BALDOR
MOTORS AND DRIVES

VECTOR DRIVE

SERIES 18H
AC Flux Vector Control

Installation & Operating Manual

9/97 MN718

Table of Contents

Section 1
Quick Start Guide

Overview

If you are an experienced user of Baldor controls, you are probably already familiar with the keypad programming and keypad operation methods. If so, this quick start guide has been prepared for you. This procedure will help get your system up and running in the keypad mode quickly. This will allow motor and control operation to be verified. This procedure assumes that the Control, Motor and Dynamic Brake hardware are correctly installed (see Section 3 for procedures) and that you have an understanding of the keypad programming & operation procedures. It is not necessary to wire the terminal strip to operate in the Keypad mode (Section 3 describes terminal strip wiring procedures). The quick start procedure is as follows:

1. Read the Safety Notice and Precautions in section 2 of this manual.
2. Mount the control. Refer to Section 3 “Physical Location” procedure.
3. Connect AC power, refer to Section 3 “AC Line Connections”.
4. Connect the motor, refer to Section 3 “Three Phase Input Power”.
5. Connect the encoder, refer to Section 3 “Encoder Installation”.
6. Install Dynamic brake hardware, if required. Refer to Section 3 “Optional Dynamic Brake Hardware”.

Quick Start Checklist

Check of electrical items.

⚠ **CAUTION: After completing the installation but before you apply power, be sure to check the following items.**

1. Verify AC line voltage at source matches control rating.
2. Inspect all power connections for accuracy, workmanship and torques as well as compliance to codes.
3. Verify control and motor are grounded to each other and the control is connected to earth ground.
4. Check all signal wiring for accuracy.
5. Be certain all brake coils, contactors and relay coils have noise suppression. This should be an R-C filter for AC coils and reverse polarity diodes for DC coils. MOV type transient suppression is not adequate.

⚠ **WARNING: Make sure that unexpected operation of the motor shaft during start up will not cause injury to personnel or damage to equipment.**

Check of Motors and Couplings

1. Verify freedom of motion for all motor shafts and that all motor couplings are tight without backlash.
2. Verify the holding brakes if any, are properly adjusted to fully release and set to the desired torque value.

Quick Start Procedure

Initial Conditions

Be sure the Control, Motor and Dynamic Brake hardware are wired according to the procedures described in section 3 of this manual. Become familiar with the keypad programming and keypad operation of the control as described in Section 4 of this manual.

1. Verify that any enable inputs to J1-8 are open.
2. Turn power on. Be sure there are no faults.
3. Set the Level 1 Input block, Operating Mode to “KEYPAD”.
4. Be sure the Level 2 Protection block, Local Enable INP parameter is OFF and the Level 2 Protection block, External Trip parameter is OFF.
5. Set the Level 2 Output Limits block, “OPERATING ZONE” parameter as desired (STD CONST TQ, STD VAR TQ, QUIET CONST TQ or QUIET VAR TQ).
6. Enter the following motor data in the Level 2 Motor Data block parameters:
   Motor Voltage (input)
   Motor Rated Amps (FLA)
   Motor Rated Speed (base speed)
   Motor Rated Frequency
   Motor Mag Amps (no load current)
   Encoder Counts
7. Go to Level 2 Motor Data block, press ENTER, at CALC PRESETS select YES (using the ▲ key) and let the control calculate preset values for the parameters that are necessary for control operation.
8. Disconnect the motor from the load (including coupling or inertia wheels). If the load cannot be disconnected, refer to Section 6 and manually tune the control. After manual tuning, perform steps 10, 11, 15, 16 and 17.

⚠ **WARNING: The motor shaft will rotate during this procedure. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment.**

9. Go to Level 2 Autotune block, and do the following tests:
   - CMD OFFSET TRIM
   - CUR LOOP COMP
   - STATOR R1
   - FLUX CUR SETTING
   - ENCODER TESTS
   - SLIP FREQ TEST
10. Set the Level 2 Output Limits block, “MIN OUTPUT SPEED” parameter.
11. Set the Level 2 Output Limits block, “MAX OUTPUT SPEED” parameter.
12. Remove all power from the control.
13. Couple the motor to its load.
14. Turn power on. Be sure no errors are displayed.
15. Go to Level 2 Autotune block and perform the SPD CNTRLR CALC test.
16. Run the drive from the keypad using one of the following: the arrow keys for direct speed control, a keypad entered speed or the JOG mode.
17. Select and program additional parameters to suit your application.

The control is now ready for use the in keypad mode. If a different operating mode is desired, refer to Section 3 Control Connections and Section 4 Programming and Operation.

Section 2
General Information

Overview

The Baldor Series 18H PWM control uses flux vector technology. Flux vector technology (sometimes referred to as Field Oriented Control) is a closed loop control scheme using an algorithm to adjust the frequency and phase of voltage and current applied to a three phase induction motor. The vector control separates the motor current into it's flux and torque producing components. These components are independently adjusted and vectorially added to maintain a 90 degree relationship between them. This produces maximum torque from base speed down to and including zero speed. Above base speed, the flux component is reduced for constant horsepower operation. In addition to the current, the electrical frequency must also be controlled. The frequency of the voltage applied to the motor is calculated from the slip frequency and the mechanical speed of the rotor. This provides instantaneous adjustment of the voltage and current phasing in response to speed and position feedback from an encoder mounted to the motors' shaft.

The control's rated horsepower is based on the use of a NEMA design B four pole motor and 60Hz operation at nominal rated input voltage. If any other type of motor is used, the control should be sized to the motor using the rated current stated on the motor nameplate.

The Baldor Series 18H control may be used in many different applications. It may be programmed by the user to operate in four different operating zones; standard or quiet constant torque or variable torque. It can also be configured to operate in a number of modes depending upon the application requirements and user preference.

It is the responsibility of the user to determine the optimum operating zone and mode to interface the control to the application. These choices are made with the keypad as explained in Section 4 of this manual.

Limited Warranty

For a period of two (2) years from the date of original purchase, BALDOR will repair or replace without charge controls and accessories which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied. BALDOR shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, BALDOR's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to BALDOR with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses.

Goods may be returned only with written notification including a BALDOR Return Authorization Number and any return shipments must be prepaid.

Safety Notice

This equipment contains voltages that may be as high as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start–up procedure or troubleshoot this equipment.

This equipment may be connected to other machines that have rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start–up procedure or troubleshoot this equipment.

PRECAUTIONS

⚠ **WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start–up procedure or troubleshoot this equipment.**

⚠ **WARNING: Be sure that you are completely familiar with the safe operation of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start–up procedure or troubleshoot this equipment.**

⚠ **WARNING: This unit has an automatic restart feature that will start the motor whenever input power is applied and a RUN (FWD or REV) command is issued. If an automatic restart of the motor could cause injury to personnel, the automatic restart feature should be disabled by changing the Level 2 Miscellaneous block, Restart Auto/Man parameter to Manual.**

⚠ **WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.**

⚠ **WARNING: Do not remove cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Dangerous voltages are present inside the equipment. Electrical shock can cause serious or fatal injury.**

⚠ **WARNING: Improper operation of control may cause violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Certain failure modes of the control can produce peak torque of several times the rated motor torque.**

⚠ **WARNING: Motor circuit may have high voltage present whenever AC power is applied, even when motor is not rotating. Electrical shock can cause serious or fatal injury.**

⚠ **WARNING: Dynamic brake resistors may generate enough heat to ignite combustible materials. Keep all combustible materials and flammable vapors away from brake resistors.**

⚠ **WARNING: The motor shaft will rotate during the autotune procedure. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment.**

Continued on next page

⚠ **Caution:** **To prevent equipment damage, be certain that the electrical service is not capable of delivering more than the maximum line short circuit current amperes listed for 230 VAC, 460 VAC or 575 VAC control rating.**

⚠ **Caution:** **Disconnect motor leads (T1, T2 and T3) from control before you perform a “Megger” test on the motor. Failure to disconnect motor from the control will result in extensive damage to the control. The control is tested at the factory for high voltage / leakage resistance as part of Underwriter Laboratory requirements.**

⚠ **Caution:** **Do not connect AC power to the Motor terminals T1, T2 and T3. Connecting AC power to these terminals may result in damage to the control.**

⚠ **Caution:** **Baldor recommends not using “Grounded Leg Delta” transformer power leads that may create ground loops and degrade system performance. Instead, we recommend using a four wire Wye.**

⚠ **Caution:** **Do not supply any power to the External Trip (motor thermostat) leads at J1-16 and 17. Power on these leads can damage the control. Use a dry contact type that requires no external power to operate.**

Section 3
Receiving & Installation

Receiving & Inspection

The Series 18H Vector Control is thoroughly tested at the factory and carefully packaged for shipment. When you receive your control, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your control.
2. Verify that the part number of the control you received is the same as the part number listed on your purchase order.
3. If the control is to be stored for several weeks before use, be sure that it is stored in a location that conforms to published storage specifications. (Refer to Section 7 of this manual).

Physical Location

The location of the 18H is important. It should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. Exposure to these elements can reduce the operating life and degrade performance of the control.

Several other factors should be carefully evaluated when selecting a location for installation:

1. For effective cooling and maintenance, the control should be mounted vertically on a flat, smooth, non-flammable vertical surface. Table 3-1 lists the Watts Loss ratings for enclosure sizing.
2. At least two inches clearance must be provided on all sides for air flow.
3. Front access must be provided to allow the control cover to be opened or removed for service and to allow viewing of the Keypad Display. (The keypad may optionally be remote mounted up to 100 feet from the control.)

   Controls installed in a floor mounted enclosure must be positioned with clearance to open the enclosure door. This clearance will also provide sufficient air space for cooling.
4. **Altitude derating**. Up to 3300 feet (1000 meters) no derating required. Above 3300 ft, derate the continuous and peak output current by 2% for each 1000 ft.
5. **Temperature derating**. Up to 40°C no derating required. Above 40°C, derate the continuous and peak output current by 2% per °C. Maximum ambient is 55°C.

Table 3-1 Series 18H Watts Loss Ratings

Enclosure Size	230 VAC		460 VAC		575 VAC	
	2.5KHz PWM	**8.0KHz PWM**	**2.5KHz PWM**	**8.0KHz PWM**	**2.5KHz PWM**	**8.0KHz PWM**
A and B	14 Watts/ Amp	17 Watts/ Amp	17 Watts/ Amp	26 Watts/ Amp	18 Watts/ Amp	28 Watts/ Amp
C, D, E, and F	12 Watts/ Amp	15 Watts/ Amp	15 Watts/ Amp	23Watts/ Amp	19Watts/ Amp	29 Watts/ Amp
G			15 Watts/ Amp			

Control Installation

The control must be securely fastened to the mounting surface. Use the four (4) mounting holes to fasten the control to the mounting surface or enclosure.

Shock Mounting

If the control will be subjected to levels of vibration greater than 0.5G at 10 to 60Hz, the control should be shock mounted. Excessive vibration within the control could cause internal connections to loosen and cause component failure or electrical shock hazard.

Through the Wall Mounting

Control sizes E and F are designed for panel or through the wall installation. To mount a control through the wall, a Through the Wall mounting kit must be purchased. These kits are:

Kit No.	Description
KT0000A00	Size A control through the wall mounting kit.
KT0001A00	Size B control through the wall mounting kit.
V0083991	Size E control through the wall mounting kit.
V0084001	Size F control through the wall mounting kit.

Procedure:

1. Refer to Section 7 of this manual for drawings and dimensions of the through the wall mounting kits. Use the information contained in these drawings to layout the appropriate size hole on your enclosure and wall.
2. Cut the holes in your enclosure and wall.
3. Locate and drill holes for mounting hardware as shown in the drawings.
4. Cut foam tape and apply to perimeter of opening as shown.
5. Secure the four (4) brackets to the exterior of the customers panel with the hardware provided.
6. Secure the control to the customers panel using the hardware provided.

Optional Remote Keypad Installation The keypad may be remotely mounted using the optional Baldor keypad extension cable. The keypad assembly (white - DC00005A-01; grey - DC00005A-02) comes complete with the screws and gasket required to mount it to an enclosure. When the keypad is properly mounted to a NEMA Type 4X indoor enclosure, it retains the Type 4X indoor rating.

Tools Required:

- Center punch, tap handle, screwdrivers (Phillips and straight) and crescent wrench.
- 8-32 tap and #29 drill bit (for tapped mounting holes) or #19 drill (for clearance mounting holes).
- 1-$^{1}/_{4}$″ standard knockout punch (1-$^{11}/_{16}$″ nominal diameter).
- RTV sealant.
- (4) 8-32 nuts and lock washers.
- Extended 8-32 screws (socket fillister) are required if the mounting surface is thicker than 12 gauge and is not tapped (clearance mounting holes).
- Remote keypad mounting template. A tear out copy is provided at the end of this manual for your convenience.

Mounting Instructions: **For tapped mounting holes**

1. Locate a flat 4″ wide x 5.5″ minimum high mounting surface. Material should be sufficient thickness (14 gauge minimum).
2. Place the template on the mounting surface or mark the holes as shown.
3. Accurately center punch the 4 mounting holes (marked A) and the large knockout (marked B).
4. Drill four #29 mounting holes (A). Thread each hole using an 8-32 tap.
5. Locate the 1-$^{1}/_{4}$″ knockout center (B) and punch using the manufacturers instructions.
6. Debur knockout and mounting holes making sure the panel stays clean and flat.
7. Apply RTV to the 4 holes marked (A).
8. Assemble the keypad to the panel. Use 8–32 screws, nuts and lock washers.
9. From the inside of the panel, apply RTV over each of the four mounting screws and nuts. Cover a $^{3}/_{4}$″ area around each screw while making sure to completely encapsulate the nut and washer.

Mounting Instructions: **For clearance mounting holes**

1. Locate a flat 4″ wide x 5.5″ minimum high mounting surface. Material should be sufficient thickness (14 gauge minimum).
2. Place the template on the mounting surface or mark the holes as shown on the template.
3. Accurately center punch the 4 mounting holes (marked A) and the large knockout (marked B).
4. Drill four #19 clearance holes (A).
5. Locate the 1-$^{1}/_{4}$″ knockout center (B) and punch using the manufacturers instructions.
6. Debur knockout and mounting holes making sure the panel stays clean and flat.
7. Apply RTV to the 4 holes marked (A).
8. Assemble the keypad to the panel. Use 8–32 screws, nuts and lock washers.
9. From the inside of the panel, apply RTV over each of the four mounting screws and nuts. Cover a $^{3}/_{4}$″ area around each screw while making sure to completely encapsulate the nut and washer.

Electrical Installation

Interconnection wiring is required between the motor control, AC power source, motor, host control and any operator interface stations. Use listed closed loop connectors that are of appropriate size for wire gauge being used. Connectors are to be installed using crimp tool specified by the manufacturer of the connector. Only Class 1 wiring should be used.

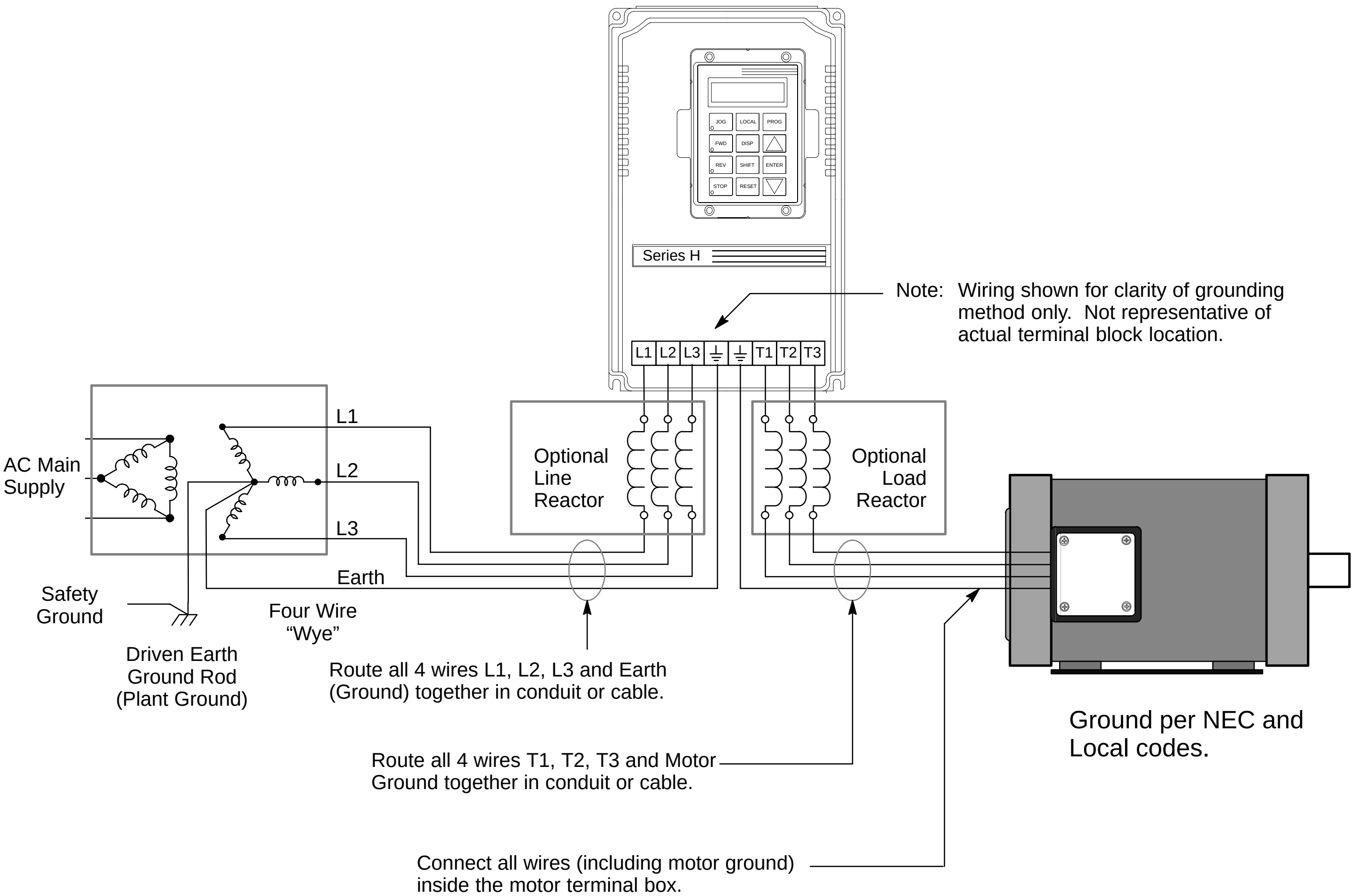
Baldor Series H controls feature UL approved adjustable motor overload protection suitable for motors rated at no less than 50% of the output rating of the control. Other governing agencies such as NEC may require separate over–current protection. The installer of this equipment is responsible for complying with the National Electric Code and any applicable local codes which govern such practices as wiring protection, grounding, disconnects and other current protection.

System Grounding

Baldor Controls are designed to be powered from standard three phase lines that are electrically symmetrical with respect to ground. System grounding is an important step in the overall installation to prevent problems. The recommended grounding method is shown in Figure 3-1.

⚠ **Caution: Baldor recommends not using "Grounded Leg Delta" transformer power leads that may create ground loops and degrade system performance. Instead, we recommend using a four wire Wye.**

Figure 3-1 Recommended System Grounding



Ungrounded Distribution System

With an ungrounded power distribution system it is possible to have a continuous current path to ground through the MOV devices. To avoid equipment damage, an Isolation transformer with a grounded secondary is recommended. This provides three phase AC power that is symmetrical with respect ground.

Input Power Conditioning

Baldor controls are designed for direct connection to standard three phase lines that are electrically symmetrical with respect to ground. Certain power line conditions must be avoided. An AC line reactor or an isolation transformer may be required for some power conditions.

- Baldor Series H controls require a minimum line impedance of 3%. Refer to "Line Impedance" for additional information.
- If the feeder or branch circuit that provides power to the control has permanently connected power factor correction capacitors, an input AC line reactor or an isolation transformer must be connected between the power factor correction capacitors and the control.
- If the feeder or branch circuit that provides power to the control has power factor correction capacitors that are switched on line and off line, the capacitors must not be switched while the control is connected to the AC power line. If the capacitors are switched on line while the control is still connected to the AC power line, additional protection is required. TVSS (Transient Voltage Surge Suppressor) of the proper rating must be installed between the AC line reactor or an isolation transformer and the AC input to the control.

