leads, teflon, and other suitable wire insulations with potting compounds to resist moisture penetration. High range RTDs -328° to 1112°F (-200° to 600°C) are constructed with nickel internal leads inside swaged MgO insulated cable to allow higher temperature measurements at the RTD element and to provide higher temperature lead protection along the sheath. The following tables allow customer selection of standard element materials, initial accuracies, sheath materials and diameters, mounting fittings and terminations. Custom built assemblies with non-standard specifications are available upon request.

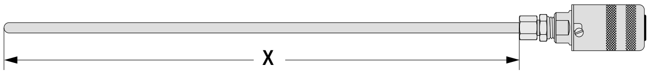












Example Order Number:

1-1	1-2	1-3		1-4
R5T185L	48	3	-	006

1-1 / 1-2

SINGLE PLATINUM RTD ELEMENTS						316 SS SHEATH			
ELEMENT ACCURACY @ 0° C				SPECS		DIAMETERS			
± .1%	± .03%	± .01%	± .12%	VALUE IN OHMS	TEMP. COEF.	1/8" OD	3/16" OD	1/4" OD	3/8" OD
ORDER CODE	ORDER CODE	ORDER CODE	ORDER CODE			ORDER CODE	ORDER CODE	ORDER CODE	ORDER CODE
Low Range -328 to 400°F (-200 to 204°C)									
R1T185L	R3T185L	R5T185L	RBF185L	100	.00385	28	38	48	68
R1T192L	R3T192L			100	.00392	28	38	48	68
R1T125L				200	.00385	28	38	48	68
			RBF155L	500	.00385	28	38	48	68
			RBF195L	1000	.00385	28	38	48	68
High Range -328 to 1112°F (-200 to 600°C)									
R1T185H				100	.00385	28	38	48	68
R1T192H				100	.00392	28	38	48	68
			RBF155H	500	.00385		38	48	68
			RBF195H	1000	.00385		38	48	68

SINGLE COPPER, NICKEL, NICKEL-IRON RTD ELEMENTS					316 SS SHEATH			
ACCURACY @ 0° C		ELEMENT MATERIAL	SPECS		DIAMETERS			
± .2%	± .5%		VALUE IN OHMS	TEMP. COEF.	1/8" OD	3/16" OD	1/4" OD	3/8" OD
ORDER CODE	ORDER CODE				ORDER CODE	ORDER CODE	ORDER CODE	ORDER CODE
Low Range -328 to 400°F (-200 to 204°C)								
RCT110L		Copper	10	.00427	28	38	48	68
	RDT112L	Nickel	120	.00672	28	38	48	68
	RDT164L	Nickel - Iron	604	.00518		38	48	68

Note: R1T191 has been changed to R1T192 to reflect a change to ITS-90 temperature scale

1-4

LENGTH
ORDER CODE
3 DIGIT 'X' LENGTH

1-3

ELEMENT WIRE	
ORDER CODE	DESCRIPTION
2	2 wire per element
3	3 wire per element
4	4 wire per element

1-2A

ORDER CODE	Nominal Sheath Dia.	Tip Dia.	Tip Length	Material
88R48	1/2" OD	1/4" OD	1 1/4"	316 SS
68R48	3/8" OD	1/4" OD	1 1/4"	316 SS
68R38	3/8" OD	3/16" OD	1 1/4"	316 SS
68R28	3/8" OD	1/8" OD	1 1/4"	316 SS
48R38	1/4" OD	3/16" OD	1 1/4"	316 SS
48R28	1/4" OD	1/8" OD	1 1/4"	316 SS

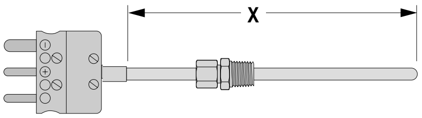
REDUCED TIP RTD's

Table 1-2A lists RTD elements with reduced tip sheaths. To order, use order code numbers from Tbl. 1-2A in place of straight sheath order code numbers from Tbl. 1-2. Other reduced tips are available upon request. Example: R1T185L**68R483**-006

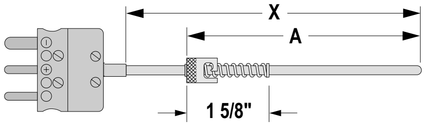
OPTIONAL SHEATH MOUNTING FITTINGS and BENDS

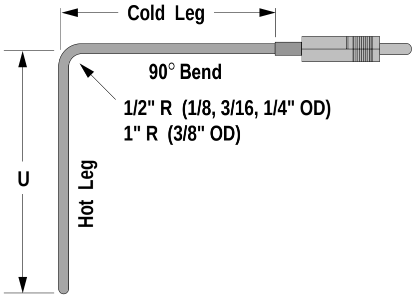
Select Sheath Mounting or Bend Options as desired from tables below.

COMPRESSION FITTING

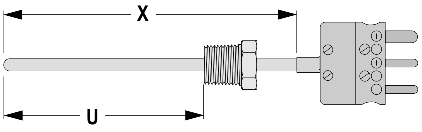


BAYONET CAP and SPRING (OPTION 13A)

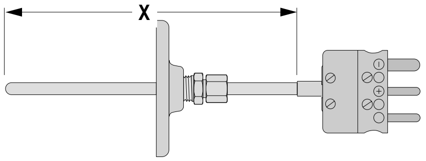




FIXED BUSHING



ADJUSTABLE FLANGE (OPTION 14)



2

EXAMPLE ORDER NUMBER: R5T185L483 - 006 - **01A, 304** - PAGE RTD 4 - PAGE RTD 5 - PAGE RTD 6

2-1

NO FITTING or BEND OPTIONS	
ORDER CODE	00

2-2

RE-ADJUSTABLE COMPRESSION FITTINGS			
ORDER CODE	TYPE	NPT SIZE	AVAILABLE SHEATH DIAMETERS (In Inches)
10A	Stainless steel	1/8"	1/8, 3/16, 1/4
10B	Stainless steel	1/4"	1/4, 3/8
10C	Stainless steel	1/2"	3/16, 1/4
11A	Brass	1/8"	1/8, 3/16, 1/4
11B	Brass	1/4"	1/8, 3/16, 1/4, 3/8
11C	Brass	1/2"	1/4, 3/8
19C	Spring loaded SS well fitting	1/2"	3/16, 1/4

*Teflon gland standard (400° max.) For lava gland (1200° max) opt. **10A** and **10B** only use letter suffix "**L**" after compression fitting order code. **EX: 10AL for lava gland***