Line Impedance

The Baldor Series 18H control requires a minimum line impedance of 3% (voltage drop across the reactor is 3% when the control draws rated input current). If the incoming power line has less than 3% impedance, a 3 phase line reactor can be used to provide the needed impedance in most cases. Line reactors are optional and are available from Baldor.

The input impedance of the power lines can be determined in two ways:

1. Measure the line to line voltage at no load and at full rated load. Use these measured values to calculate impedance as follows:

$$\%Impedance = \frac{(Volts_{No\ Load\ Speed} - Volts_{Full\ Load\ Speed})}{(Volts_{No\ Load\ Speed})} \times 100$$

2. Calculate the short circuit current capacity of the power line. If the short circuit current capacity is greater than the published maximum short circuit current ratings for the control, a line reactor should be installed.

   Two methods of calculating short circuit current capacity are provided:

   A. Method 1
   Calculate short circuit current as follows:

$$I_{SC} = \frac{(KVA_{XFMR} \times 1000 \times 100)}{(\%Z_{XFMR} \times V_{L-L} \times \sqrt{3})}$$

   Example: 50KVA transformer with 2.75% impedance @ 460VAC

$$I_{SC} = \frac{(50 \times 1000 \times 100)}{(2.75 \times 460 \times \sqrt{3})} = 2282\ Amps$$

   B. Method 2
   Step 1: Calculate KVA short circuit as follows:

$$KVA_{SC} = \frac{(KVA_{XFMR})}{\left(\frac{\%Z_{XFMR}}{100}\right)} = \left(\frac{50}{.0275}\right) = 1818.2\ KVA$$

   Step 2: Calculate short circuit current as follows:

$$I_{SC} = \frac{(KVA_{SC} \times 1000)}{(V_{L-L} \times \sqrt{3})} = \frac{1818.2 \times 1000}{460 \times \sqrt{3}} = 2282\ Amps$$

   where:
   KVA_{XFMR}=Transformer KVA
   I_{SC}=short circuit current
   Z_{XFMR}=Transformer Impedance
   V_{L-L}=Input volts measured line to line

Line Reactors

Three phase line reactors are available from Baldor. The line reactor to order is based on the *Quad Rated HP of the control. If providing your own line reactor, use the following formula to calculate the minimum inductance required. Table 3-3 lists the input current required for this calculation, for each control size.

$$L = \frac{(V_{L-L} \times 0.03)}{(I \times \sqrt{3} \times 377)}$$

Where:

L	Minimum inductance in Henries.
V_{L-L}	Input volts measured line to line.
0.03	Desired percentage of input impedance.
I	Input current rating of control.
377	Constant used with 60Hz power. Use 314 if input power is 50Hz.

Load Reactors

Line reactors may be used at the control output to the motor. When used this way, they are called Load Reactors. Load reactors serve several functions that include:

- Protect the control from a short circuit at the motor.
- Limit the rate of rise of motor surge currents.
- Slowing the rate of change of power the control delivers to the motor.

Load reactors should be installed as close to the control as possible. Selection should be based on the motor nameplate FLA value.

*Quad Rated HP of the control refers to the four (4) different HP ratings of the control that are based on operating in Standard (2.5KHz PWM) or Quiet (8.0KHz PWM) in either Constant Torque or Variable Torque. The ratings are provided in Section 7 of this manual.

Table 3-2 Short Circuit Current Ratings

230VAC		460VAC		575VAC	
Catalog Numbers	Max. Line Short Circuit Amps	Catalog Numbers	Max. Line Short Circuit Amps	Catalog Numbers	Max. Line Short Circuit Amps
ZD18H201–E	250	ZD18H401–E	150	ZD18H501–E	50
ZD18H201–W	350	ZD18H401–W	200	ZD18H502–E	100
ZD18H202–E	350	ZD18H402–E	200	ZD18H503–E	150
ZD18H202–W	550	ZD18H402–W	300	ZD18H505–E	200
ZD18H203–E or W	550	ZD18H403–E or W	300	ZD18H507–E	300
ZD18H205–E	550	ZD18H405–E	300	ZD18H510–E	400
ZD18H205–W	1000	ZD18H405–W	500	ZD18H515–E, EO or ER	600
ZD18H207–E or W	1000	ZD18H407–E or W	500	ZD18H520–EO or ER	1000
ZD18H210–E	1000	ZD18H410–E	500	ZD18H525–EO or ER	1100
ZD18H210L–ER	1500	ZD18H410L–ER	800	ZD18H530–EO or ER	1500
ZD18H215–E, EO or ER	1900	ZD18H415–E, EO or ER	1000	ZD18H540–EO or ER	1800
ZD18H215L–ER	1900	ZD18H415L–ER	1000	ZD18H550–EO or ER	2200
ZD18H220–EO or ER	2400	ZD18H420–EO or ER	1200	ZD18H560–EO or ER	2700
ZD18H220L–ER	2100	ZD18H420L–ER	1200	ZD18H575–EO or ER	3300
ZD18H225–EO or ER	2800	ZD18H425–EO or ER	1400	ZD18H5100–EO or ER	4200
ZD18H225L–ER	2500	ZD18H425L–ER	1400	ZD18H5150V–EO or ER	4800
ZD18H230V–EO or ER	3600	ZD18H430V–EO or ER	1800		
ZD18H230–EO or ER	3600	ZD18H430–EO or ER	1800		
ZD18H230L–ER	3600	ZD18H430L–ER	1800		
ZD18H240–MO or MR	4500	ZD18H440–MO or MR	2300		
ZD18H240L–MR	4000	ZD18H440L–MR	2300		
ZD18H250V–MO or MR	4500	ZD18H450–EO or ER	2800		
ZD18H250–MO or MR	4500	ZD18H450L–ER	2800		
		ZD18H460–EO or ER	3500		
		ZD18H460V–EO or ER	3500		
		ZD18H460L–ER	3500		
		ZD18H475–EO	4300		
		ZD18H475L–EO	4300		
		ZD18H4100–EO	5500		
		ZD18H4150V–EO	6200		
		ZD18H4150–EO	8300		
		ZD18H4200–EO	11000		
		ZD18H4250–EO	13800		
		ZD18H4300–EO	16600		
		ZD18H4350–EO	19900		
		ZD18H4400–EO	19900		
		ZD18H4450–EO	25000		

Input Current Requirements

Table 3-3 Input Current Requirements

230 VAC Control Catalog Numbers	Input Amps	460 VAC Control Catalog Numbers	Input Amps	575 VAC Control Catalog Numbers	Input Amps
ZD18H201-E or W	6.8	ZD18H401-E or W	3.4	ZD18H501-E	2.7
ZD18H202-E or W	9.6	ZD18H402-E or W	4.8	ZD18H502-E	4.0
ZD18H203-E or W	15.2	ZD18H403-E or W	7.6	ZD18H503-E	6.1
ZD18H205-E	15.2	ZD18H405-E or W	11	ZD18H505-E	11
ZD18H205-W	22	ZD18H407-E	11	ZD18H507-E	11
ZD18H207-E or W	28	ZD18H407-W	14	ZD18H510-E	11
ZD18H210-E	28	ZD18H410-E	21	ZD18H515-EO or ER	22
ZD18H210L-ER	42	ZD18H410L-ER	21	ZD18H520-EO or ER	27
ZD18H215-E	42	ZD18H415-E	21	ZD18H525-EO or ER	32
ZD18H215-EO or ER	54	ZD18H415-EO or ER	27	ZD18H530-EO or ER	41
ZD18H220-EO or ER	68	ZD18H415L-ER	27	ZD18H540-EO or ER	52
ZD18H220L-ER	60	ZD18H420-E or ER	34	ZD18H550-EO or ER	62
ZD18H225-EO or ER	80	ZD18H420L-ER	30	ZD18H560-EO or ER	62
ZD18H225L-ER	75	ZD18H425-EO or ER	40	ZD18H575-EO	100
ZD18H230-EO or ER	104	ZD18H425L-ER	38	ZD18H5100-EO	125
ZD18H230V-EO or ER	104	ZD18H430-EO or ER	52	ZD18H5150V-EO	145
ZD18H230L-ER	104	ZD18H430L-ER	52		
ZD18H240-MO or MR	130	ZD18H430V-EO or ER	52		
ZD18H240L-MR	115	ZD18H430L-ER	52		
ZD18H250-MO or MR	130	ZD18H440-EO or ER	65		
ZD18H250V-MR	130	ZD18H440L-ER	60		
		ZD18H450-EO or ER	80		
		ZD18H450L-ER	80		
		ZD18H460-EO or ER	100		
		ZD18H460V-EO or ER	100		
		ZD18H460L-ER	100		
		ZD18H475-EO	125		
		ZD18H475L-EO	125		
		ZD18H4100-EO	160		
		ZD18H4150-EO	240		
		ZD18H4150V-EO	180		
		ZD18H4200-EO	310		
		ZD18H4250-EO	370		
		ZD18H4300-EO	420		
		ZD18H4350-EO	480		
		ZD18H4400-EO	540		
		ZD18H4450-EO	590		

AC Main Circuit

Protection Devices

Be sure a suitable input power protection device is installed. Use the recommended circuit breaker or fuses listed in Tables 3-4 through 3-6 (Wire Size and Protection Devices). Wire sizes and protective device specifications are based on the controls' maximum output power rating for the operating zone. Refer to Quad ratings in Section 7 of this manual. If the output power from the control will be less than the maximum, the sizes of the wire and protective devices may be adjusted accordingly. Be sure to follow NEC, UL and other applicable codes. Input and output wire size is based on the use of copper conductor wire rated at 75 °C. The table is specified for NEMA B motors.

Circuit Breaker: 1 phase, thermal magnetic.
Equal to GE type THQ or TEB for 230 VAC
3 phase, thermal magnetic.
Equal to GE type THQ or TEB for 230 VAC or
GE type TED for 460 VAC and 575 VAC.

Fast Action Fuses: 230 VAC, Buss KTN
460 VAC, Buss KTS to 600A (KTU 601 - 1200A)
575VAC, Buss FRS

Very Fast Action: 230 VAC, Buss JJN
460 VAC, Buss JJS
575 VAC, , Buss JJS

Time Delay Fuses: 230 VAC, Buss FRN
460 VAC, Buss FRS to 600A (KTU 601 - 1200A)
575 VAC, Buss FRS to 600A (KTU 601 - 1200A)

Power Disconnect

A power disconnect should be installed between the input power service and the control for a fail safe method to disconnect power. The control will remain in a powered-up condition until all input power is removed from the control and the internal bus voltage is depleted.

Wire Size and Protection Devices

Table 3-4 Wire Size and Protection Devices - 230 VAC Controls

Control Output Power Rating	Input Breaker	Input Fuse		Wire Gauge	
		Fast Acting	Time Delay	AWG	mm^2
1	5A	5A	5A	14	2.5
2	10A	10A	8A	14	2.5
3	15A	15A	12A	14	2.5
5	20A	25A	12.5A	14	2.5
7.5	25A	30A	25A	12	4
10	35A	40A	35A	10	10
15	50A	60A	50A	8	10
20	60A	80A	60A	4	25
25	80A	100A	80A	4	25
30	100A	125A	100A	3	30
40	125A	150A	125A	1	50
50	150A	200A	150A	2/0	70

Note: All wire sizes based on 75°C copper wire, 3% line impedance. Higher temperature smaller gauge wire may be used per NEC and local codes. Recommended fuses/breakers are based on 25°C ambient, maximum continuous control output current and no harmonic current.

Table 3-5 Wire Size and Protection Devices - 460 VAC Controls

Control Output Power Rating	Input Breaker	Input Fuse		Wire Gauge	
		Fast Acting	Time Delay	AWG	mm^2
1	4A	4A	3A	14	2.5
2	10A	5A	4A	14	2.5
3	10A	8A	6A	14	2.5
5	10A	12A	9A	14	2.5
7.5	15A	20A	15A	14	2.5
10	20A	25A	17.5A	12	4
15	25A	30A	25A	10	6
20	30A	40A	30A	8	10
25	40A	50A	40A	8	10
30	45A	60A	45A	6	16
40	60A	80A	60A	4	25
50	70A	100A	75A	4	25
60	90A	125A	90A	2	35
75	125A	150A	125A	1/0	54
100	150A	200A	150A	2/0	70
125	175A	250A	175A	2/0	70
150	200A	300A	200A	4/0	120
200	250A	350A	250A	(2)1/0	(2)54
250	350A	450A	350A	(2)3/0	(2)95
300	400A	500A	400A	(2)4/0	(2)120
350	500A	600A	500A	(3)4/0	(3)120
400	600A	800A	600A	(3)250 mcm	(3)125
450	600A	800A	600A	(3)250 mcm	(3)125
500	800A	1000A	800A	(3)350 mcm	(3)185

Note: All wire sizes based on 75°C copper wire, 3% line impedance. Higher temperature smaller gauge wire may be used per NEC and local codes. Recommended fuses/breakers are based on 25°C ambient, maximum continuous control output current and no harmonic current.

Table 3-6 Wire Size and Protection Devices - 575 VAC Controls

Control Output Power Rating	Input Breaker	Input Fuse		Wire Gauge	
		Fast Acting	Time Delay	AWG	mm^2
1	5A	5A	4A	14	2.5
2	10A	5A	4A	14	2.5
3	10A	6A	5A	14	2.5
5	10A	10A	7A	14	2.5
7.5	10A	15A	10A	14	2.5
10	15A	15A	12A	14	2.5
15	20A	25A	20A	12	4
20	25A	35A	25A	10	6
25	30A	40A	30A	8	10
30	35A	50A	35A	8	10
40	45A	60A	45A	6	16
50	60A	80A	60A	4	25
60	70A	90A	70A	4	25
75	120A	150A	120A	3	27
100	120A	150A	120A	1/0	54
125	150A	200A	150A	2/0	70
150	175A	225A	175A	2/0	70

Note: All wire sizes based on 75°C copper wire, 3% line impedance. Higher temperature smaller gauge wire may be used per NEC and local codes. Recommended fuses/breakers are based on 25°C ambient, maximum continuous control output current and no harmonic current.

AC Line Connections

Be sure all power to the control is disconnected before proceeding. If power has been applied to the control, wait at least 5 minutes after power disconnect for residual voltage across bus capacitors to discharge.

Reduced Input Voltage Derating

All power ratings stated in Section 7 are for the stated nominal AC input voltages (230, 460 or 575VAC). The power rating of the control must be reduced when operating at a reduced input voltage. The amount of reduction is the ratio of the voltage change.

Examples:

For example, a 10HP, 230VAC control operating at 208VAC has a reduced power rating of 9.04HP.

$$10HP \times \frac{208VAC}{230VAC} = 9.04HP$$

Likewise, a 10HP, 460VAC control operating at 380VAC has a reduced power rating of 8.26HP.

$$10HP \times \frac{380VAC}{460VAC} = 8.26HP$$

To obtain the full output rating of 10HP in either case requires a 15HP Control.

380-400 VAC Configuration

Size A and B controls may be used directly with a 380-400 VAC power source, control modification is not necessary.

Size C, D, E, F and G controls all require modification for operation on the reduced line voltage (380-400VAC).

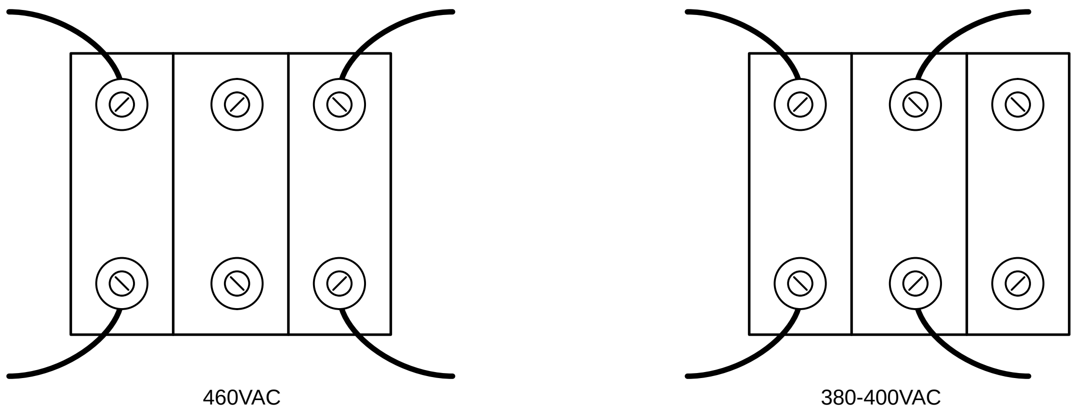
Tap Change Procedure (size C, D, E and F controls).

1. Be sure drive operation is terminated and control is disabled.
2. Remove all power sources from the control. If power has been applied, wait at least 5 minutes for bus capacitors to discharge.
3. Remove or open the front cover.
4. Remove the wire from terminal 5.
5. Place the wire that was removed from terminal 5 onto terminal 4.
6. Install or close the front cover.

Tap Change Procedure (size G controls). See Figure 3-2.

1. Be sure drive operation is terminated and control is disabled.
2. Remove all power sources from the control. If power has been applied, wait at least 5 minutes for bus capacitors to discharge.
3. Remove or open the front cover.
4. Remove the wires from the two right side terminals.
5. Place the wires on the center terminals as shown.
6. Install or close the front cover.

Figure 3-2 Configuring the Control Transformer Terminal Block for 380 - 400 VAC (Size G)



Three Phase Input Power

Three phase AC power and motor connections are shown in Figure 3-3. Overloads are not required. The 18H control has an electronic I^2t motor overload protection. If motor overloads are desired, they should be sized according to the manufacturers specifications and installed between the motor and the T1, T2 and T3 terminals of the control.

⚠ **Caution: Do not connect AC power to the Motor terminals T1, T2 and T3. Connecting AC power to these terminals may result in damage to the control.**

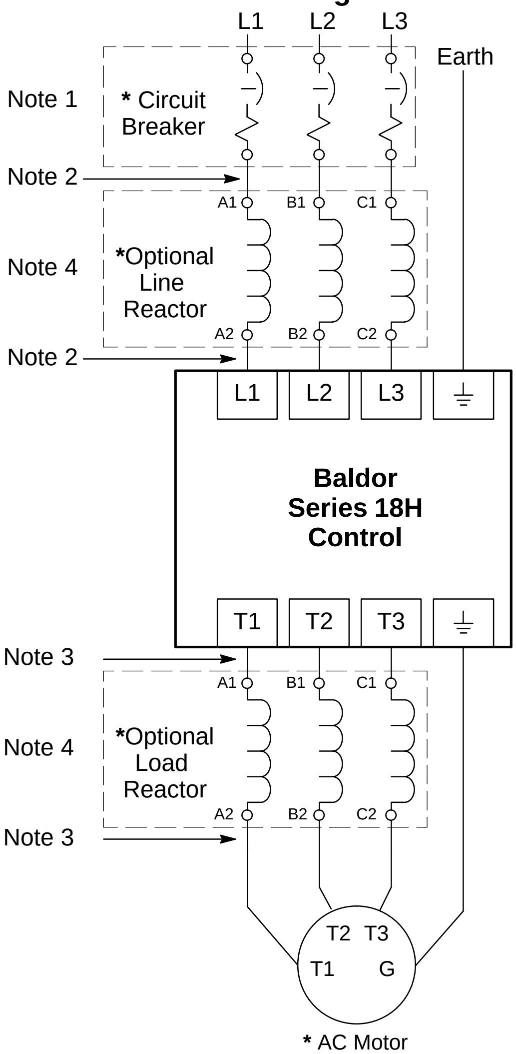
⚠ **Caution: Baldor recommends not using "Grounded Leg Delta" transformer power leads that may create ground loops and degrade system performance. Instead, we recommend using a four wire Wye.**

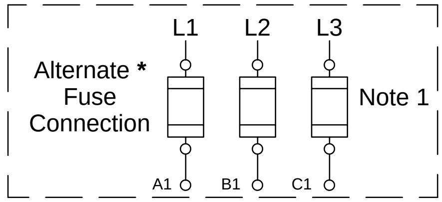
1. Connect the incoming AC power wires from the protection devices to L1, L2 and L3 at the Main Circuit Terminals. The phase rotation is not important as the control is not phase sensitive.
2. * Connect earth ground to the "⏚" of the control. Be sure to comply with local codes.

   Note: Use same gauge wire for earth ground as is used for L1, L2 and L3 connections. Refer to the Wire Size and Protection Devices tables shown previously in this section.
3. Connect the three phase power leads of the AC motor to terminals T1, T2, and T3 of the Main Circuit Terminals.
4. * Connect motor ground wire to the "⏚" of the control. Be sure to comply with all applicable codes.

* Grounding by using conduit or panel connection is not adequate. A separate conductor of the proper size must be used as a ground conductor.

Figure 3-3 Three Phase AC Power and Motor Connections

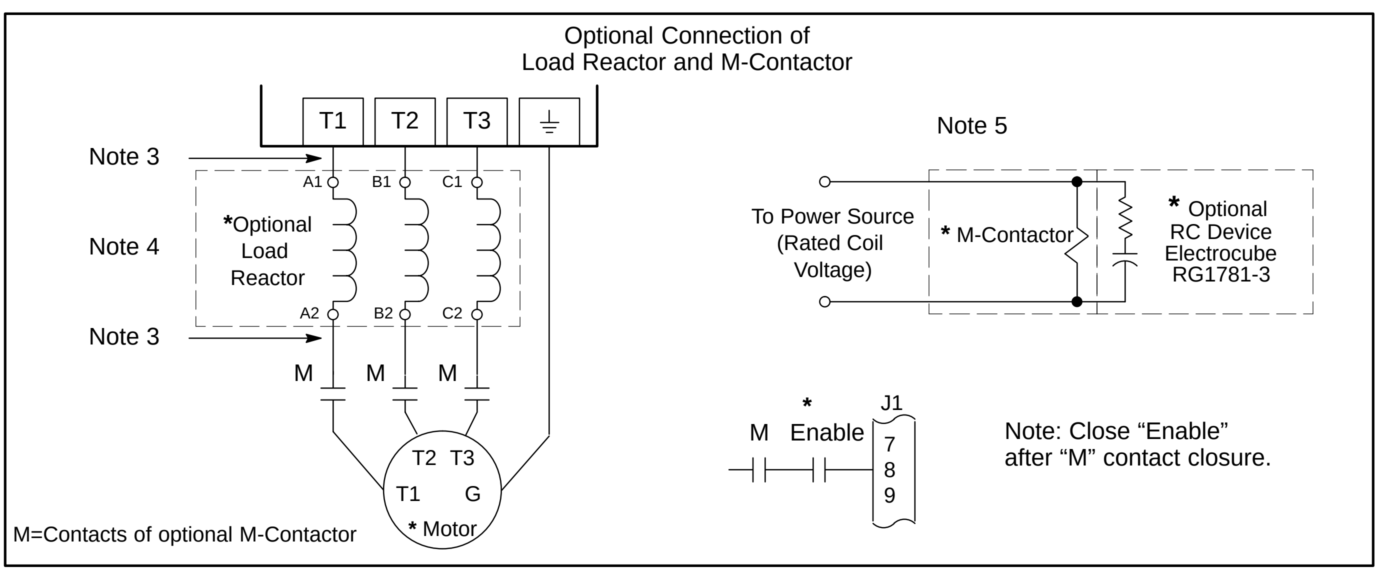




* Optional components not provided with 18H Control.

Notes:

1. See “Protective Devices” described previously in this section.
2. Shield wires inside a metal conduit.
3. Metal conduit should be used to shield output wires (between control and motor). Connect conduits so the use of Load Reactor or RC Device does not interrupt EMI/RFI shielding.
4. See Line/Load Reactors described later in this section.
5. A motor circuit contactor is recommended to provide a positive disconnect and prevent motor rotation which could pose a safety hazard. Connect the M-Contactor as shown. The contactor should open the enable input at J1-8 at least 20 msec before the main M-contacts open to prevent arcing at contacts. This greatly increases contactor life and allows use of IEC rated contactors.



See Recommended Tightening Torques in Section 7.

Table 3-7 Single Phase Rating Wire Size and Protection Devices - 230 VAC Controls

Control Output Power Rating	Input Breaker	Input Fuse		Wire Gauge	
		Fast Acting	Time Delay	AWG	mm^2
1	15A	5A	5A	14	2.5
2	15A	10A	10A	14	2.5
3	15A	15A	15A	14	2.5
5	30A	30A	30A	12	4
7.5	25A	25A	25A	14	2.5
10	40A	30A	30A	12	4
15	50A	45A	45A	10	6
20	60A	45A	45A	8	10
25	70A	70A	70A	8	10
30	80A	80A	80A	6	16
40	100A	100A	100A	4	25
50	125A	125A	125A	4	25

Table 3-8 Single Phase Rating Wire Size and Protection Devices - 460 VAC Controls

Control Output Power Rating	Input Breaker	Input Fuse		Wire Gauge	
		Fast Acting	Time Delay	AWG	mm^2
1	15A	4A	4A	14	2.5
2	15A	8A	8A	14	2.5
3	15A	10A	10A	14	2.5
5	15A	15A	15A	14	2.5
7.5	15A	15A	15A	14	2.5
10	20A	15A	15A	14	2.5
15	25A	25A	25A	14	2.5
20	30A	30A	30A	14	2.5
25	35A	30A	30A	14	2.5
30	40A	40A	40A	10	6
40	60A	50A	50A	8	10
50	70A	60A	60A	8	10
60	80A	80A	80A	6	16

Note: All wire sizes based on 75°C copper wire, 3% line impedance. Higher temperature smaller gauge wire may be used per NEC and local codes. Recommended fuses/breakers are based on 25°C ambient, maximum continuous control output current and no harmonic current.

Single Phase Input Power Considerations

⚠ **Caution:** **Do not connect AC power to the Motor terminals T1, T2 and T3. Connecting AC power to these terminals may result in damage to the control.**

⚠ **Caution:** **Baldor recommends not using "Grounded Leg Delta" transformer power leads that may create ground loops and degrade system performance. Instead, we recommend using a four wire Wye.**

Single phase AC input power can be used to power the control instead of three phase for control sizes A, B, C, D, E and F. Single phase operation of G size controls is not possible. The specifications and control sizes are listed in Section 7 of this manual. If single phase power is to be used, the rated Horsepower of the control may have to be reduced (derated). In addition, power wiring and jumper changes are required.

Single phase rating wire size and protection devices are listed in Tables 3-7 and 3-8.

Single Phase Control Derating: Single phase power derating requires that the continuous and peak current ratings of the control be reduced by the following percentages:

1. **1-2 HP 230 and 460 VAC controls:**
   No derating required.
2. **3-15 HP (Size B) 230 and 460 VAC controls:**
   Derate HP by 40% of the nameplate rating.
3. **15 HP (Size C) and Larger 230 and 460 VAC controls:**
   Derate HP by 50% of the nameplate rating.

Size A and B Single Phase Power Installation

Jumper Configuration

Size A and B controls, no jumper changes required.

Power and Control Connections

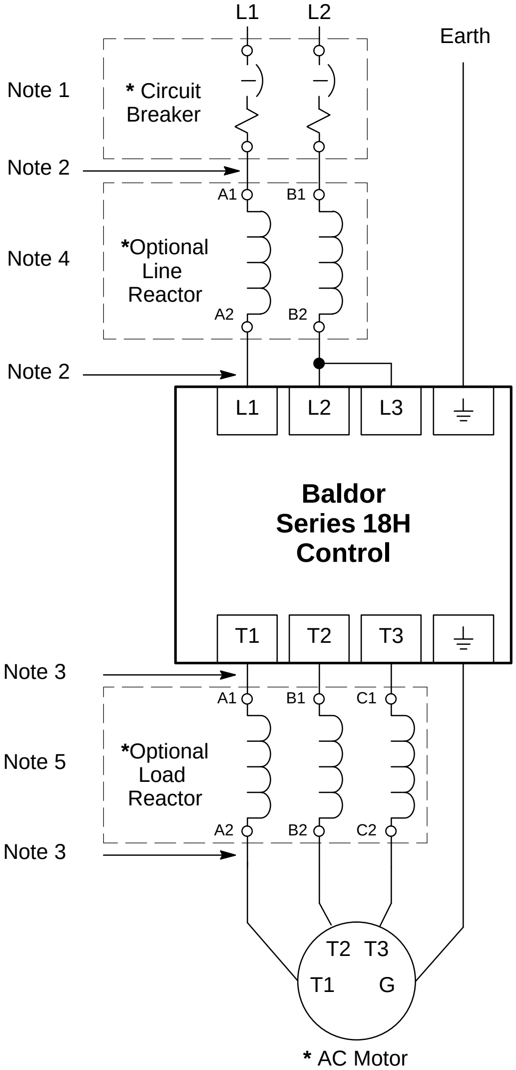
The single phase power and motor connections are shown in Figure 3-4.

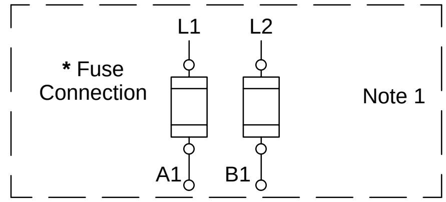
1. Connect the incoming power wires to Main Circuit Terminals L1 and L2.
2. Place a jumper across control power input terminals L2 and L3. Use the same size wire for the jumper as the incoming power wires on L1 and L2.
3. Connect earth ground to the "⏚" of the control. Be sure to comply with local codes.

   Note: Use same gauge wire for earth ground as is used for L1, L2 and L3 connections. Refer to the Wire Size and Protection Devices tables shown previously in this section.
4. Connect the three phase power leads of the AC motor to terminals T1, T2, and T3 of the Main Circuit Terminals.
5. Connect motor ground wire to the "⏚" of the control. Be sure to comply with all applicable codes.

Note: In steps 3 and 5 grounding by using conduit or panel connection is not adequate. A separate conductor of the proper size must be used as a ground conductor.

Figure 3-4 Size A & B Single Phase 230/460VAC Power and Motor Connections

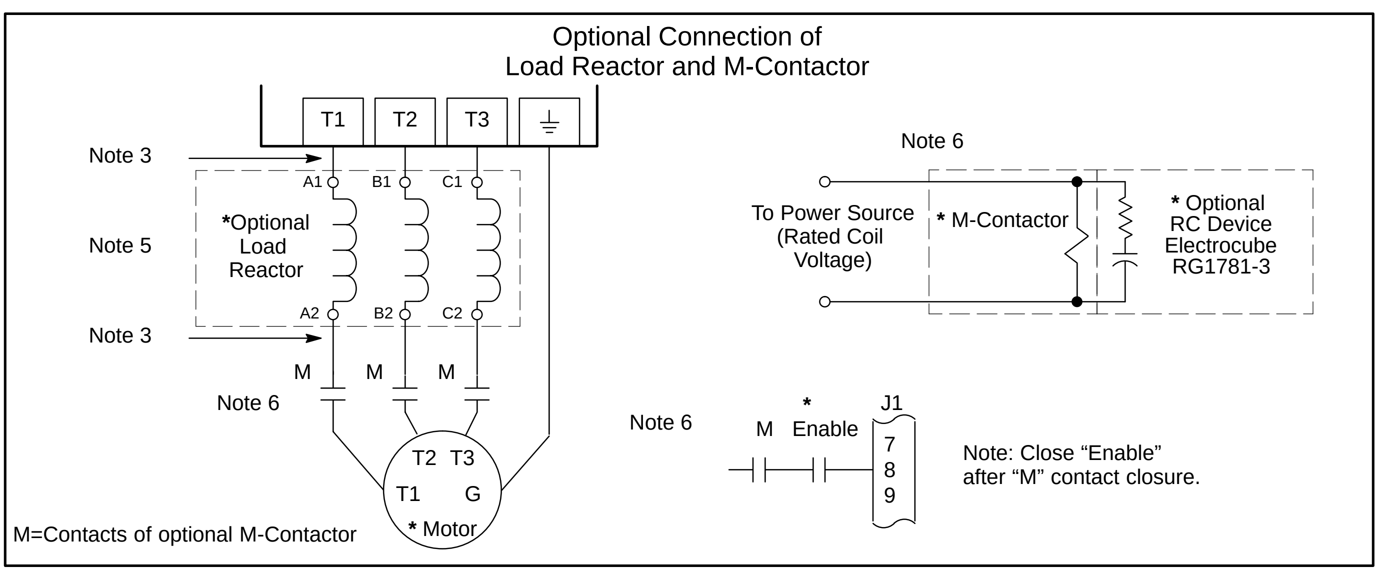




* Optional components not provided with 18H Control.

Notes:

1. See “Protective Devices” described previously in this section.
2. Shield wires inside a metal conduit.
3. Metal conduit should be used to shield output wires (between control and motor).
4. See “Line Impedance” described previously in this section.
5. See Line/Load Reactors described previously in this section.
6. A motor circuit contactor is recommended to provide a positive disconnect and prevent motor rotation which could pose a safety hazard. Connect the M-Contactor as shown. The contactor should open the enable input at J1-8 at least 20 msec before the main M-contacts open to prevent arcing at contacts. This greatly increases contactor life and allows use of IEC rated contactors.

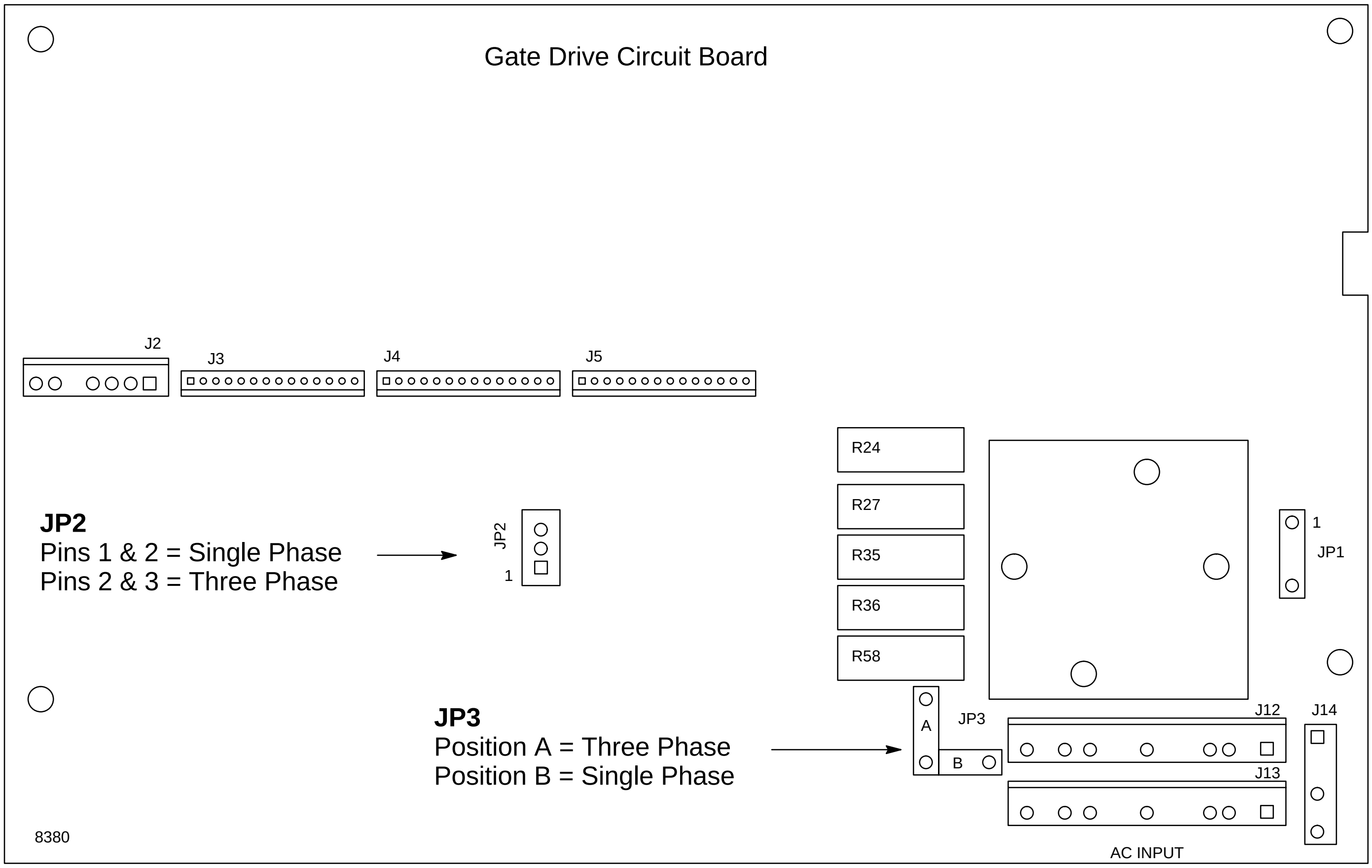


See Recommended Tightening Torques in Section 7.

Size C and D Single Phase Power Installation

Figure 3-5 Jumper Configuration

Place JP2 on pins 1 & 2 for control single phase operation.
Place JP3 in position B for fan single phase operation.



Power and Control Connections

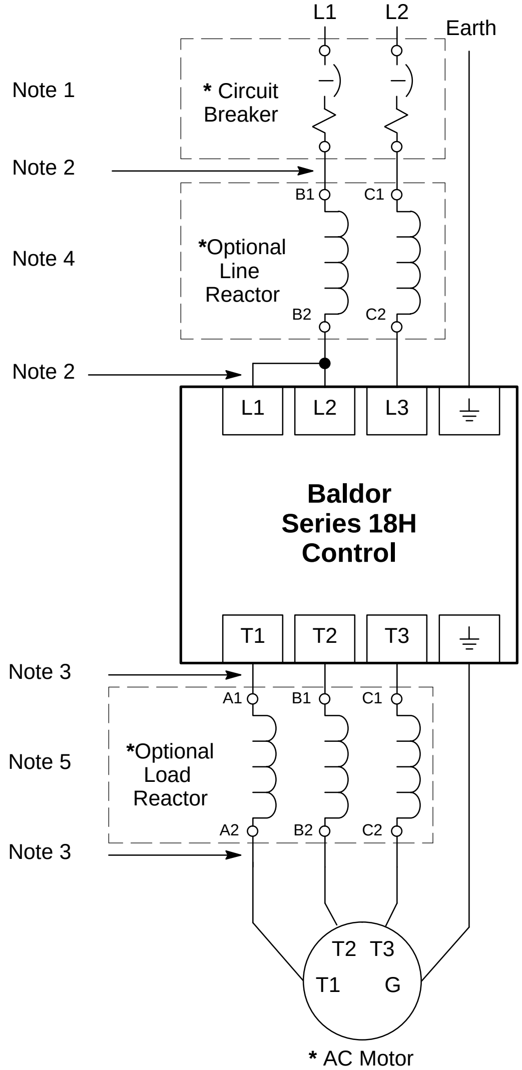
The single phase power and motor connections are shown in Figure 3-4.

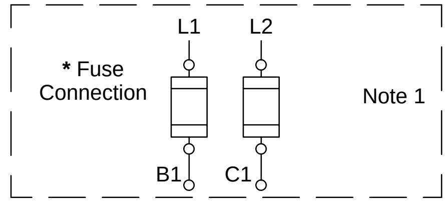
1. Connect the incoming power wires to Main Circuit Terminals L2 and L3.
2. Place a jumper across control power input terminals L1 and L2. Use the same size wire for the jumper as the incoming power wires on L2 and L3.
3. Connect earth ground to the "⏚" of the control. Be sure to comply with local codes.

   Note: Use same gauge wire for earth ground as is used for L1, L2 and L3 connections. Refer to the Wire Size and Protection Devices tables shown previously in this section.
4. Connect the three phase power leads of the AC motor to terminals T1, T2, and T3 of the Main Circuit Terminals.
5. Connect motor ground wire to the "⏚" of the control. Be sure to comply with all applicable codes.

Note: In steps 3 and 5 grounding by using conduit or panel connection is not adequate. A separate conductor of the proper size must be used as a ground conductor.