2-3

ONE-TIME ADJUSTABLE COMPRESSION FITTINGS			
ORDER CODE	TYPE	NPT SIZE	AVAILABLE SHEATH DIAMETERS (In Inches)
01A	Stainless steel	1/8"	1/8, 3/16, 1/4
01B	Stainless steel	1/4"	1/8, 3/16, 1/4, 3/8
01C	Stainless steel	1/2"	1/8, 1/4, 3/8
15A	Brass	1/8"	1/8, 3/16, 1/4
15B	Brass	1/4"	3/16, 1/4, 3/8
15C	Brass	1/2"	1/4, 3/8

2-6

MISCELLANEOUS OPTIONS		
ORDER CODE	DESCRIPTION	AVAILABLE SHEATH DIAMETERS (In Inches)
13A_ _*	Spring loaded bayonet fitting	1/8, 3/16
14	Adjustable flange with brass compression fitting	1/8, 3/16, 1/4, 3/8
16A	Spring loaded adjustable bayonet compression fitting	1/8

** When ordering fixed bayonet fitting specify hot leg dimension **"A"**. **EX: order code 13A06 is for a fixed bayonet adapter with 6" hot leg**. Total sheath length is Table 1 **"X"** length = hot leg **plus** cold leg.*

2-5

FIXED BUSHINGS		
ORDER CODE 316 SS	MOUNTING THREAD	AVAILABLE SHEATH DIAMETERS (In Inches)
8A _ _*	1/8" NPT	1/8, 3/16, 1/4
8B _ _	1/4" NPT	1/8, 3/16, 1/4, 3/8
8C _ _	1/2" NPT	1/8, 3/16, 1/4, 3/8
8D _ _	3/4" NPT	1/8, 3/16, 1/4, 3/8

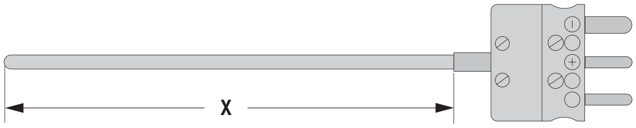
** When ordering fixed bushings, specify order code above plus insertion length **"U"**, as measured from hot tip to bottom of threaded bushing. **EX: order code 8A06 is 1/8" NPT, 316 SS bushing located 6" from hot tip.***

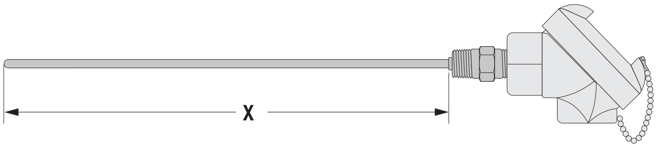
2-4

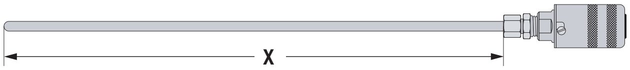
SHEATH BENDS	
ORDER CODE	DESCRIPTION
2 _ _	Sheath bent 45 degrees
3 _ _	Sheath bent 90 degrees

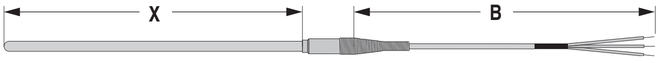
2" minimum hot leg length

*When ordering bend options, specify hot leg dim. **"U"**. **Ex :order code 206 is a 45° bend with 6" hot leg.** Total sheath length is Table 1 **"X"** length = hot leg **plus** cold leg*









EXAMPLE ORDER NUMBERS:

R5T185L483 - 006 - 00 - **6HN** (3-1) **31** (3-2)

OR

R5T185L483 - 006 - 01A,304 - **16** (3-1)

3-1

HEAD MOUNTING FITTINGS FOR STANDARD HEADS

For head terminations, a head mounting fitting must be selected

ORDER CODE	DESCRIPTION
6HN	1/2" x 1/2" NPT steel hex nipple
8HN	1/2" x 1/2" NPT stainless steel hex nipple
8HP	1/2" NPT stainless steel bushing (no process threads)
8RNDC	3/4" process x 1/2" NPT stainless steel hex nipple
22CF	Brass compression fitting (not available with head termination order codes 52, 71, or 81)

HEAD MOUNTING FITTINGS FOR MINIATURE HEADS

ORDER CODE	DESCRIPTION
8HPB	1/4" NPT stainless steel bushing (no process threads)
9HNB	1/4" x 1/4" NPT stainless steel hex nipple
22CFB	Brass compression fitting

3-2

STANDARD HEAD TERMINATIONS

ORDER CODE	DESCRIPTION
22	No head - 3" individual leads with terminal pins
23	Extension leadwire (requires Table 4 and 5 selections)
31	Cast aluminum screw cover head
34	Cast iron screw cover head
49	Flip top aluminum head
52	Class B explosion proof head
53	Delrin screw cover head
63	Polypropylene screw cover head
71	Cast iron/aluminum explosion proof head
81	316L stainless steel explosion proof head
91	316L stainless steel head
OPTIONS	
CT	Ceramic terminal block (opt. 53 and 63 only)
GS	Ground screw (standard with opt. 52, 71, 81)
I	Stainless steel tag (supply tag information)
SB	1/2"NPT conduit reducer bushing
T	Transmitter (see INS-1 thru 5)
W	White epoxy coating

MINIATURE HEAD TERMINATIONS

ORDER CODE	DESCRIPTION
14	Ceramic Wafer head (not available in high temp construction)
17	Miniature plastic head
25	Miniature nickel plated head

3-1

LEADWIRE TRANSITIONS (Requires Tbl. 4 and 5 selections)

ORDER CODE	DESCRIPTION
22	3" individual leads with terminal pins
15	Extension leadwire transition with relief spring (400°F)
16	Extension leadwire transition with heat shrink tubing (220°F)
13	Same size transition with heat shrink tubing (220°F) **Note 1**
18	Same size transition without heat shrink tubing (400°F) **Note 1**
19	Extension leadwire transition without spring or heat shrink (400°F)

The temperature rating for the transition is for the epoxy. Individual lead selection might alter maximum rating.