Figure 3-6 Size C & D Single Phase 230/460VAC Power and Motor Connections

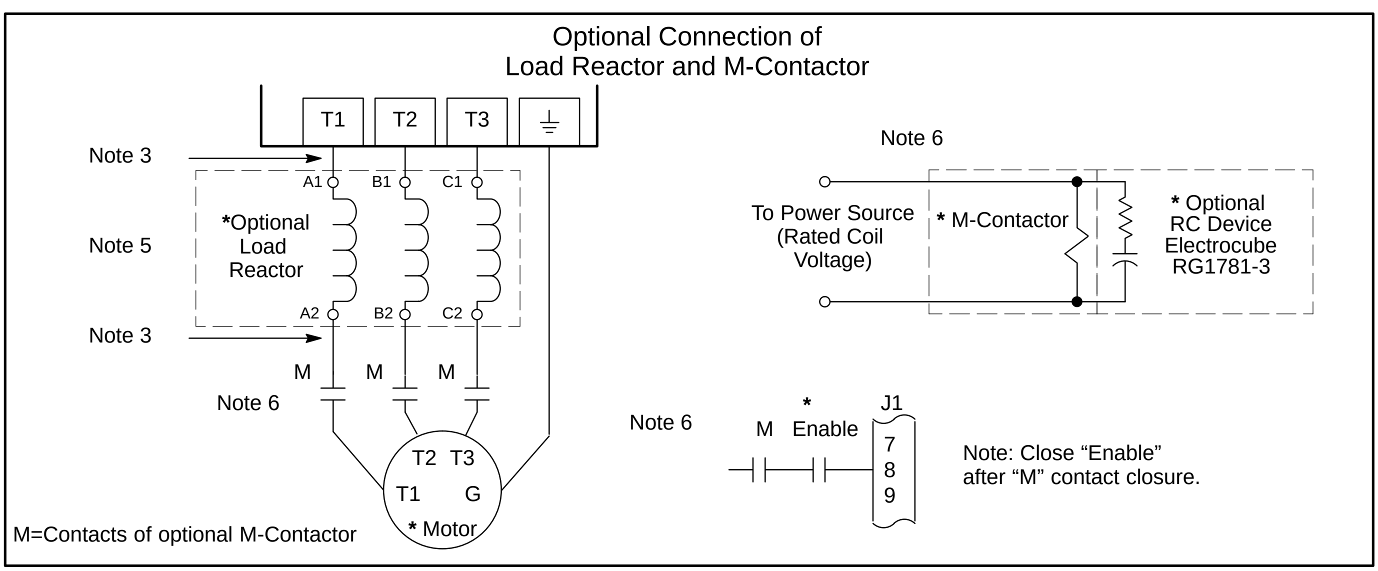




* Optional components not provided with 18H Control.

Notes:

1. See “Protective Devices” described previously in this section.
2. Shield wires inside a metal conduit.
3. Metal conduit should be used to shield output wires (between control and motor).
4. See “Line Impedance” described previously in this section.
5. See Line/Load Reactors described previously in this section.
6. A motor circuit contactor is recommended to provide a positive disconnect and prevent motor rotation which could pose a safety hazard. Connect the M-Contactor as shown. The contactor should open the enable input at J1-8 at least 20 msec before the main M-contacts open to prevent arcing at contacts. This greatly increases contactor life and allows use of IEC rated contactors.

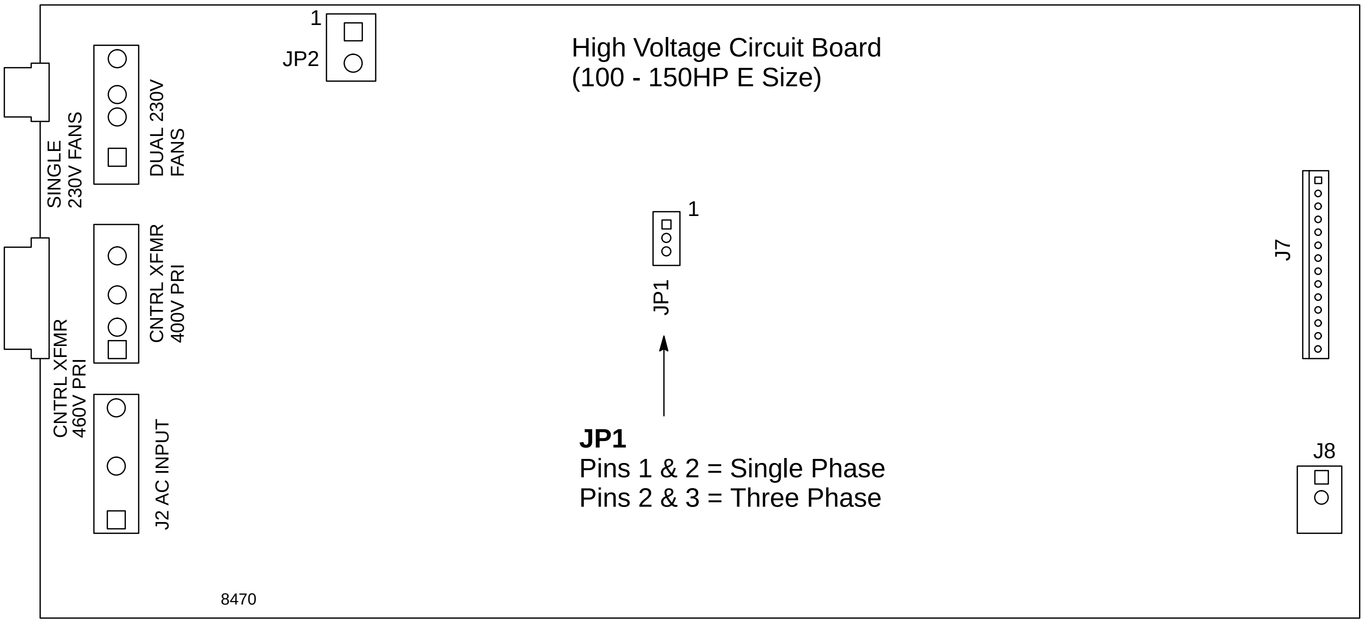


See Recommended Tightening Torques in Section 7.

Size E Single Phase Power Installation

Figure 3-7 Jumper Configuration

Place JP1 on the High Voltage Circuit Board across pins 1 and 2.



Power and Control Connections

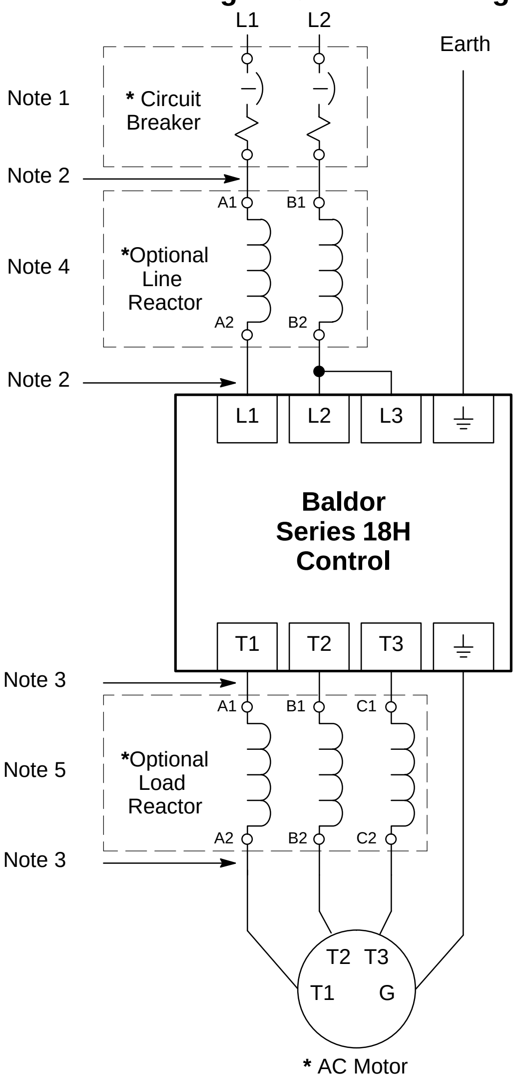
The single phase power and motor connections are shown in Figure 3-8.

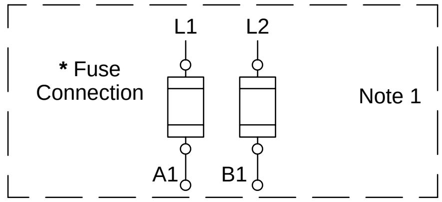
1. Connect the incoming power wires to Main Circuit Terminals L1 and L2.
2. Place a jumper across control power input terminals L2 and L3. Use the same size wire for the jumper as the incoming power wires on L1 and L2.
3. Connect earth ground to the "⏚" of the control. Be sure to comply with local codes.

   Note: Use same gauge wire for earth ground as is used for L1, L2 and L3 connections. Refer to the Wire Size and Protection Devices tables shown previously in this section.
4. Connect the three phase power leads of the AC motor to terminals T1, T2, and T3 of the Main Circuit Terminals.
5. Connect motor ground wire to the "⏚" of the control. Be sure to comply with all applicable codes.

Note: In steps 3 and 5 grounding by using conduit or panel connection is not adequate. A separate conductor of the proper size must be used as a ground conductor.

Figure 3-8 Size E Single Phase 230/460VAC Power and Motor Connections

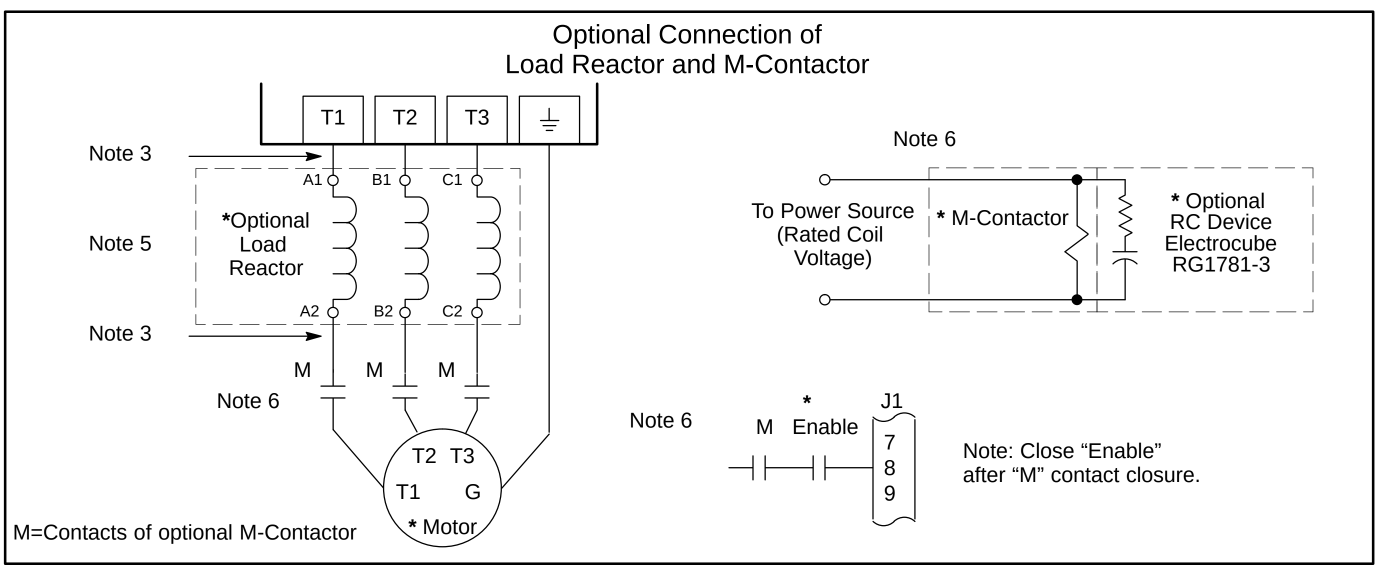




* Optional components not provided with 18H Control.

Notes:

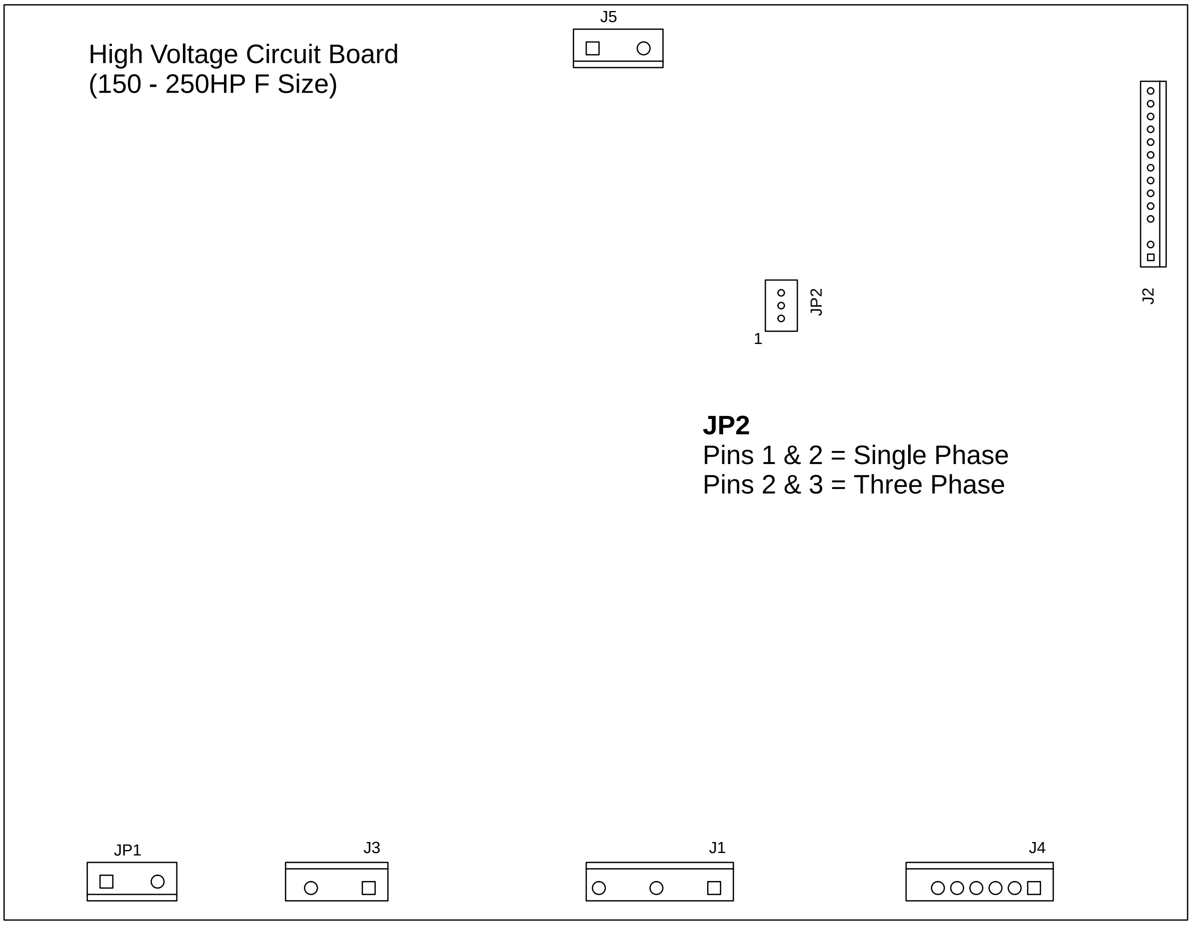
1. See “Protective Devices” described previously in this section.
2. Shield wires inside a metal conduit.
3. Metal conduit should be used to shield output wires (between control and motor).
4. See “Line Impedance” described previously in this section.
5. See Line/Load Reactors described previously in this section.
6. A motor circuit contactor is recommended to provide a positive disconnect and prevent motor rotation which could pose a safety hazard. Connect the M-Contactor as shown. The contactor should open the enable input at J1-8 at least 20 msec before the main M-contacts open to prevent arcing at contacts. This greatly increases contactor life and allows use of IEC rated contactors.



See Recommended Tightening Torques in Section 7.

Size F Single Phase Power Installation

Figure 3-9 Jumper Configuration
Place JP2 on the High Voltage Circuit Board across pins 1 and 2.



Power and Control Connections

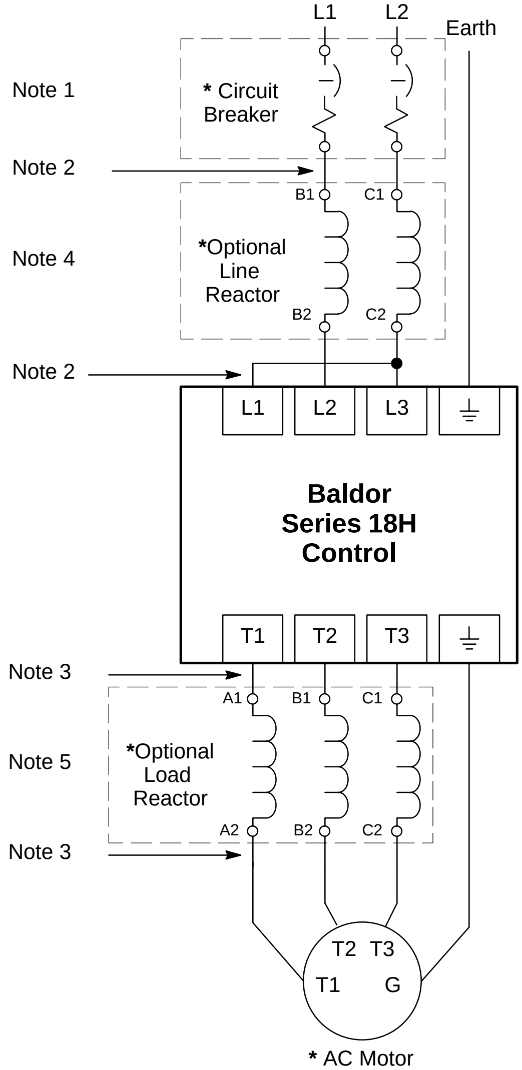
The single phase power and motor connections are shown in Figure 3-10.

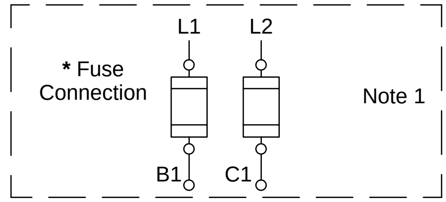
1. Connect the incoming power wires to Main Circuit Terminals L2 and L3.
2. Place a jumper across control power input terminals L1 and L3. Use the same size wire for the jumper as the incoming power wires on L2 and L3.
3. Connect earth ground to the "⏚" of the control. Be sure to comply with local codes.

   Note: Use same gauge wire for earth ground as is used for L1, L2 and L3 connections. Refer to the Wire Size and Protection Devices tables shown previously in this section.
4. Connect the three phase power leads of the AC motor to terminals T1, T2, and T3 of the Main Circuit Terminals.
5. Connect motor ground wire to the "⏚" of the control. Be sure to comply with all applicable codes.

Note: In steps 3 and 5 grounding by using conduit or panel connection is not adequate. A separate conductor of the proper size must be used as a ground conductor.

Figure 3-10 Size F Single Phase 230/460VAC Power and Motor Connections

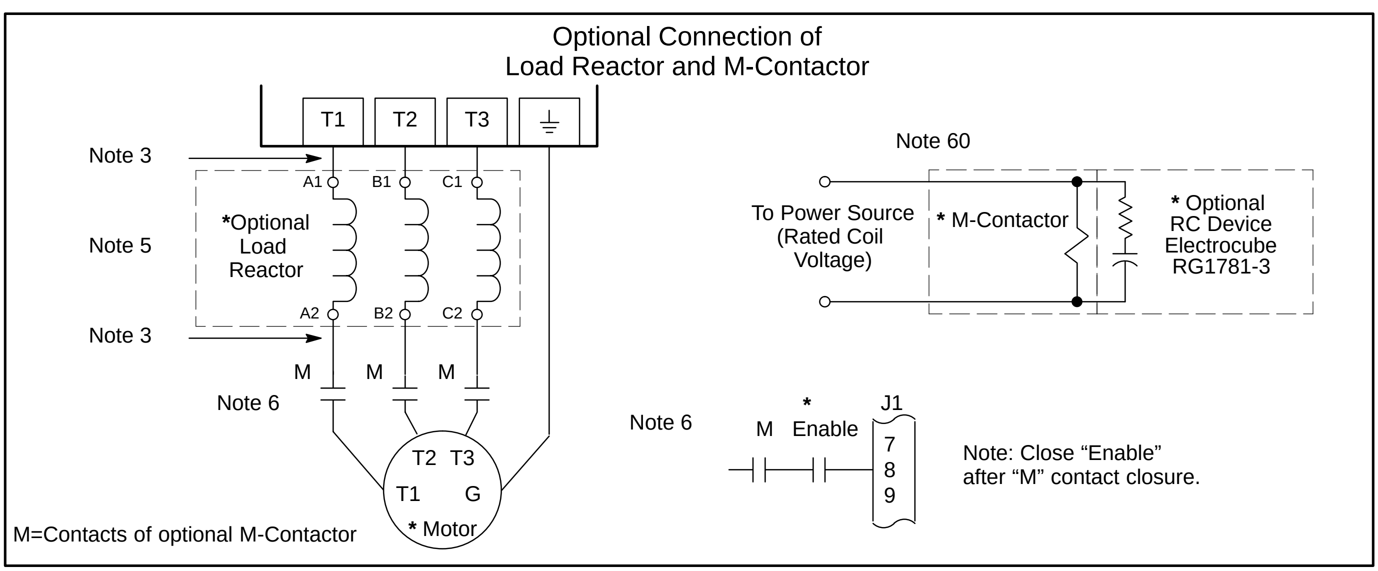




* Optional components not provided with 18H Control.

Notes:

1. See "Protective Devices" described previously in this section.
2. Shield wires inside a metal conduit.
3. Metal conduit should be used to shield output wires (between control and motor).
4. See "Line Impedance" described previously in this section.
5. See Line/Load Reactors described previously in this section.
6. A motor circuit contactor is recommended to provide a positive disconnect and prevent motor rotation which could pose a safety hazard. Connect the M-Contactor as shown. The contactor should open the enable input at J1-8 at least 20 msec before the main M-contacts open to prevent arcing at contacts. This greatly increases contactor life and allows use of IEC rated contactors.



See Recommended Tightening Torques in Section 7.

Optional Dynamic Brake Hardware

⚠ **WARNING: Resistors may generate enough heat to ignite combustible materials. To avoid fire hazard, keep all combustible materials and flammable vapors away from brake resistors.**

Physical Installation

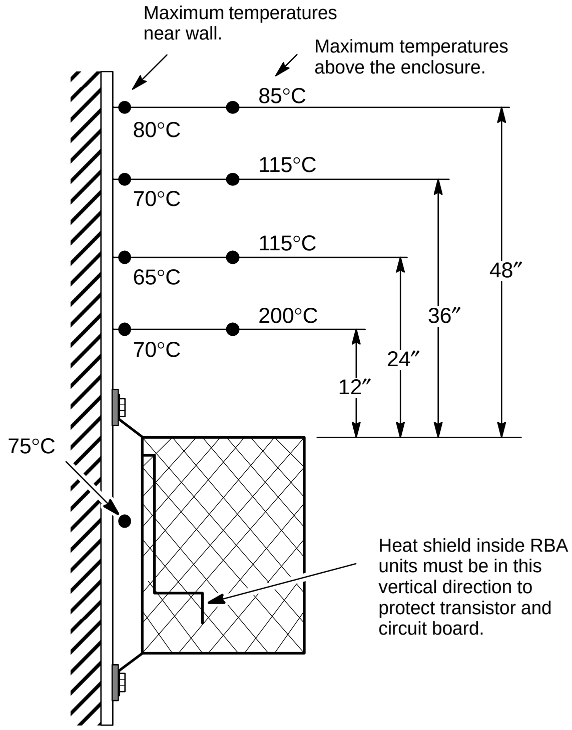
Dynamic Brake (DB) Hardware must be installed on a flat, non-flammable, vertical surface to obtain effective cooling and operation. The ambient temperature must not exceed 80°C.

1. Select a clean **VERTICAL** surface that is free from corrosive gasses, liquids, vibration, dust and metallic particles.

⚠ **Caution: If the DB hardware mounting is in any position other than vertical (Figure 3-11), the DB hardware must be derated by 35% of its rated capacity.**

2. Mount the DB hardware as shown in Figure 3-11.

Figure 3-11 DB Hardware Installation



Electrical Installation

Terminal connections for DB hardware is determined by 18H Control model number suffix (E, EO, ER or MO). See Figure 3-12 for terminal identification.

Figure 3-12 DB Terminal Identification

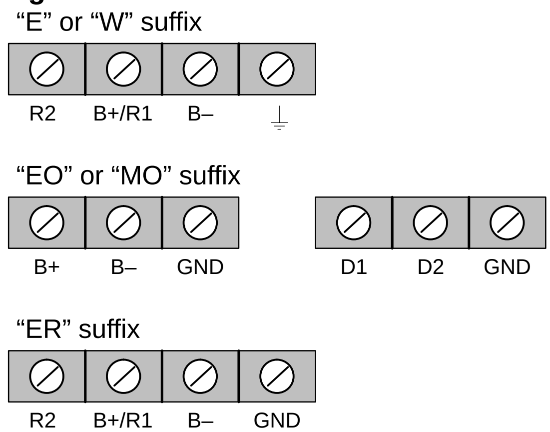
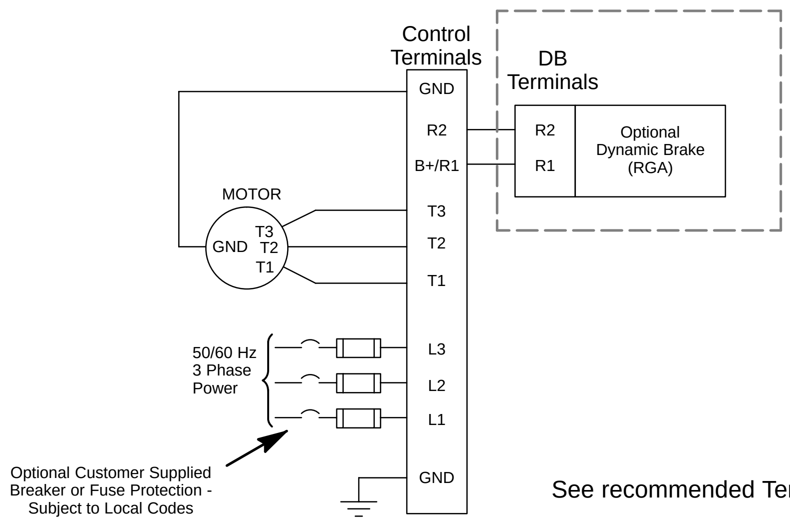


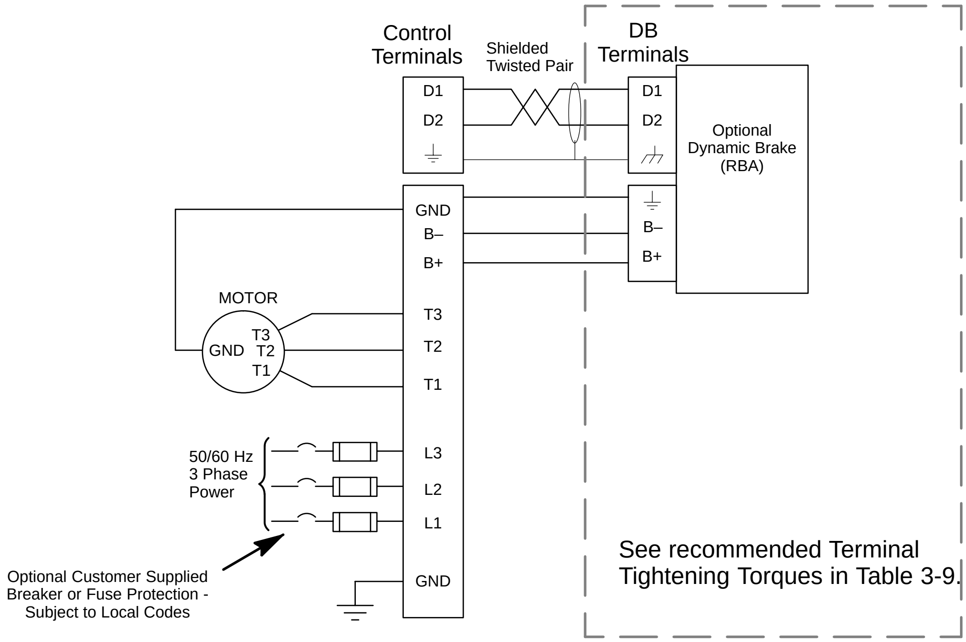
Figure 3-13 Wiring for RGA Assembly



See recommended Terminal Tightening Torques in Table 3-10.

Note: Although not shown, metal conduit should be used to shield all power wires and motor leads.

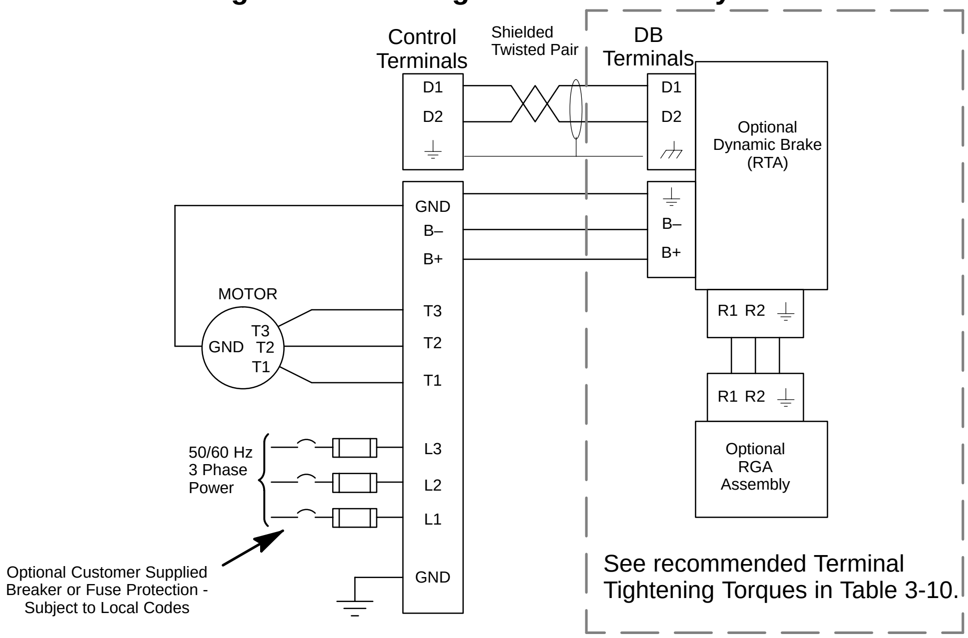
Figure 3-14 Wiring for RBA Assembly



See recommended Terminal Tightening Torques in Section 7.

Note: Although not shown, metal conduit should be used to shield all power wires and motor leads.

Figure 3-15 Wiring for RTA Assembly



See recommended Terminal Tightening Torques in Section 7.

Note: Although not shown, metal conduit should be used to shield all power wires and motor leads.

Table 3-9 Terminal Torques & Wire Size for Model No. Suffix E or W

Control Voltage Rating VAC	B+ / B– / R1 / R2 / ⏚ Terminals				
	Wire SIze		Volt	Tightening Torque	
	AWG	mm^2		Nm	Lb–in
230, 460, 575	10	6	600	2.26	20

Table 3-10 Terminal Torques & Wire Size for Model No. Suffix EO, MO, or ER

Control Voltage Rating VAC	Braking Option Watts Rating	B+ / B– and R1 / R2 / ⏚ Terminals					D1 / D2 / ⏚ Terminals				
		Wire SIze		Volt	Tightening Torque		Wire SIze		Volt	Tightening Torque	
		AWG	mm^2		Nm	Lb–in	AWG	mm^2		Nm	Lb–in
230	<10,000	10	6	600	2.26	32	20-22	0.5	600	0.4	3.5
230	>10,000	8	10	600	2.26	32	20-22	0.5	600	0.4	3.5
460	<20,000	10	6	600	2.26	32	20-22	0.5	600	0.4	3.5
460	>20,000	8	10	600	2.26	32	20-22	0.5	600	0.4	3.5
575	<20,000	10	6	600	2.26	32	20-22	0.5	600	0.4	3.5
575	>20,000	8	10	600	2.26	32	20-22	0.5	600	0.4	3.5

Table 3-11 DB Terminal Torques (All)

Tightening Torque	
Nm	Lb–in
2.26	32

Encoder Installation

Electrical isolation of the encoder shaft and housing from the motor is required. Electrical isolation prevents capacitive coupling of motor noise that will corrupt the encoder signals. See electrical noise considerations in Section 7 of this manual.

Cable Preparation

Encoder wiring must be shielded twisted pairs, #22 AWG (0.34mm^2) minimum size, 200′ (60m) maximum, with an insulated overall shield.

Control End (See Figure 3-16.)

1. Strip the outside jacket approximately 0.375″ (9.5mm) from the end.
2. Solder a #22 AWG (0.34mm^2) wire to the braided shield.
3. Connect all shields to J1-30. To do this, solder a "Drain Wire" from each shield to the wire soldered to the braided shield in step 2.
4. Insulate or tape off ungrounded end of shields to prevent contact with other conductors or ground.

Encoder End

1. Strip the outside jacket approximately 0.375″ (9.5mm) from the end.
2. Identify each of the four twisted pair and label or use the color codes shown in Figure 3-17 for the optional Baldor Encoder Cable.
3. Insulate or tape off ungrounded end of shields and unused conductors to prevent contact with other conductors or ground.

⚠ **CAUTION: Do not connect any shields to the encoder case or motor frame. The encoder +5VDC supply at J1-29 is referenced to circuit board common. Do not connect any shields to ground or another power supply or damage to the control may result.**

Figure 3-16 Encoder Cables

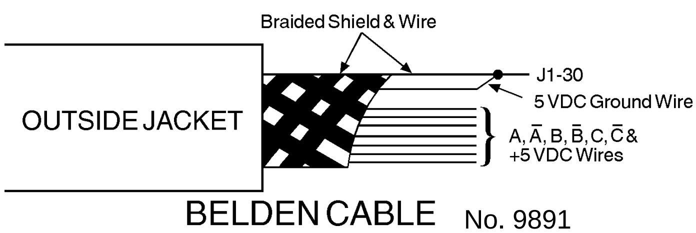
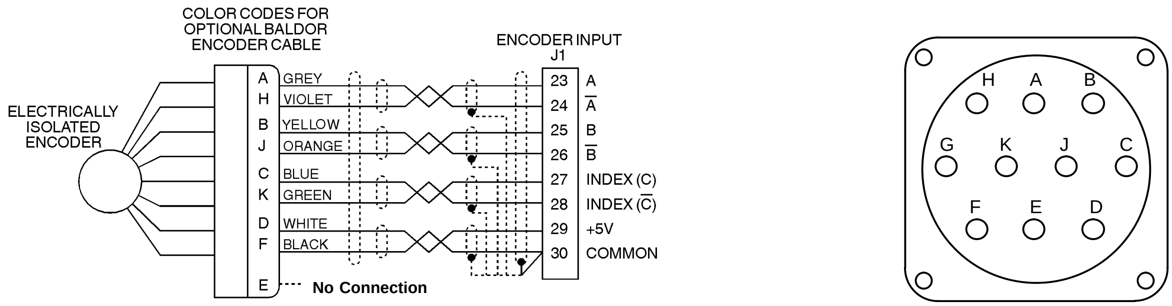


Figure 3-17 Encoder Connections



Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

Encoder Cable Connection

Encoder cable must be separated by at least 3” (76mm) from parallel runs of power wires. Encoder cables that cross power wires must cross at a 90° angle only. Encoder wires must be #22 AWG (0.34mm^2) minimum, 200 feet (60m) maximum length and must have an overall shield.

Note: Be careful not to pinch the wires’ insulation in J1 terminals as proper electrical connection may not be made.

1. Feed the control end of the cable through one of the “Knock-out” holes in the control case so connections can be made inside the control.
2. **Differential Connections**
   Connect the cable braided shield to J1-30 at control end.

   Connect the cable ends as follows: (See Figure 3-17.)

Encoder End	Control End
A	J1-23 (A)
H	J1-24 ($\overline{A}$)
B	J1-25 (B)
J	J1–26 ($\overline{B}$)
C	J1–27 Index(C)
K	J1–28 Index($\overline{C}$)
D	J1–29 (+5VDC)
F	J1–30 (Common)
E	No Connection

3. **Single Ended Connections**
   Differential inputs are recommended for best noise immunity. If only single ended encoder signals are available, connect them to A, B, and INDEX (C) (J1-23, J1-25 and J1-27 respectively).

Home (Orient) Switch Input

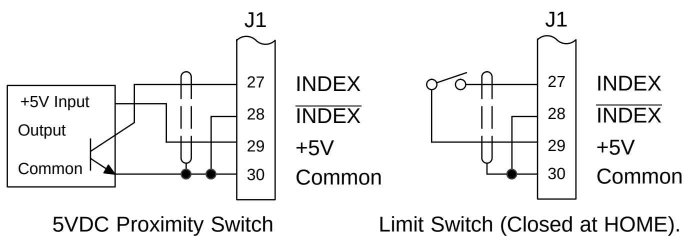
The Home or Orient function causes the motor shaft to rotate to a predefined home position. The homing function allows shaft rotation in the drive forward direction only. The home position is located when a machine mounted switch or the encoder "Index" pulse is activated (closed). Home is defined by a rising signal edge at terminal J1-27. The shaft will continue to rotate only in a "Drive Forward" direction for a user defined offset value. The offset is programmed in the Level 2 Miscellaneous Homing Offset parameter. The speed at which the motor will "Home" or orient is set with the Level 2 Miscellaneous Homing Speed parameter.

A machine mounted switch may be used to define the Home position in place of the encoder index channel. A differential line driver output from a solid state switch is preferred for best noise immunity. Connect this differential output to terminals J1-27 and J1-28.

A single ended solid-state switch or limit switch should be wired as shown in Figure 3-18. Regardless of the type of switch used, clean rising and falling edges at J1-27 are required for accurate positioning.

Note: Control requires dynamic brake hardware for Orient (Homing) function to work. Control will trip without dynamic brake hardware installed. Size A and B controls ("–E" suffix) are shipped with factory installed dynamic brake hardware.

Figure 3-18 Typical Home or Orient Switch Connections

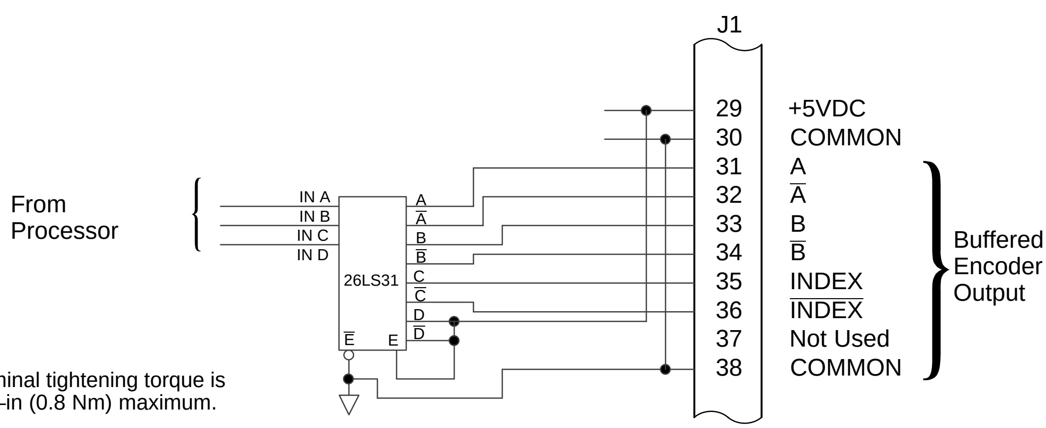


Terminal Tightening Torque = 7 Lb-in. (0.8 Nm).

Buffered Encoder Output

The control provides a buffered encoder output on pins J1-31 to J1-38 as shown in Figure 3-19. This output may be used by external hardware to monitor the encoder signals. It is recommended that this output only drive one output circuit load.

Figure 3-19 Buffered Encoder Output



Terminal tightening torque is 7 lb–in (0.8 Nm) maximum.