OPTIONS	
HT Note 2	High temperature potting (1000°F) not available with option 13 or option 16

PLUG AND JACK TERMINATIONS

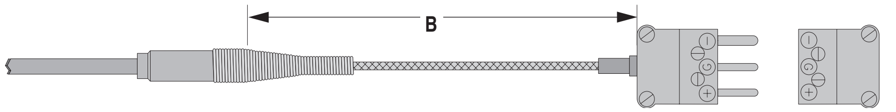
ORDER CODE	DESCRIPTION	
4	Standard male plug	(350°F)
5	Standard female jack	(350°F)
6	Miniature male plug	(350°F)
7	Miniature female jack	(350°F)
OPTIONS		
MC	Mating connector	
CL	Compression L bracket to hold plug to sheath	

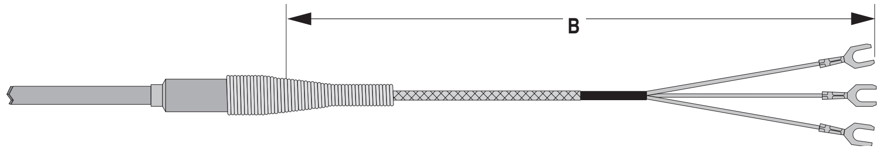
Note 1: 1/8" sheath diameter limited to wire code T3J, T3 or K3

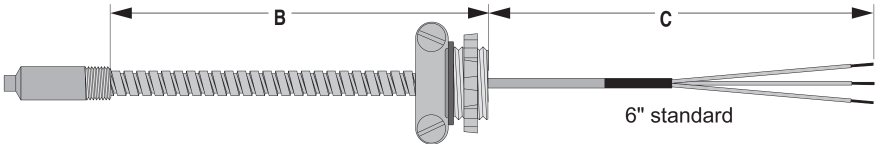
Note 2: Not available with teflon or PVC insulated leadwire

EXTENSION LEADWIRE OPTIONS

Select desired leadwire type by order code number, followed by desired length in inches.







EXAMPLE ORDER NUMBER: R5T185L483 - 006 - 01A,304 - 16 - **T3 036** - **PAGE RTD 6**

4-1

STRANDED CONDUCTOR EXTENSION LEADWIRE										
INSULATED WIRE ONLY		INSULATED WIRE in SS FLEX ARMOR		INSULATED WIRE with SS OVERBRAID		WIRE GAUGE SIZE		LEADWIRE INSULATION		INSUL. MAX. TEMP. LIMITS
ORDER CODE [1]		ORDER CODE [1,2,3]		ORDER CODE [1]				EACH CONDUCTOR	OVERALL JACKET	
SINGLE	DUPLEX	SINGLE	DUPLEX	SINGLE	DUPLEX	SGL	DUP			
FIBERGLASS										
F3J _ _ _ (12" Length Limit)	F3J _ _ _ (12" Length Limit)	-----	-----	-----	-----	24	24	Glass	None	900°F
F3 _ _ _	F3 _ _ _	F3A _ _ _	F3A _ _ _	F3B _ _ _	-----	24	24	Glass	Glass	900°F
KAPTON										
K3 _ _ _	K3 _ _ _	K3A _ _ _	K3A _ _ _	K3B _ _ _	K3B _ _ _	24	---	Kapton	Kapton	600°F
TEFLON										
T3J _ _ _ (12" Length Limit)	T3J _ _ _ (12" Length Limit)	----	-----	-----	-----	24	28	Teflon	None	400°F
T3 _ _ _	T3 _ _ _	T3A _ _ _	T3A _ _ _	T3B _ _ _	-----	24	28	Teflon	Teflon	400°F
M3 _ _ _	-----	-----	-----	-----	-----	24	---	Teflon	FEP/OB/FEP	400°F
T3M _ _ _	-----	T3MA _ _ _	-----	-----	-----	24	---	Teflon	Aluminum Mylar Shield with Drain Teflon	400°F
S3 _ _ _	-----	-----	-----	-----	-----	24	---	Teflon	Silicone Rubber	400°F

COIL CORDS	
C3060	Stranded; polyvinyl insulated coil cord (available only in 60" extended length)

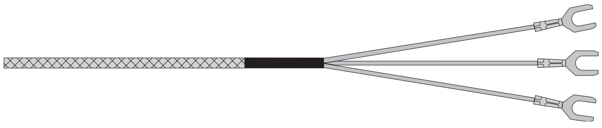
1) *Insert wire code number and 3 digit 'B' length code.* ***EX: T3036 = 36"B length***

2) *For assemblies requiring leadwire beyond the flexible armor (illustrated in 'C' in drawing), insert 3 digit 'C' length after armor length.*
EX: F3A036 -012 = 36" B length with additional 12" 'C' length leads beyond armor

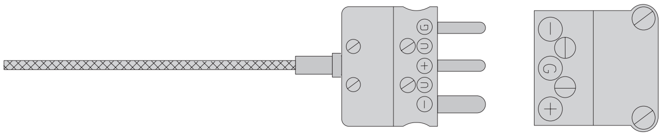
3) *All insulated leadwires in flexible armor are available with either extruded PVC or teflon coverning over the flexible armor. Substitute suffix codes T (teflon) or P (PVC) for the suffix 'A' code above.* ***EX: T3T is teflon covered armor***

Select desired leadwire termination and options (if desired), by order code numbers below.

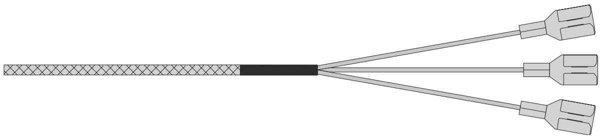
OPTION #3



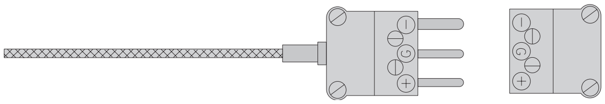
OPTION #4, 4MC



OPTION #8



OPTION #6, 6MC



EXAMPLE ORDER NUMBER:

5

R5T185L483 - 006 - 01A,304 - 16 - T3036 - 4 MC

5-1

TERMINATIONS	
ORDER CODE	**DESCRIPTION**
0	Leads not stripped
2	Leads stripped 2" tinned 1/2"
3	Leads stripped 2" with spade lugs
4	Standard RTD male plug (350°F max)
5	Standard RTD jack (350°F max)
6	Miniature RTD plug (350°F max)
7	Miniature RTD jack (350°F max)
8	1/4" quick disconnect female terminal lug - 2" leads

OPTIONS	
ORDER CODE	**DESCRIPTION**
BX	1/2" NPT Bx connector with Options 0, 2, 3, or 8
CC	Plug or jack secured to leads with cable clamp
CG	Cord Grip (1/2" NPT weatherproof PVC connector)
MC	Mating connector

401-385U-S
(-50-120F)

ITEM # 67

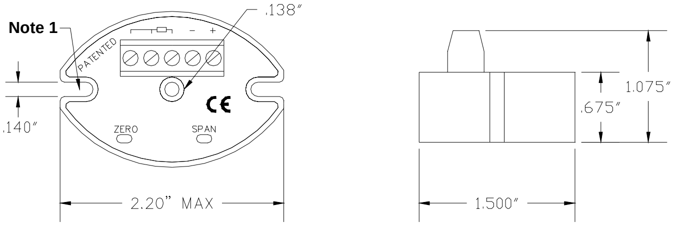
Pyromation, Inc.
Quality in Every Degree™

INSTALLATION AND OPERATING INSTRUCTIONS
SERIES 401 RTD TEMPERATURE TRANSMITTER

General Information

The Pyromation Series 401 RTD temperature transmitter is a “two wire” loop powered resistance to current transducer. This transmitter will produce a linearized (4 to 20) mA dc output current proportional to the temperature of the RTD temperature sensor.

The transmitter’s small size allows universal mounting inside Series 300, 400, and 900 screw cover heads, Series 800 explosion-proof, thermostat housings, and panel surface mounting using two 6-32 screws**1**. The transmitter is designed for an operating ambient temperature of (-30 to 65) °C [(-22 to 149) °F].



Power Supply

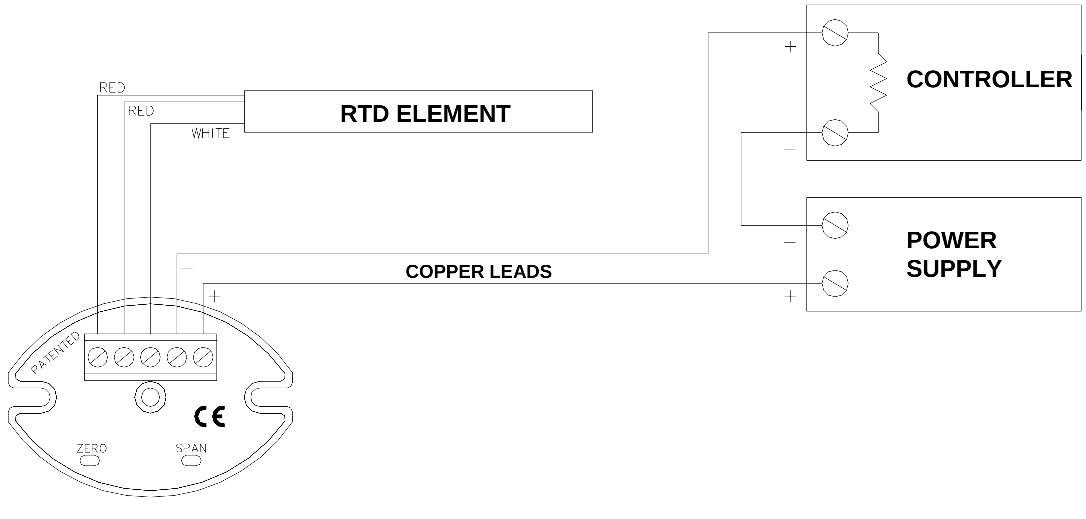
The transmitter is designed for a nominal 24 V dc power supply. The transmitter will operate over a range of (9 to 36) V dc depending on the resistive load. Use the following formulas to determine the maximum resistive loading (RL) allowed for the power used, or to determine minimum supply voltage (V) required for fixed resistive loads. The formulas assume a maximum current of 20 mA.

$$V_{MIN} = 20\ \text{mA} \times R_{LOAD} + 9\ \text{V dc} \qquad R_{MAXLOAD} = (V_{SUPPLY} - 9\ \text{V dc}) / 20\ \text{mA}$$

One power supply can be used for several transmitter loops. Each loop must have only one transmitter in it and all loops must be wired in parallel. Do not forget to observe the maximum current rating for your power supply.
Note: If used in a manner not specified by the manufacture, the protection provided by the equipment may be impaired.

Wiring

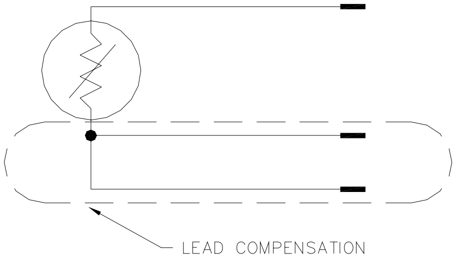
The terminal block on the transmitter can accept wire from 14 to 24 gauge. Shielded or conduit encased (twisted pair) cable is required from the transmitter to the controller, including the sensing element and lead wire. Note that low voltage lines should be run in separate conduit isolated from high voltage or high current carrying lines.



Open Sensor Indication

When an RTD has failed due to an open sensor, the transmitter will indicate an error. The way the error is produced is by either driving the current low, under 4 mA (***downscale burnout***) or by driving the current high, above 20 mA (***upscale burnout***). Upscale burnout is standard for all Pyromation transmitters.

However, the burnout indication does not apply to a break in the lead compensation loop. In this case, the burnout signal will drive the transmitter either high or low depending upon which lead has broken.



PyroMATION®, INC.
Quality in Every Degree™

INSTALLATION AND OPERATING INSTRUCTIONS
SERIES 401 RTD TEMPERATURE TRANSMITTER

Troubleshooting

Problem	***Possible Causes***
No Current Flow in Signal Loop	• Current loop may be open at some point • No Voltage out at power supply • Reverse polarity on loop connection
Current Over 20 mA	• RTD is open • Current loop connections shorted
Erratic Readings	• Loose connection in RTD or signal loop • Damaged RTD • AC noise on loop connections • Exceeds loop resistance RL
Destructive Errors	• Do not connect power to the RTD input; this could destroy the unit • Do not connect power to the RTD sensor • Do not use AC line power
Non-Destructive Errors	• Reverse polarity on loop connection • Do not connect multiple transmitter in series

Calibration

Pyromation RTD transmitters are factory calibrated. If recalibration is necessary, a **zero** and **span** adjustment can be made from the top of the unit. **Note: adjustment to calibration will void warranty**

1. Remove the RTD sensor wires and attach a RTD simulator.
2. Apply a simulated 'zero' resistance input and adjust the **zero** potentiometer for 4.00 mA output.
3. Apply a simulated 'span' resistance input and adjust the **span** potentiometer for 20.00 mA output.
4. The **zero** and **span** adjustments are interactive. Repeat steps 2 and 3 as necessary.

Application Hints

The calibrated output of the Pyromation transmitter is (4 to 20) mA. However, the lower and upper limits of output current are approximately (2.2 and 30) mA respectively. This means that for a system using a 250 ohm resistor (1 to 5) V, the maximum voltage could be as high as 7.5 volts (30 mA x 250 Ω) in the case of an open RTD.