Control Circuit Connections

Eight different operating modes are available in the Series 18H vector control. These operating modes define the basic motor control setup and the operation of the input and output terminals. After the circuit connections are completed, the operating mode is selected by programming the Operating Mode parameter in the Level 1 Input programming Block. Available operating modes include:

- Keypad Control
- Standard Run, 3 Wire Control
- 15 Speed, 2 Wire Control
- Fan Pump 2 Wire Control
- Fan Pump 3 Wire Control
- Bipolar Speed or Torque
- Process Control
- Serial

Note: The Serial operating mode requires one of the optional Serial Interface expansion boards (RS232 or 422/485). Installation and operation information for these serial expansion boards is provided in Serial Communications expansion board manual MN1310. This manual is shipped with the serial expansion boards.

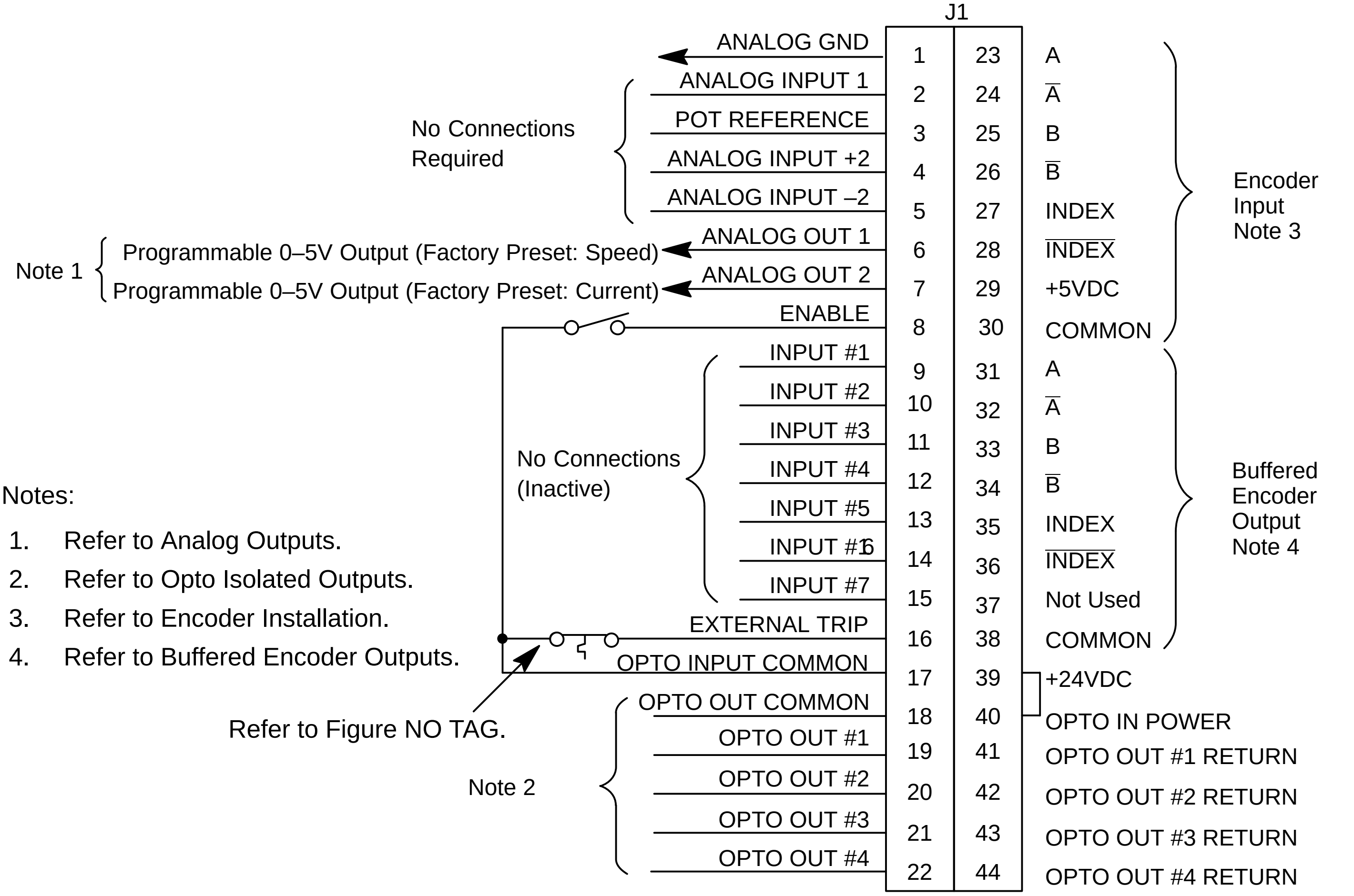
Keypad Mode Connections

To operate in the Keypad mode, set the Level 1 Input block, Operating Mode parameter to Keypad. In this mode, only the External Trip Opto Input at J1-16 is active (if the Level 2 Protection block, External Trip parameter is set to ON). Both analog outputs remain active. Connections are made as shown in Figure 3-20.

The STOP key can operate in either of two ways:

- Press STOP key one time to brake or coast to stop (as set in the Level 1 Keypad Setup block, Keypad Stop Mode parameter).
- Press STOP key two times to disable control.

Figure 3-20 Keypad Control Connection Diagram



Notes:

1. Refer to Analog Outputs.
2. Refer to Opto Isolated Outputs.
3. Refer to Encoder Installation.
4. Refer to Buffered Encoder Outputs.

Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

J1-8 Optional, is active when Level 2 Protection block, Local Enable INP parameter is set to ON.
OPEN disables the control and motor coasts to a stop.
CLOSED allows current to flow in the motor and produce torque.

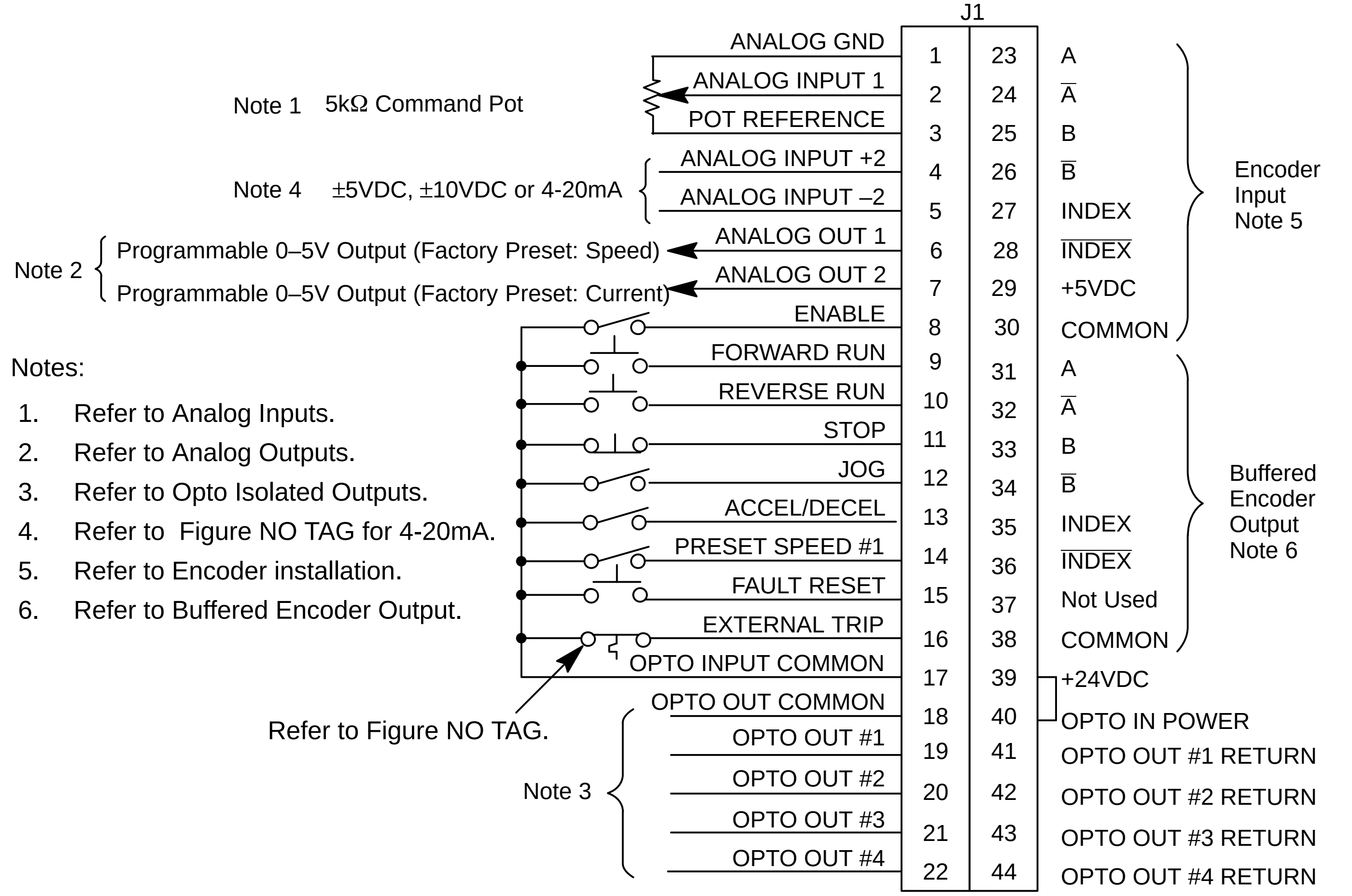
J1-16 OPEN causes an external trip to be received by control. The control will disable and display external trip when programmed “ON”. When this occurs, the motor stop command is issued, drive operation is terminated and an external trip fault is displayed on the keypad display (also logged into the fault log).
If J1-16 is connected, you must set Level 2 Protection block, External Trip to “ON”.

J1-39 & 40 Jumper as shown to power the Opto Inputs from the internal +24VDC supply.

Standard Run 3 Wire Mode Connections

In Standard Run mode, the control is operated by the opto Isolated inputs at J1-8 through J1-16 and the analog command input. The opto inputs can be switches as shown in Figure 3-21 or logic signals from another device.   The External Trip opto input at J1-16 is active if connected as shown and the Level 2 Protection block, External Trip parameter is set to ON.

Figure 3-21 Standard Run 3-Wire Connection Diagram



Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

J1-8	OPEN disables the control and motor coasts to a stop. CLOSED allows current to flow in the motor and produce torque.
J1-9	MOMENTARY CLOSED starts motor operation in the Forward direction. In JOG mode (J1-12 CLOSED), continuous CLOSED jogs motor in the Forward direction.
J1-10	MOMENTARY CLOSED starts motor operation in the Reverse direction. In JOG mode (J1-12 CLOSED), CONTINUOUS closed JOGS motor in the Reverse direction.
J1-11	MOMENTARY OPEN causes motor to decel to stop (depending on Keypad Stop Mode parameter setting). Motor current continues to be applied to the motor.
J1-12	CLOSED places control in JOG mode, Forward and Reverse run are used to jog the motor.
J1-13	OPEN selects ACC / DEC / S-CURVE group 1. CLOSED selects group 2.
J1-14	CLOSED selects preset speed #1, (J1-12, will override this preset speed). OPEN allows speed command from Analog input #1 or #2 or Jog.
J1-15	CLOSED to reset fault condition. OPEN to run.
J1-16	OPEN causes an external trip to be received by control. The control will disable and display external trip when programmed “ON”. When this occurs, the motor stop command is issued, drive operation is terminated and an external trip fault is displayed on the keypad display (also logged into the fault log). If J1-16 is connected, you must set Level 2 Protection block, External Trip to “ON”.

J1–39 & 40 Jumper as shown to power the Opto Inputs from the internal +24VDC supply.

15 Speed 2-Wire Mode Connections Switch Truth Table is defined in Table 3-12.

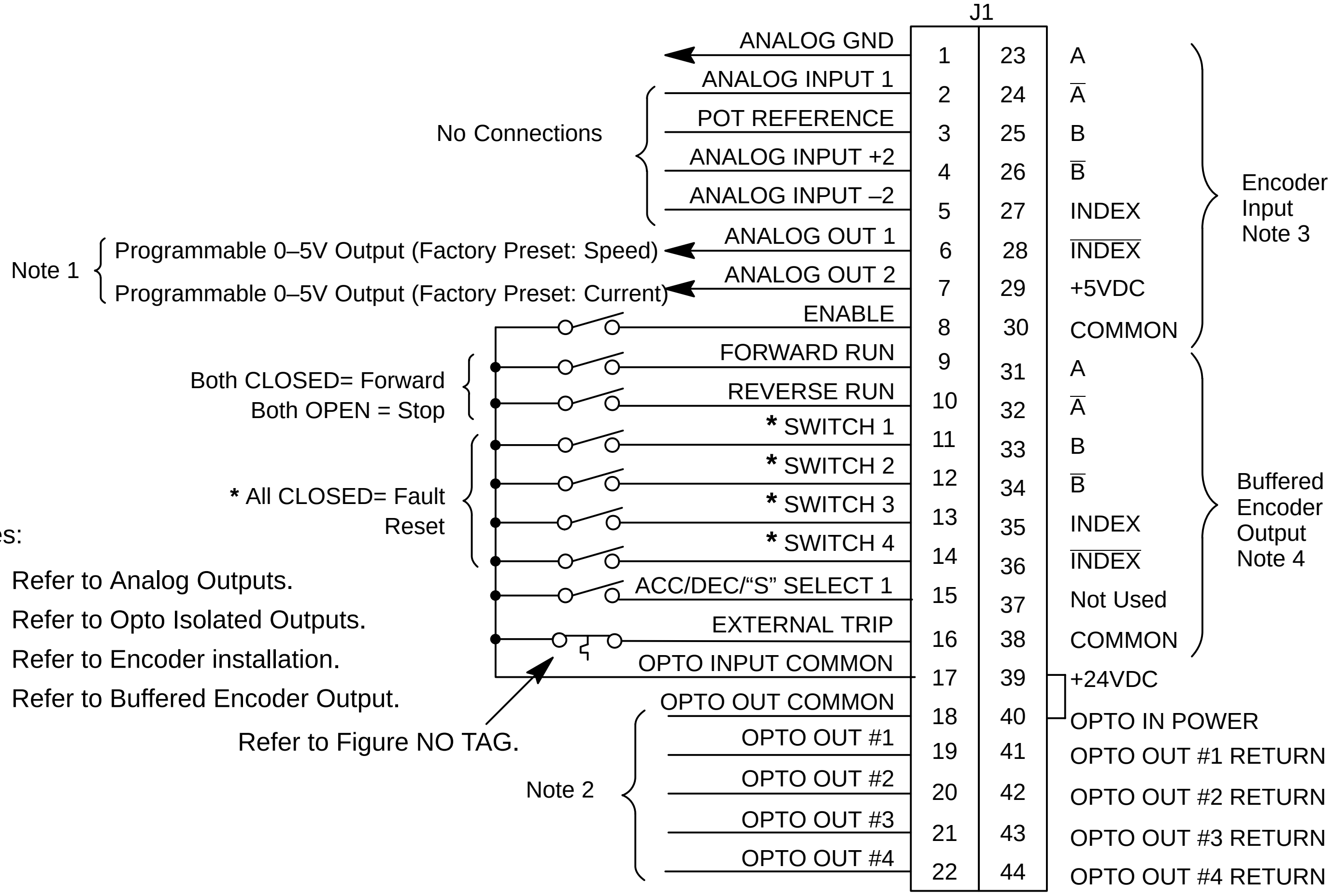
Operation in the 15 Speed 2-Wire mode is controlled by the Opto Isolated inputs at J1-8 through J1-16. The Opto inputs can be switches as shown in Figure 3-22 or logic signals from another device. The External Trip Opto Input at J1-16 is active if connected as shown and the Level 2 Protection block, External Trip parameter is set to ON.

Switched inputs at J1-11 through J1-14 allow selection of 15 preset speeds and provide Fault Reset as defined in Table 3-12.

Table 3-12 Switch Truth Table for 15 Speed, 2 Wire Control Mode

Function	J1-11	J1-12	J1-13	J1-14
Preset 1	Open	Open	Open	Open
Preset 2	Closed	Open	Open	Open
Preset 3	Open	Closed	Open	Open
Preset 4	Closed	Closed	Open	Open
Preset 5	Open	Open	Closed	Open
Preset 6	Closed	Open	Closed	Open
Preset 7	Open	Closed	Closed	Open
Preset 8	Closed	Closed	Closed	Open
Preset 9	Open	Open	Open	Closed
Preset 10	Closed	Open	Open	Closed
Preset 11	Open	Closed	Open	Closed
Preset 12	Closed	Closed	Open	Closed
Preset 13	Open	Open	Closed	Closed
Preset 14	Closed	Open	Closed	Closed
Preset 15	Open	Closed	Closed	Closed
Fault Reset	Closed	Closed	Closed	Closed

Figure 3-22 15 Speed 2-Wire Control Connection Diagram



Notes:

1. Refer to Analog Outputs.
2. Refer to Opto Isolated Outputs.
3. Refer to Encoder installation.
4. Refer to Buffered Encoder Output.

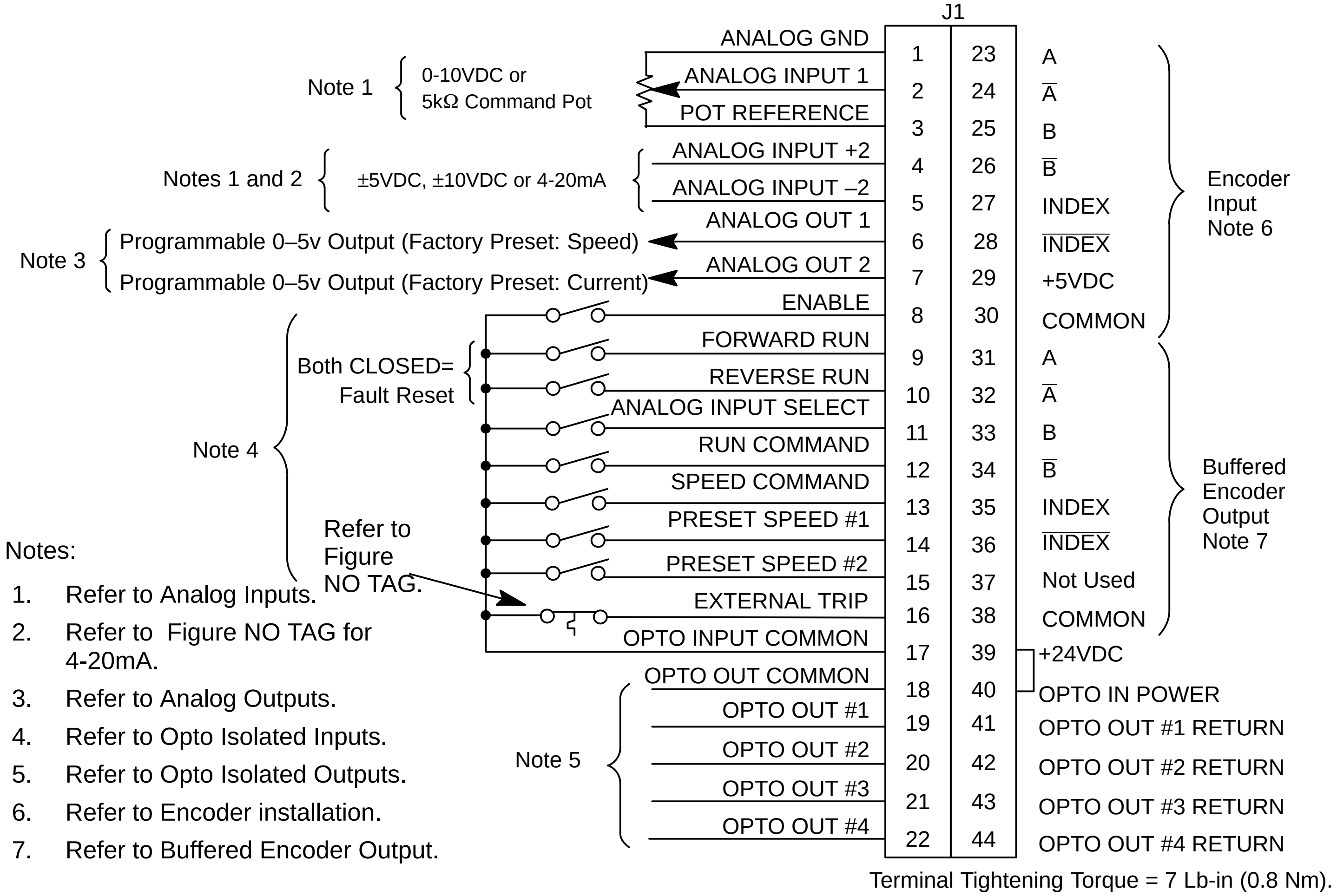
* Refer to truth table, Table 3-12.

Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

J1-8	OPEN disables the control & motor coasts to a stop. CLOSED allows current to flow in the motor and produce torque.
J1-9	CLOSED operates the motor in the Forward direction (with J1-10 open). OPEN motor decels to stop (depending on Keypad Stop mode parameter setting).
J1-10	CLOSED operates motor in the Reverse direction (with J1-9 open). OPEN motor decels to stop depending on Keypad Stop mode parameter setting.
J1-11 to J1-14	Selects programmed preset speeds as defined in Table 3-12.
J1-15	Selects ACC/DEC group. OPEN selects group 1. CLOSED selects group 2.
J1-16	OPEN causes an external trip to be received by control. The control will disable and display external trip when programmed "ON". When this occurs, the motor stop command is issued, drive operation is terminated and an external trip fault is displayed on the keypad display (also logged into the fault log). If J1-16 is connected, you must set Level 2 Protection block, External Trip to "ON".
J1-39 & 40	Jumper as shown to power the Opto Inputs from the internal +24VDC supply.

Fan Pump 2 Wire Control Mode

Figure 3-23 Fan Pump, 2 Wire Control Connection Diagram



J1-8 OPEN disables the control and motor coasts to a stop.
CLOSED allows current to flow in the motor.

J1-9 CLOSED starts motor operation in the Forward direction.
OPEN initiates Stop command.

J1-10 CLOSED starts motor operation in the Reverse direction.
OPEN initiates Stop command.

J1-11 OPEN selects setting of “Command Select” parameter. Closed selects Analog Input #1.

Note: If Command Select (Level 1 Input block) is set to Potentiometer, then Analog Input #1 is always selected regardless of this switch position.

J1-12 Run Command. OPEN selects STOP/START and Reset commands from Keypad.
CLOSED selects STOP/START and Reset commands from terminal strip.

J1-13 Speed Command. OPEN selects speed commanded from Keypad.
CLOSED selects terminal strip speed source (selected in the Level 1 Input block, Command Select parameter).

Note: When changing from Keypad to Terminal Strip (J1-12 or J1-13) the motor speed and direction will remain the same after the change.

J1-14 OPEN selects preset speed #1 regardless of the Speed Command input J1-13. (FIRESTAT).

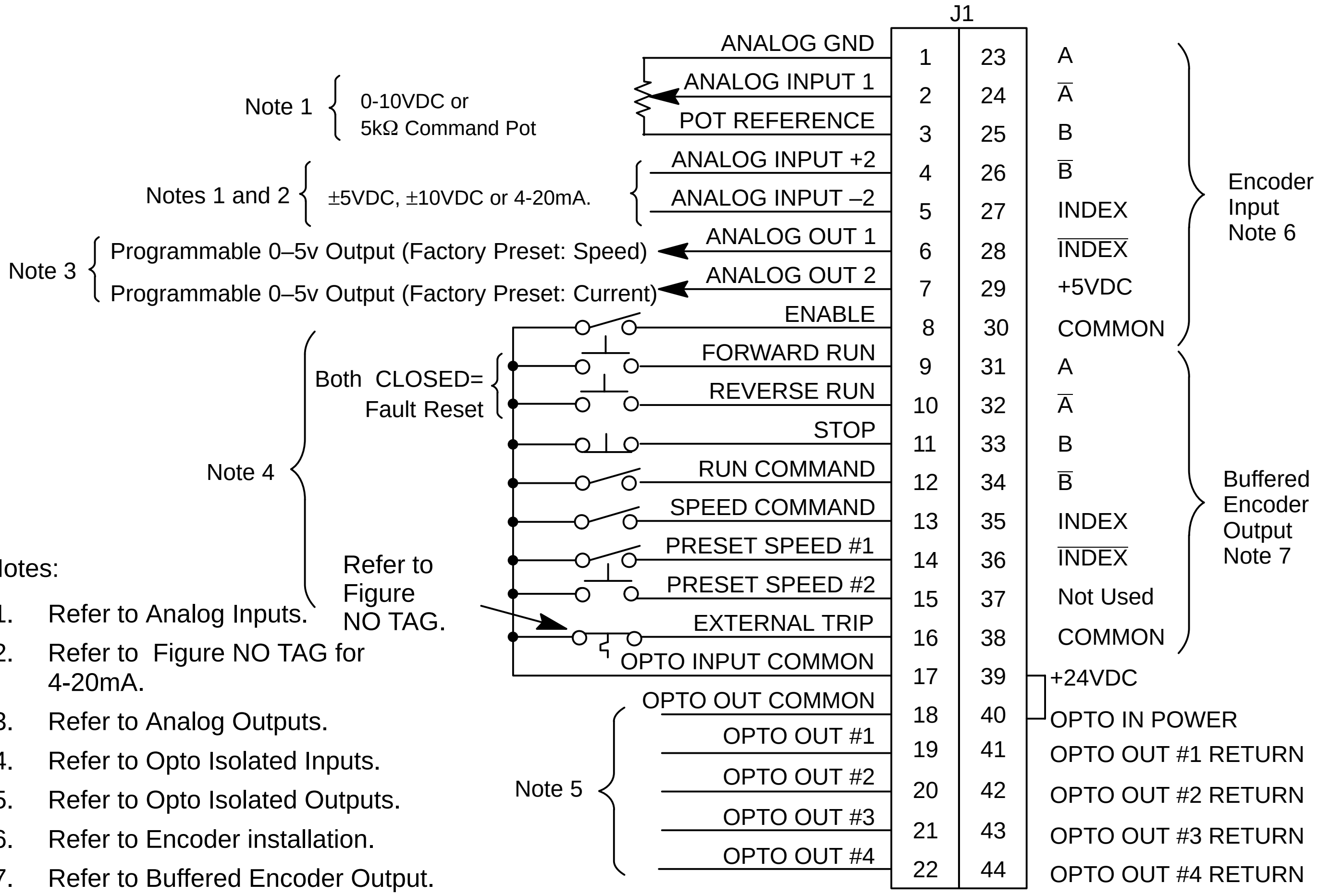
J1-15 OPEN selects preset speed #2 regardless of the Speed Command input J1-13. (FREEZESTAT).

Note: If J1-14 and J1-15 are both Open, Preset Speed #1 is selected.

J1-16 OPEN causes an external trip to be received by control. The control will disable and display external trip when programmed “ON”. When this occurs, the drive is disabled and an external trip fault is displayed on the keypad display (also logged into the fault log). If J1-16 is connected, you must set Level 2 Protection block, External Trip to “ON”.

Fan Pump 3 Wire Control Mode

Figure 3-24 Fan Pump, 3 Wire Control Connection Diagram



Notes:

1. Refer to Analog Inputs.
2. Refer to Figure NO TAG for 4-20mA.
3. Refer to Analog Outputs.
4. Refer to Opto Isolated Inputs.
5. Refer to Opto Isolated Outputs.
6. Refer to Encoder installation.
7. Refer to Buffered Encoder Output.

Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

J1-8	OPEN disables the control and motor coasts to a stop. CLOSED allows current to flow in the motor.
J1-9	MOMENTARY CLOSED starts motor operation in the Forward direction.
J1-10	MOMENTARY CLOSED starts motor operation in the Reverse direction.
J1-11	When OPEN motor Decels to stop.
J1-12	Run Command. OPEN selects STOP/START and Reset commands from Keypad. CLOSED selects STOP/START and Reset commands from terminal strip.
J1-13	Speed Command. OPEN selects speed commanded from Keypad. CLOSED selects terminal strip speed source (selected in the Level 1 Input block, Command Select parameter).

Note: When changing from Keypad to Terminal Strip (J1-12 or J1-13) the motor speed and direction will remain the same after the change.

J1-14	OPEN selects preset speed #1 regardless of the Speed Command input J1-13. (FIRESTAT)
J1-15	OPEN selects preset speed #2 regardless of the Speed Command input J1-13. (FREEZESTAT)

Note: If J1-14 and J1-15 are both Open, Preset Speed #1 is selected.

J1-16	OPEN causes an external trip to be received by control. The control will disable and display external trip when programmed “ON”. When this occurs, the drive is disabled and an external trip fault is displayed on the keypad display (also logged into the fault log). If J1-16 is connected, you must set Level 2 Protection block, External Trip to “ON”.

Bipolar Speed and Torque Mode Connections

In addition to individual motor bipolar speed or torque control, this mode of operation allows the user to store up to four (4) different complete sets of operating parameters. This is important if you wish to store and use different acceleration rates, speed commands, jog speeds or to store tuning parameter values for different motors etc. Table 3-13 shows switch settings required to access each parameter table. The following procedure allows you to program up to four complete sets of parameter values and to use these multiple parameter sets. When programming each parameter set, use the ENTER key to accept and automatically save parameter values.

Note: Except for the Level 1 Operating Mode parameter, the control can be programmed in the REMOTE mode with the drive enabled and switches closed. The control must be disabled to change the operating mode parameter.

1. Set the Level 1 INPUT block, Operating Mode parameter value to BIPOLAR in each of the parameter sets.
2. Set switches J1-13 and J1-14 to Parameter Table #0 (both switches open). Be sure switches J1-9 and J1-10 are OPEN, J1-8 is CLOSED. Enter all parameter values, and autotune as instructed in Section 3 of this manual. This creates and saves the first parameter set which is numbered Table#0.
3. Set switches J1-13 and J1-14 to Parameter Table #1. Be sure switches J1-9 and J1-10 are OPEN, J1-8 is CLOSED. Enter all parameter values, and autotune as instructed in Section 3 of this manual. This creates and saves the second parameter set which is numbered Table#1.
4. Set switches J1-13 and J1-14 to Parameter Table #2. Be sure switches J1-9 and J1-10 are OPEN, J1-8 is CLOSED. Enter all parameter values, and autotune as instructed in Section 3 of this manual. This creates and saves the third parameter set which is numbered Table#2.
5. Set switches J1-13 and J1-14 to Parameter Table #3. Be sure switches J1-9 and J1-10 are OPEN, J1-8 is CLOSED. Enter all parameter values, and autotune as instructed in Section 3 of this manual. This creates and saves the final parameter set which is numbered Table#3.
6. Remember that to change the value of a parameter in one of the parameter tables, you must first select the table using the switches. You cannot change a value in a table until you have first selected that table.

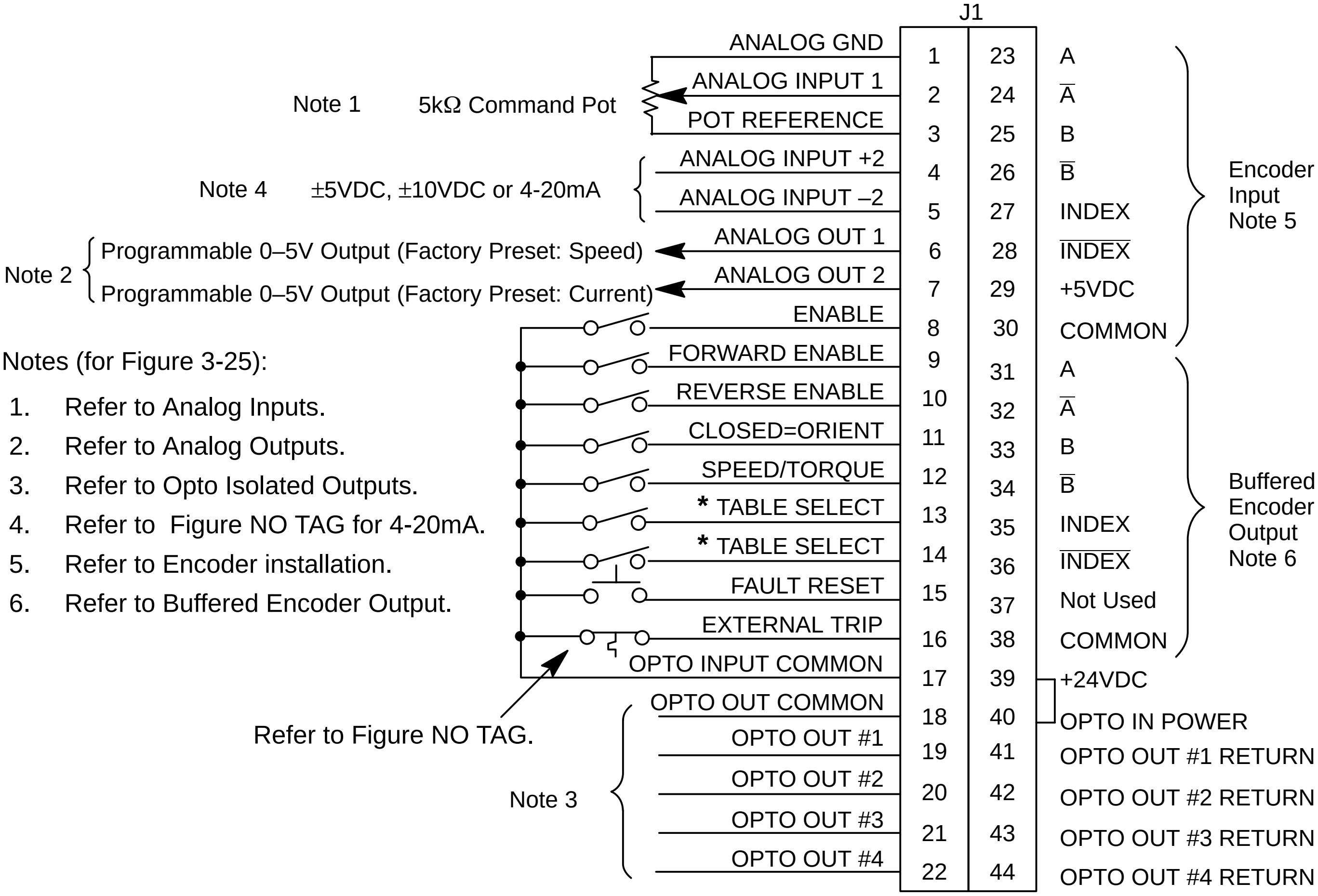
Table 3-13 Bipolar Mode Table Select Truth Table

Function	J1-13	J1-14
Parameter Table #0	Open	Open
Parameter Table #1	Closed	Open
Parameter Table #2	Open	Closed
Parameter Table #3	Closed	Closed

Note: All parameters except operating mode can be changed and saved for each table.

Note: Preset speed does not apply to table select.

Figure 3-25 Bipolar Speed or Torque Connection Diagram



Notes (for Figure 3-25):

1. Refer to Analog Inputs.
2. Refer to Analog Outputs.
3. Refer to Opto Isolated Outputs.
4. Refer to Figure NO TAG for 4-20mA.
5. Refer to Encoder installation.
6. Refer to Buffered Encoder Output.

* See Table 3-13.

Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

J1-8	OPEN disables the control & motor coasts to a stop. CLOSED allows current to flow in the motor and produce torque.
J1-9	CLOSED to enable operation in the Forward direction. OPEN TO DISABLE Forward operation (drive will brake to a stop if a Forward command is still present).
J1-10	CLOSED to enable operation in the Reverse direction. OPEN to disable Reverse operation (drive will brake to a stop if a Reverse command is still present).
J1-11	Causes the motor shaft to orient to a marker or external switch.
J1-12	CLOSED puts the control in torque mode. OPEN puts the control in velocity mode.
J1-13 & J1-14	Select from four parameter tables as defined in Table 3-13.
J1-15	Momentary CLOSED to reset fault condition. OPEN to run,
J1-16	OPEN causes an external trip to be received by control. The control will disable and display external trip when programmed “ON”. When this occurs, the motor stop command is issued, drive operation is terminated and an external trip fault is displayed on the keypad display (also logged into the fault log). If J1-16 is connected, you must set Level 2 Protection block, External Trip to “ON”.
J1-39 & 40	Jumper as shown to power the Opto Inputs from the internal +24VDC supply.

Process Mode Connections

The process control mode provides an auxiliary closed loop general purpose PID set point control that is shown in Figure 3-26. The process control loop may be configured in either of two ways.

1. Using two (2) inputs; a set point and a process feedback input. The error signal (between the setpoint and the feedback signals) adjusts the speed or torque of the motor to eliminate error.
2. Using three (3) inputs; a setpoint, process feedback and feedforward inputs. Instead of waiting for an error signal to develop between the setpoint and the process feedback signals, the feedforward signal adjusts the speed or torque of the motor to reduce the amount of error that will develop between the feedback and setpoint inputs.

The objective of either method is to force the process feedback to be as close to the setpoint as possible and eliminate process error. Table 3-14 shows a matrix of Process Mode Input Signal Compatibility for the Setpoint Source, Process Feedback and Feedforward signals. Be sure to use this information to select the signal types and expansion boards for your application.

Two Input Configuration
For 2 input operation, several parameters must be set as follows:

1. Level 2 Process Control block, "Process Feedback" parameter must be set to the type of feedback signal used. The process feedback signal can be any Analog input available at the J1 terminal strip or expansion board. Selections are shown in Figure 3-26.
2. Level 2 Process Control block, "Setpoint Source" parameter must be set to the type of set point being used.
   - A. A fixed value setpoint is a keypad programmed parameter value. To program a fixed setpoint, do the following:
     - i. Set the Level 2 Process Control block, "Setpoint Source" parameter to Setpoint CMD.
     - ii. Set the Level 2 Process Control block, "Setpoint CMD" parameter to a value between –100% to +100% of the process feedback input.
   - B. If a variable value setpoint is used, the Setpoint Source must be set to any available terminal strip or expansion board input not being used for the process feedback input. Selections are shown in Figure 3-26.
3. Level 1 Input block "Command Select" parameter must be set to "None".

Three Input Configuration
For 3 input operation, several parameters must be set as follows:

1. Level 2 Process Control block "Process Feedback" parameter must be set to the type of feedback signal used. The process feedback signal can be any Analog input available at the J1 terminal strip or expansion board. Selections are shown in Figure 3-26.
2. Level 2 Process Control block "Setpoint Source" parameter must be set to the type of set point being used.
   - A. If a fixed value setpoint is used, set the Level 2 Process Control block, Setpoint Source parameter to "Setpoint CMD". Set the Level 2 Process Control block "Setpoint Command" parameter to a value between –100% to +100% of the process feedback.
   - B. If a variable value setpoint is used, set the Level 2 Process Control block, Setpoint Source parameter to any Analog1, Analog2 or expansion board input not being used for the process feedback input. Selections are shown in Figure 3-26.

3. Level 1 Input block "Command Select" parameter must be set to the feedforward signal type. This signal may be any Analog1, Analog2 or expansion board input not being used for the process feedback or setpoint source inputs. Selections are shown in Figure 3-26.

Note: An input can only be used one time for Process Feedback, **OR** Setpoint Source, **OR** Feedforward.