Some computer based systems will not tolerate input voltages greater than approximately 5.5 volts. Instead of selecting a different scaling resister (167 Ω for example gives 5 V for an open RTD), a 5.1 V zener diode in parallel with the scaling resistor will clamp the voltage across the scaling resistor to 5.1 V while still allowing the calibrated range to remain (1 to 5) V.

Limited Warranty

THE SERIES 401 RTD TEMPERATURE TRANSMITTER SOLD BY OR PURCHASED FROM PYROMATION, INC. OR FROM AN AUTHORIZED PYROMATION, INC. DISTRIBUTOR, OR AGENT IS SUBJECT TO THE FOLLOWING LIMITED WARRANTY.

This product is warranted to be free from functional defects in materials and workmanship at the time the product leaves the Pyromation, Inc. factory, and to conform at that same time to the specifications set forth in the relevant Pyromation, Inc. installation, wiring, operation manual for this product for a period of one year after shipment from the Pyromation, Inc. factory.

Pyromation's exclusive and sole obligation, and Buyer's exclusive and sole remedy under the above Limited Warranty is limited to either repair or replacement of such product, at Pyromation's option, free of charge to Buyer. Pyromation shall have no obligation to repair or replace unless the claimed defect in material or workmanship is reported in writing to Pyromation at 5211 Industrial Road, Fort Wayne, Indiana 46825 within ten (10) days after delivery to the Buyer from Pyromation or an authorized Pyromation distributor, representative or reseller. If so requested by Pyromation, the product shall be returned to a designated facility during normal business hours, transportation prepaid.

Any action for breach of this warranty or other action arising out of this contract must be commenced within one year after delivery.

Pyromation shall not be liable for any warranty, express or implied, other than the warranty stated above, and in the event of a breach of the above stated warranty, Pyromation shall not be liable for any incidental, consequential, special, or other damages, costs, or expenses other than repair or replacement as described above. Pyromation excludes any and all warranties of merchantability or fitness for a particular purpose. The above stated warranty extends only to the original Buyer from Pyromation, Inc. or from an authorized Pyromation distributor or agent, and may not be transferred or assigned.

PyroMATION®, INC. 5211 Industrial Road • Fort Wayne, IN 46825 USA • (260) 484-2580 FAX: (260) 482-6805 • http://www.pyromation.com 3/02

Form 401f

TA1L6750 ITEM # 10

Lug information

Optional Mechanical Lugs

Selection

For Use With Type	Circuit Breaker Ampere Rating	Cables Per Lug	Lug Material	Lug Wire Range	Qty Per Catalog No	Catalog Number	List Price $
QJ2, QJH2, QJ2H, HQJ2H	60–225	1	Cu	#6 AWG–250 kcmil (Cu)	3	**TC1Q250**	**28.50** (pkg. of 3)
ED, HED 1,2&3 pole	1,2&3 pole 30-125	1	Cu	#10–#1/0 (Cu)		**TC1ED6150**	**30.00**
HFD6, HHFD6, CFD6, F(X)D6-A	70–250	1	Cu	#6 AWG–350 kcmil (Cu)	1	**TC1FD350**	**31.00**
J(X)D2(A), J(X)D6(A), HJD6(A), HHJD6, SHJD6(A), L(X)D6(A), HHLD6, SCD6, HLD6(A), SHLD6(A), CJD6, CLD6, SCJD6, SCLD6	200–600	1 1–2	Cu	3/0–600 kcmil (Cu) 3/0–500 kcmil (Cu)	1 1	**TC1J6600**① **TC2J6500**①	**69.00** **68.00**
	250–600	1 1	Al	500–750 kcmil (Al) 500–600 kcmil (Cu)	1 ➡	**TA1L6750**	**68.00**
SMD6, M(X)D6, HM(X)D6, HMD6, CMD6, SCMD6, SND6, N(X)D6, HN(X)D6, SHND6, CND6, SCND6	500–600	1–2	Cu	#1 AWG–500 kcmil (Cu)	1	**TC2K500**	**107.00**
	700–800	1–3	Cu	#1 AWG–350 kcmil (Cu)	1	**TC3K350**	**135.00**
		1–2	Al	500–750 kcmil (Cu) 500–750 kcmil (Al)	2 3	**2TA2N8750** **3TA2N8750**	**327.00** **459.00**
	800–1200	1–3	Al	500–750 kcmil (Cu) 500–750 kcmil (Al)	2 3	**2TA3N8750** **3TA3N8750**	**517.00** **744.00**
R(X)D6, HR(X)D6	1600–2000	1–5	Cu	300–600 kcmil (Cu)	1	**TC5R600**	**381.00**
P(X)D6, HP(X)D6, CPD6, SPD6, SHPD6	1200–1600	1–4	Al	600–750 kcmil (Cu/Al)	1	**TA4P750▲**	**227.00**

Compression Lugs

For Circuit Breaker Types	Ampere Rating	Poles	Lugs Per Kit	Lug Wire Size	Catalog Number	List Price $
Lugs (contains indicated number of lugs and necessary hardware per kit)						
ED2, ED4, ED6, HED4, HHED6, CED6	15–125	1, 2, 3	1	#2/0 AWG Cu/Al	**CCE125**	**24.00**
QJ2, QJH2, QJ2-H	125–225	2, 3	1	350 kcmil Cu/Al	**CCQ225**	**45.50**
F(X)D6-A, HF(X)D6, HHF(X)D6, CFD6	125–250	2, 3	1	350 kcmil	**CCF250**	**45.50**
JXD2-A, J(X)D6-A, HJ(X)D6-A, HHJ(X)D6-A, CJD6, SJD6-A, SHJD6-A, SCJD6, L(X)D6-A, HL(X)D6-A, CLD6, SLD6-A, SHLD6-A, SCLD6	200–600	2, 3	1	500 kcmil	**CCL600**	**134.00**
Kits (contain lugs and hardware for complete line or load end of 2 or 3 pole breaker)						
M(X)D6, HM(X)D6, CMD6, SMD6, SHMD6, SCMD6	500–800	2	6	500 kcmil	**CCM800K2**	**649.00**
		3	9		**CCM800K3**	**945.00**
N(X)D6, HN(X)D6, CND6, SND6, SHND6, SCND6	900–1200	2	8		**CCN1200K2**	**851.00**
		3	12		**CCN1200K3**	**1246.00**

Distribution Lugs

For Circuit Breaker Types	Ampere Rating	Poles	Lugs Per kit	Wires Per Lug	Lug Wire Size	Catalog Number	List Price $
NEG, HEG	15-125	1,2,3	3	3	#14-#2 AWG Cu	**3TA3EG02**	**90.00** (for 3)
NEG, HEG	15-125	1,2,3	3	6	#14-#6 AWG Cu	**3TA6EG06**	**90.00** (for 3)
ED2, ED4, ED6, HED4, HHED6, CED6	15-125	1,2,3	1	6	#14-#4 AWG Cu #6-#4 AWG Al	**TA6ED06**	**30.00**
F(X)D6-A, HF(X)D6, HHF(X)D6, CFD6	70-250	2,3	1	6	#14-#4 AWG Cu #6-#4 AWG Al	**TA6FD04**	**37.00**
JXD2-A, J(X)D6-A, HJ(X)D6-A, HHJ(X)D6-A, CJD6-A, SJD6, SHJD6-A, SCJD6, L(X)D6-A, HL(X)D6-A, CLD6-A, SLD6-A, SHLD6-A, SCLD6	200-600	2,3	1	6	#14-2/0 AWG Cu #6-2/0 AWG Al	**TA6JD20**	**80.00**

▲ Built to order. Allow 6–8 weeks for delivery.
①Used for 100% rated JD/LD frame circuit breakers.

RHOJBO
RHOSXD

ITEM # 7 & 8

Molded Case Circuit Breakers

External Accessories

Selection

Rotary Door Mounted Operating Handles

Types 1, 3, 3R , 12, 4 4X

For Use With Breaker Frames	Complete Mechanism			Handle Only		Breaker Operator		Shaft Only		
	Catalog Number Standard Depth	Catalog Number Variable Depth	List Price $	Catalog Number	List Price $	Catalog Number	List Price $	Length (inches)	Catalog Number	List Price $
EG	**RHVE6**	**RHVE12**	**CSO**			**—**	**—**	**—**	**—**	**—**
ED①	**CRHOESD**	**CRHOEVD**	**141.50**	**CRHOH**	**45.50**	**RHOEBO**	**68.00**	**2**	**RHOSSD**	**28.00**
FD	**CRHOFSD**	**CRHOFVD**	**190.50**			**RHOFBO**	**117.00**	**12**	**RHOSVD**	**28.00**
JD, LD	**CRHOJSD**	**CRHOJVD**	**263.50**			**RHOJBO**	**190.00**	**16**	**RHOSXD**	
LMD	**CRHOLMSD**	**CRHOLMVD**	**263.50**			**RHOLMBO**	**190.00**			
MD, ND PD, RD	**RHONSD**	**RHONVD**	**403.00**	**RHOH**	**103.00**	**RHONBO**	**214.00**	**3** **12** **24**	**RHONSSD▲** **RHONSVD** **RHONSXD**	**86.00** **86.00** **114.00**

For 3 or 3R, order shaft and breaker operator as shown, and handle RHOH. For 4 & 4X, order handle RHOH4. List Price $134.00

Rotary Door Mounted Operating Handles

Types 1 & 12

For Use With Breaker Frames	Standard Depth		Variable Depth		Handle and Shaft		Breaker Operator	
	Catalog Number	List Price $	Catalog Number	List Price $	Catalog Number	List Price $	Catalog Number	List Price $
CQD, NGG	**—**	**—**	**RHOCQVD**	**130.00**	**RHOH62**	**49.00**	**CQDOP**	**81.00**
ED	**D11CEU1**	**143.00**	**D11CEU2**	**163.00**	**—**	**—**	**—**	**—**
FD	**D11CFU1▲**	**177.00**	**D11CFU2**	**214.00**	**—**	**—**	**—**	**—**
JD, LD, LMD	**—**	**—**	**D11CJU2**	**303.00**	**—**	**—**	**—**	**—**

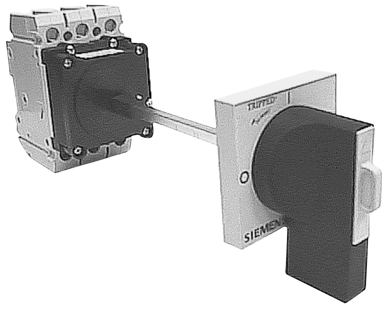
Through Door Mounted Operating Handles②

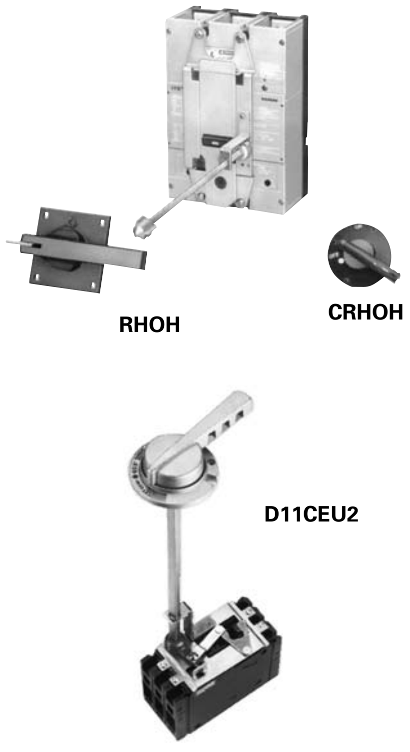
Types 1 & 12

For Use With Breaker Frames	Standard Depth		Variable Depth	
	Catalog Number	List Price $	Catalog Number	List Price $
CQD, NGG	**FMHOS**	**90.00**	**—**	**—**
QJ	**OH9498■**	**124.00**	**VH9499**	**195.00**
EG	**RHFESD**	**CSO**	**—**	**—**
ED	**E2RH1**	**139.00**	**E2RHV9**	**197.00**
FD	**F6RH1**	**139.00**	**F6RHV9**	**197.00**

Door Latch Kits

Type	Catalog Number Right Hand	List Price $	Catalog Number Left Hand	List Price $
2 point latch	**DKR2**	**302.00**	**DKL2■**	**302.00**
3 point latch	**DKR3**	**337.00**	**DKL3■**	**337.00**

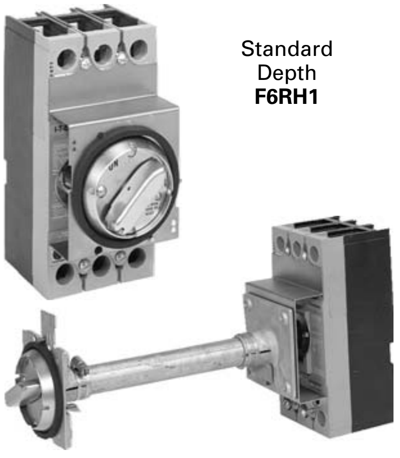

Rotary Handle **RHOCQVD**


RHOH

CRHOH

D11CEU2

Rotary Door Mounted Operating Handles


Standard Depth **F6RH1**

Variable Depth **F6RHV9**

■ Built to order. Allow 2–3 weeks for delivery.
▲ Built to order. Allow 6–8 weeks for delivery.
① For use on 3-pole ED frame only.

② Meets the requirements of NFPA 79, section 5.3.3.1 for locking external operator disconnecting devices.

JXD63B400 ITEM # 9

Molded Case Circuit Breakers

JD 400A Frame Sentron Series

Selection

Type JXD2-A⑤

240V AC, 2-Pole 250V DC Only

Blue Label

Non-Interchangeable Trip (Assembled Circuit Breaker without Lugs)

Continuous Current Rating @ 40°C	2-Pole (3 Pole Width) Catalog Number	List Price $	3-Pole Catalog Number	List Price $
200	JXD22B200■	2277.00	JXD23B200	2767.00
225	JXD22B225■	2277.00	JXD23B225	2767.00
250	JXD22B250■	2277.00	JXD23B250	2767.00
300	JXD22B300	2277.00	JXD23B300	2767.00
350	JXD22B350■	2277.00	JXD23B350	2767.00
400	JXD22B400	2277.00	JXD23B400	2767.00

Type JXD6-A①⑤

600V AC, 2-Pole 250V DC, 3-Pole 500V DC②

Blue Label

Non-Interchangeable Trip (Assembled Circuit Breaker without Lugs)

Continuous Current Rating @ 40°C	2-Pole (3 Pole Width) Catalog Number	List Price $	3-Pole Catalog Number	List Price $
200	JXD62B200■	2847.00	JXD63B200	3366.00
225	JXD62B225■	2847.00	JXD63B225	3366.00
250	JXD62B250■	2847.00	JXD63B250	3366.00
300	JXD62B300	2847.00	JXD63B300	3366.00
350	JXD62B350■	2847.00	JXD63B350	3366.00
400	JXD62B400	28	JXD63B400	3366.00

Type JD6-A⑤

Blue Label

Interchangeable Trip

Continuous Current Rating @ 40°C	Complete Breaker Unassembled with Lugs Catalog Number	List Price $	Frame Only Catalog Number	List Price $	Trip Unit Only Catalog Number	List Price $
2-Pole 600V AC, 250V DC (3 Pole Width)						
200	JD62B200■	2958.00	JD62F400	1184.00	JD62T200■	1662.00
225	JD62B225■	2958.00			JD62T225■	1662.00
250	JD62B250■	2958.00			JD62T250■	1662.00
300	JD62B300■	2958.00			JD62T300■	1662.00
350	JD62B350■	2958.00			JD62T350■	1662.00
400	JD62B400	2958.00			JD62T400	1662.00
3-Pole 600V AC, 500V DC②						
200	JD63B200	3534.00	JD63F400	1515.00	JD63T200	1851.00
225	JD63B225	3534.00			JD63T225	1851.00
250	JD63B250	3534.00			JD63T250	1851.00
300	JD63B300	3534.00			JD63T300	1851.00
350	JD63B350	3534.00			JD63T350	1851.00
400	JD63B400	3534.00			JD63T400	1851.00

Interrupting Ratings

Breaker Type	RMS Symmetrical Amperes (KA)										
	UL 489 AIR (File E10848)					IEC 947-2					
	Volts AC (50/60Hz)			Volts DC		Volts AC (50/60Hz)					
						220/240		380/415		500	
	240	480	600	250	500②	Icu	Ics	Icu	Ics	Icu	Ics
JXD2-A	65	—	—	30 (2-P)	—	—	—	—	—	—	—
JXD6-A, JD6-A	65	35	25	30 (2-P)	25 (3-P)	65	33	40	20	30	15
HJD6-A, HJXD6-A	100	65	35	30 (2-P)	35 (3-P)	100	50	65	33	42	21
HHJD6, HHJXD6④	200	100	50	—	—	200	100	100	50	65	33
CJD6-A	200	150	100	—	50 (3-P)	—	—	—	—	—	—

Instantaneous Adjustment Trip Range

Breaker Ampere Rating	Nominal Instantaneous Values							
	±20% Tolerance Low	2	3	4	5	6	7	±20% Tolerance High
200-300	1250	1430	1610	1790	1960	2140	2320	2500
350-400	2000	2290	2570	2860	3140	3430	3710	4000

■ Built to order. Allow 2–3 weeks for delivery.

① Type JXD2 and JXD6 circuit breakers are UL Listed for reverse feed applications.

② When wired as shown on page 6-3, this circuit breaker is UL listed and rated for use on 500V DC ungrounded UPS systems only.

③ See **Note: A**, page 6-73.

④ HHJD6 type circuit breakers meet the UL criteria for "current limiting" at 240 and 480V AC.

⑤ HACR rated.

Note: JD frame qualified to UL489 supplement B "NAVAL." See page 6-76 for additional information.

Ordering Information

Complete Breaker Unassembled with Lugs

Prices of JD6, HJD6, and HHJD6 breakers include frame, trip and both line and load lugs (TA2J6500). When ordered by these catalog numbers, the customer will receive the frame, trip, and lugs separately packaged. For applications requiring different lugs, order individual items as needed.

Complete Breaker Assembled without Lugs

Prices of JXD6, HJXD6, HHJXD6, and CJD6 include frame with non-interchangeable trip unit installed only. Order required lugs separately. For line and load lugs (TA2J6500) installed, add suffix "L" to catalog number (add 2 times list price of lugs for each pole).

100% Rated

Types JXD6 and HJXD6 breakers are available with 100% ratings. To order add suffix "H" to catalog number, and 10% to list price.■ 100% rated JD breakers require the use of 90°C Cu cable and lugs TC1J6600 or TC2J6500.

50°C Applications see page 6-76.

400Hz Applications see page 6-76.

Lugs For 75°C Wire③

Catalog Number	Cables per Lug	Wire Range	List Price $
TA2J6500	1, 2 2 1	#3/0-500 kcmil Cu #4/0-500 kcmil Al 250-500 kcmil Al	28.00
TA1L6750	1 1	500-750 kcmil Al 500-600 kcmil Cu	68.00
TC1J6600	1	#3/0-600 kcmil Cu	69.00
TC2J6500	1, 2	#3/0-500 kcmil Cu	68.00
Compression Lug			
CCL600	1	500 kcmil Cu/Al	134.00

Modifications page 6-76
Enclosures pages 5
Accessories pages 6-35 and 6-78 to 6-83

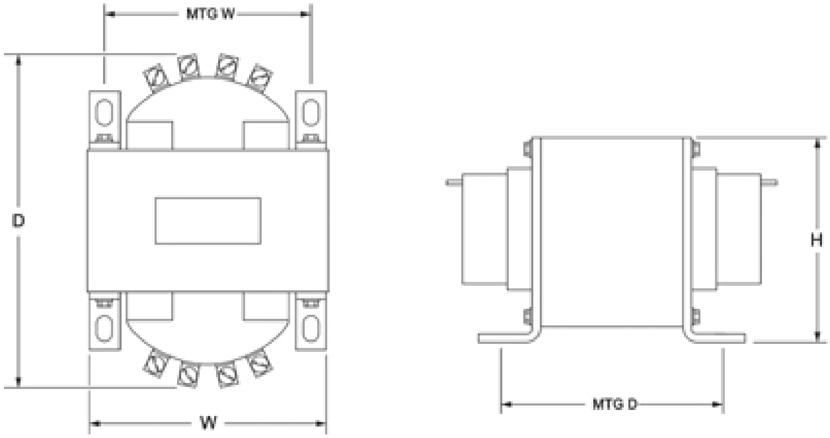
Y2000

ITEM # 13

- Linear Power Supplies
- DIN Rail DC Power Supplies
- Constant Voltage Transformers
- Line Reactors

SBE Open Style Design

Top



Selection Tables

Top

Weights and dimensions may change and should not be used for construction purposes.
Fuse holders are not available for these voltage configurations.

Group 1 - 240 x 480 Volt Primary, 120 Volt Secondary, 60 Hz
230 x 460 Volt Primary, 115 Volt Secondary, 50/60 Hz
220 x 440 Volt Primary, 110 Volt Secondary, 50/60 Hz

Drawing

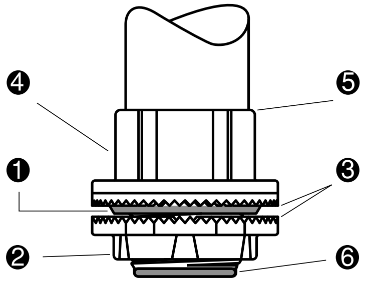
VA	Catalog Number	Height (inch)	Width (inch)	Depth (inch)	Mtg Width	Mtg Depth	Slot Size	Ship Weight Approx. (lbs)
1500	Y1500	6.25	6.75	8.75	5.75	6.38	.44 x .69	43
2000	Y2000	6.25	6.75	10.00	5.75	7.75	.44 x .69	55
3000	Y3000	8.00	9.00	9.63	8.00	6.00	.44 x .69	74
5000	Y5000	8.00	9.00	12.00	8.00	8.75	.44 x .69	120

H075CP | ITEM # 62

T&B® Fittings

Rigid and Intermediate Metal Conduit Fittings

Never before has a single hub fit like this one. Designed for unequalled performance. The innovative engineering of the T&B® Hub will, quite simply, raise your performance expectations for threaded hubs.



❶ **Sealing Ring And Groove** with innovative profile outperforms standard 'O' ring design. Sealing ring is captivated in place before installation and resists buckling or slipping during installation. The seal groove is designed for optimum compression of the sealing ring. The sealing ring is designed to provide a complete 360° seal, even when the conduit is not perpendicular with the enclosure. (See Figure 1)

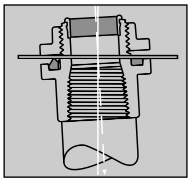


Fig. 1

❷ **Locknut Design** with peripheral slots and a hexagonal/angled spline spaced every 30° enables easy application of torque with wrench or hammer and screwdriver. (See Figures 2 & 3)

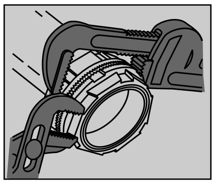


Fig. 2

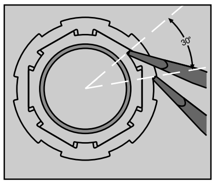


Fig. 3

❸ **Sharper and Deeper Teeth** on locknut and body designed for a more penetrating bite for improved bonding to the enclosure.

❹ **Hexagonal/Splined Body Design** for fast, easy installation with wrench or hammer and screwdriver.

❺ **Precision Machined Tapered Threads** designed to create watertight union.

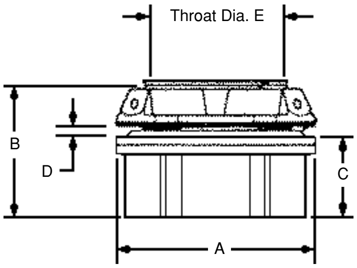
❻ **Insulated Throat** molded from 105° C rated thermoplastic with a flammability rating of 94 V-O.

T&B Hub

		A	B	C	D	E
Cat. No.	Trade Size	Dia.			Max. Panel Thickness	Throat Dia.
H050-TB	½	1 7⁄16	1 9⁄16	7⁄8	3⁄16	19⁄32
H075-TB	¾	1 21⁄32	1 19⁄32	29⁄32	3⁄16	25⁄32
H100-TB	1	2	1 13⁄16	1 1⁄16	¼	1
H125-TB	1¼	2⅜	1⅞	1 1⁄16	¼	1 5⁄16
H150-TB	1½	2¾	1⅞	1 1⁄16	¼	1 17⁄32
H200-TB	2	3¼	1 15⁄16	1 5⁄32	¼	1 31⁄32
H250-TB	2½	3¾	2 9⁄16	1 9⁄16	¼	2 13⁄32
H300-TB	3	4⅜	2 21⁄32	1 19⁄32	¼	2 31⁄32
H350-TB	3½	5	2 23⁄32	1⅝	¼	3 13⁄32
H400-TB	4	5½	2 23⁄32	1⅝	¼	3⅞
H500-TB	5	6⅞	3 1⁄32	1 15⁄16	¼	4 15⁄16
H600-TB	6	7 11⁄16	3 5⁄32	2	5⁄16	6

Material –	Hub and Locknut:	zinc or copper free aluminum
	Insulating Throat:	thermoplastic temp. rating – 105°C Flammability Rating: – 94V-0
	Sealing Ring	Nitrile (BUNA "N")

For Aluminum Hubs add suffix **A** [illegible]). For Chrome Plated Hubs add suffix **CP** (i.e. H050CP). For 316 Stainless Steel Hubs add suffix **GRSST** (i.e. H050GRSST). (½" through 2" only.) Meets NEMA sealing requirements for NEMA 3R, 4 & 13 enclosures.
U.L. Listed and CSA Certified. CSA Certified for hazardous locations Class II Groups E.F.G. Class III.
U.L. File No. E-23018 CSA File No. 4484
Chrome Plated Hubs (suffix-"CP") are rated NEMA 4X.



Thomas&Betts

www.tnb.com