Figure 3-26 Simplified Process Control Block Diagram

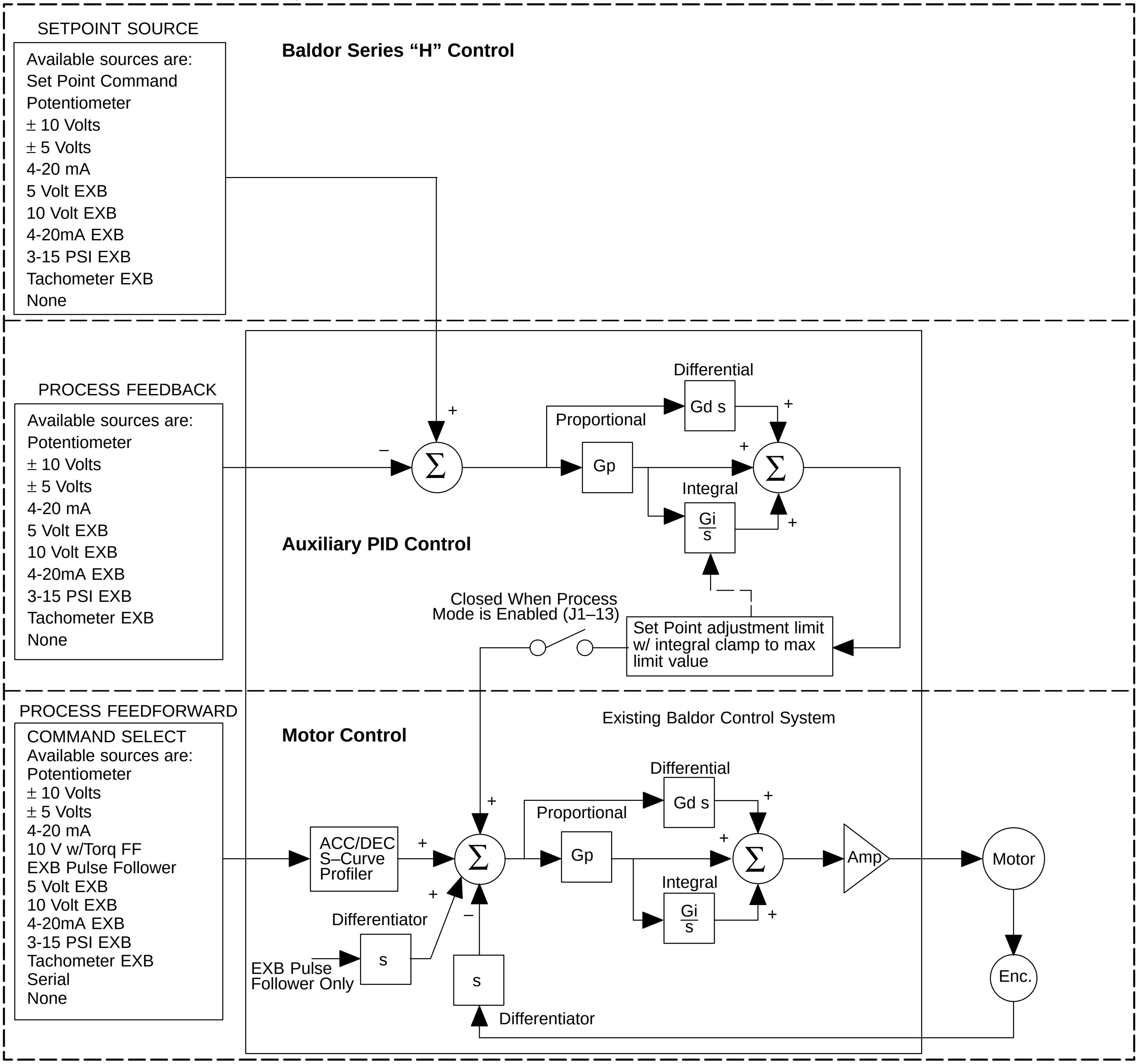


Table 3-14 Process Mode Input Signal Compatibility

Setpoint or Feedforward	Feedback						
	J1-1 & 2	J1-4 & 5	5V EXB [1]	10V EXB [1]	4-20mA EXB [1]	3-15 PSI EXB [2]	DC Tach EXB [3]
J1-1 & 2	■						
J1-4 & 5		■					
5V EXB [1]			■	■	■	▥	
10V EXB [1]			■	■	■	▥	
4-20mA EXB [1]			■	■	■	▥	
3-15 PSI EXB [2]			▥	▥	▥	■	
DC Tach EXB [3]						▥	■
EXB PULSE FOL [4] [1] [5]						▥	
Serial [5] [1] [6]			▥	▥	▥	▥	

[1] Requires expansion board EXB007A01 (High Resolution Analog I/O EXB).

[2] Requires expansion board EXB004A01 (4 Output Relays/3-15 PSI Pneumatic Interface EXB).

[3] Requires expansion board EXB006A01 (DC Tachometer Interface EXB).

[4] Requires expansion board EXB005A01 (Master Pulse Reference/Isolated Pulse Follower EXB).

[5] Used for Feedforward only. Must not be used for Setpoint Source or Feedback.

[6] Requires expansion board EXB001A01 (RS232 Serial Communication EXB). or
Requires expansion board EXB002A01 (RS422/RS485 High Speed Serial Communication EXB).

■ Conflicting inputs. Do not use same input signal multiple times.

▥ Conflicting level 1 or 2 expansion boards. Do not use!

Specific Process Mode Outputs

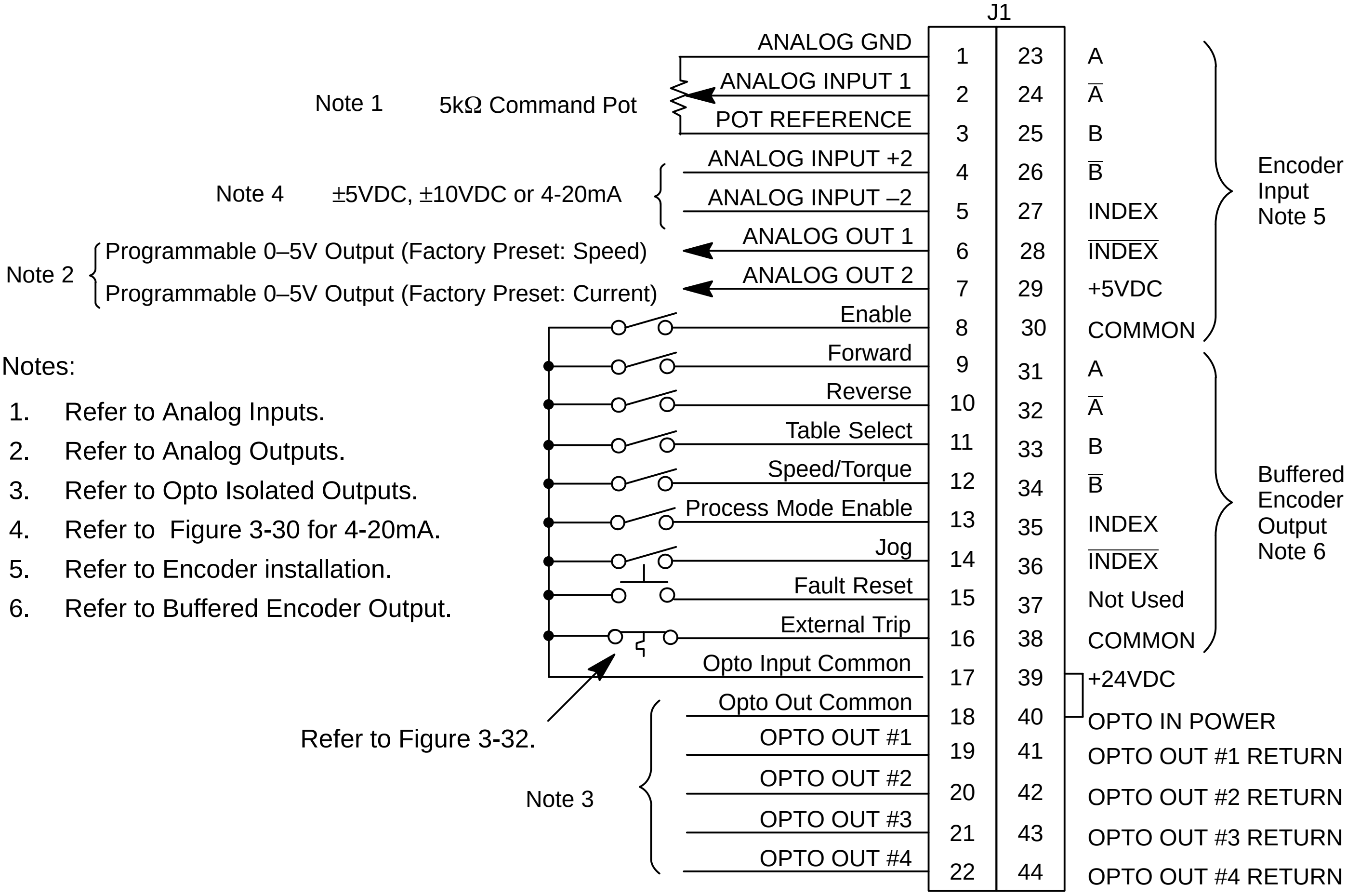
Process Mode Only, Analog Monitoring Outputs

Name	Description
Process FDBK	Process Feedback scaled input. Useful for observing or tuning the process control loop.
Setpoint CMD	Setpoint Command scaled input. Useful for observing or tuning the process control loop.
Speed Command	Commanded Motor Speed. Useful for observing or tuning the output of the control loop.

Process Mode Only, Opto Isolated Outputs

Name	Description
Process Error	CLOSED when the Process Feedback is within the specified tolerance band. OPEN when the Process Feedback is greater than the specified tolerance band. The width of the tolerance band is adjusted by the Level 2 Process Control block Process ERR TOL parameter value.

Figure 3-27 Process Mode Connection Diagram



Notes:

1. Refer to Analog Inputs.
2. Refer to Analog Outputs.
3. Refer to Opto Isolated Outputs.
4. Refer to Figure 3-30 for 4-20mA.
5. Refer to Encoder installation.
6. Refer to Buffered Encoder Output.

Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

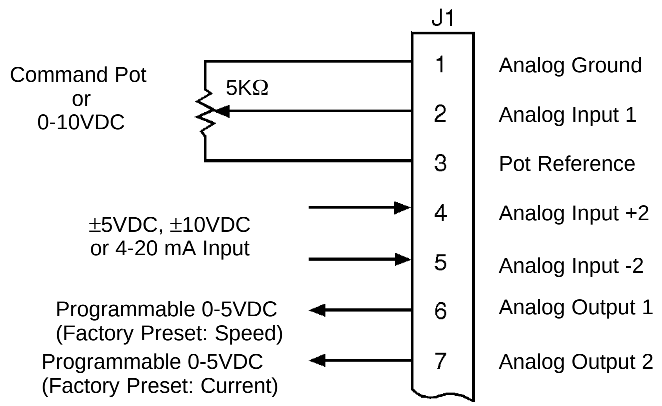
J1-8	OPEN disables the control & motor coasts to a stop. Closed allows current to flow in the motor and produce torque.
J1-9	CLOSED operates the motor in the Forward direction (with J1-10 open). OPEN motor decels to stop (depending on Keypad Stop mode parameter setting).
J1-10	CLOSED operates motor in the Reverse direction (with J1-9 open). OPEN motor decels to stop depending on Keypad Stop mode parameter setting.
J1-11	OPEN = TABLE 0, CLOSED = TABLE 1
J1-12	CLOSED, the control is in torque mode. OPEN, the control is in velocity mode.
J1-13	CLOSED to enable the Process Mode.
J1-14	CLOSED places control in JOG mode. The control will only JOG in the forward direction.
J1-15	CLOSED to reset a fault condition. OPEN to run.
J1-16	OPEN causes an external trip to be received by control. The control will disable and display external trip when programmed “ON”. When this occurs, the motor stop command is issued, drive operation is terminated and an external trip fault is displayed on the keypad display (also logged into the fault log). If J1-16 is connected, you must set Level 2 Protection block, External Trip to “ON”.
J1-39 & 40	Jumper as shown to power the Opto Inputs from the internal +24VDC supply.

Analog Inputs and Outputs

Analog Inputs

Two analog inputs are available: analog input #1 (J1-1 and J1-2) and analog input #2 (J1-4 and J1-5) as shown in Figure 3-28. Either analog input #1 or #2 may be grounded provided the common mode range is not exceeded. Either analog input may be selected in the Level 1 INPUT block, Command Select parameter value. Analog input #1 is selected if parameter value "Potentiometer" is selected. Analog input #2 is selected if parameter value "+/–10Volts, +/–5 Volts or 4-20mA" is selected. Figure 3-29 shows the equivalent circuits of the Analog Inputs.

Figure 3-28 Analog Inputs and Outputs



Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

Analog Input #1

The single ended analog input #1 is used when the controller is set to Standard 3 Wire, Fan Pump 2 or 3 Wire, Process, or Bipolar Control (not Keypad or 15 Speed 2 Wire modes). When using a potentiometer as the speed command, process feedback or setpoint source, the Level 1 Input block COMMAND SELECT parameter must be set to "POTENTIOMETER".

1. Connect the wires from the 5KΩ pot as shown in Figure 3-28. One end of the pot is connected to J1-1 (analog ground) and the other end is connected to J1-3 (reference voltage).
2. Connect the wiper of the pot to J1-2. The voltage across terminals J1-1 and J1-2 is the speed command input.
3. A 0-10VDC speed command signal may be connected across J1-1 and J1-2 instead of a 5KΩ pot.

Analog Input #2

Analog input #2 accepts a differential command ±5VDC, ±10VDC or 4-20 mA. The operating mode is defined in the of the Level 1 Input block OPERATING MODE parameter.

Note: Analog Input #2 is used with Standard Run 3-Wire, Fan Pump 2 or 3 Wire or Bipolar Control modes and not used for the Keypad or 15 Speed 2 Wire or the Serial operating modes.

1. Connect the Analog Input +2 wire to J1-4 and the –2 wire to J1-5.
2. If using a 4-20 mA command signal, jumper JP1 located on the main control board must be on pins 2 & 3. For all other modes, JP1 must be on pins 1 & 2. Refer to Figure NO TAG for jumper position information.

Note: Analog Input #2 can be connected for single ended operation by grounding either of the inputs, provided the common mode voltage range is not exceeded. The common mode voltage can be measured with a voltmeter. Apply the maximum command voltage to analog input 2 (J1A-4, 5). Measure the AC and DC voltage across J1A-1 to J1A-4. Add the AC and DC readings together. Measure the AC and DC voltage from J1A-1 to J1A-5. Add the AC and DC readings together.

If either of these measurement totals exceeds a total of ±15 volts, then the common mode voltage range has been exceeded. If the common mode voltage range has been exceeded, the solution is either to change the command voltage source or isolate the command voltage with a commercially available signal isolator.

Figure 3-29 Analog Inputs Equivalent Circuits

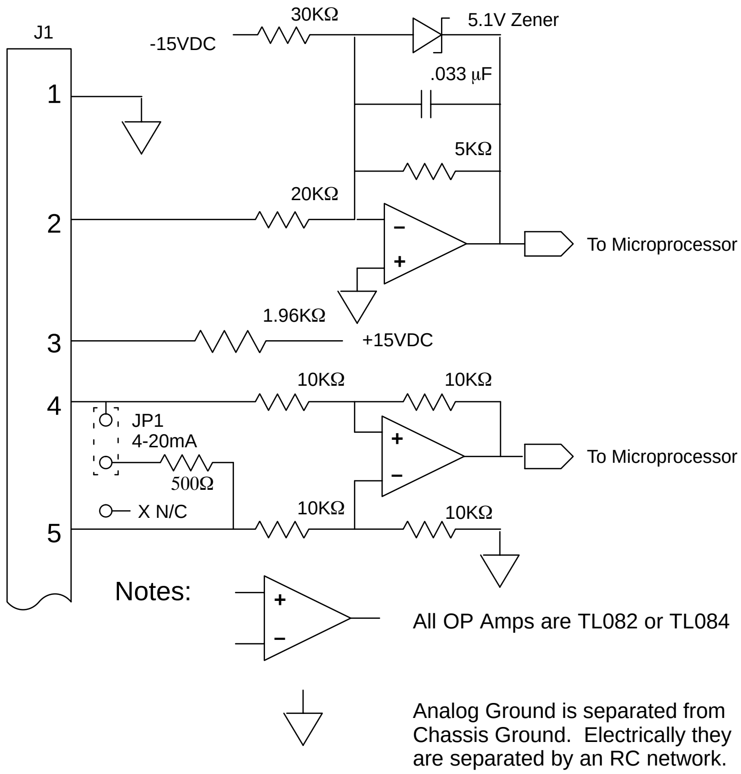
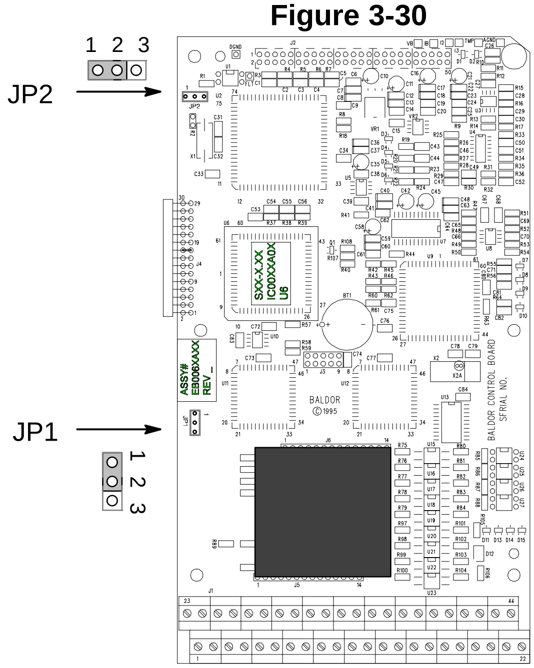


Figure 3-30



Refer to Table 3-15 for jumper placement information.

Table 3-15 Control Board Jumper

Jumper	Jumper Position	Description of Jumper Position Setting
JP1	1–2	Voltage Speed Command Signal. (Factory Setting)
	2–3	4-20mA input at Analog #2
JP2	1–2	Factory Setting
	2–3	Not used.

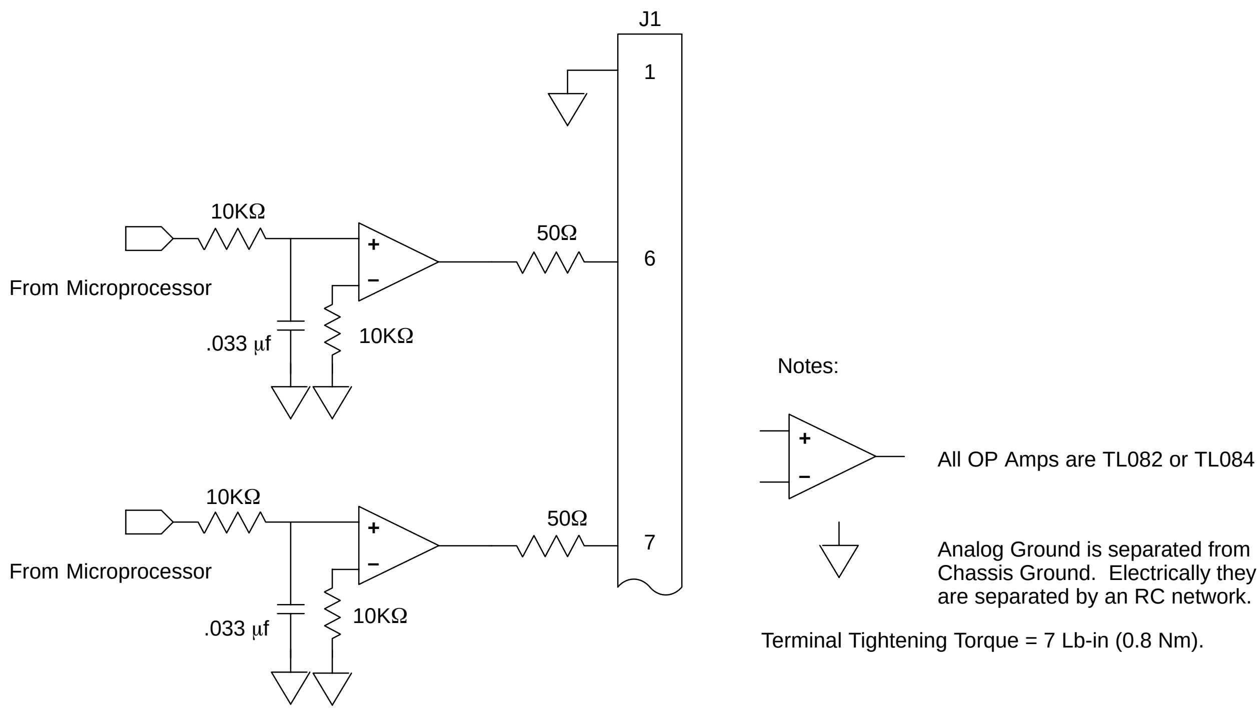
Analog Outputs

Two programmable analog outputs are provided on J1-6 and J1-7. See Figure 3-31. These outputs are scaled 0 - 5 VDC (1mA maximum output current) and can be used to provide real-time status of various control conditions. The output conditions are defined in Table NO TAG of Section 4 of this manual.

The return for these outputs is J1-1 analog ground. Each output is programmed in the Level 1 Output block.

1. Connect the Output #1 wires to J1-6 and J1-1.
2. Connect the Output #2 wires to J1-7 and J1-1.

Figure 3-31 Analog Outputs Equivalent Circuits



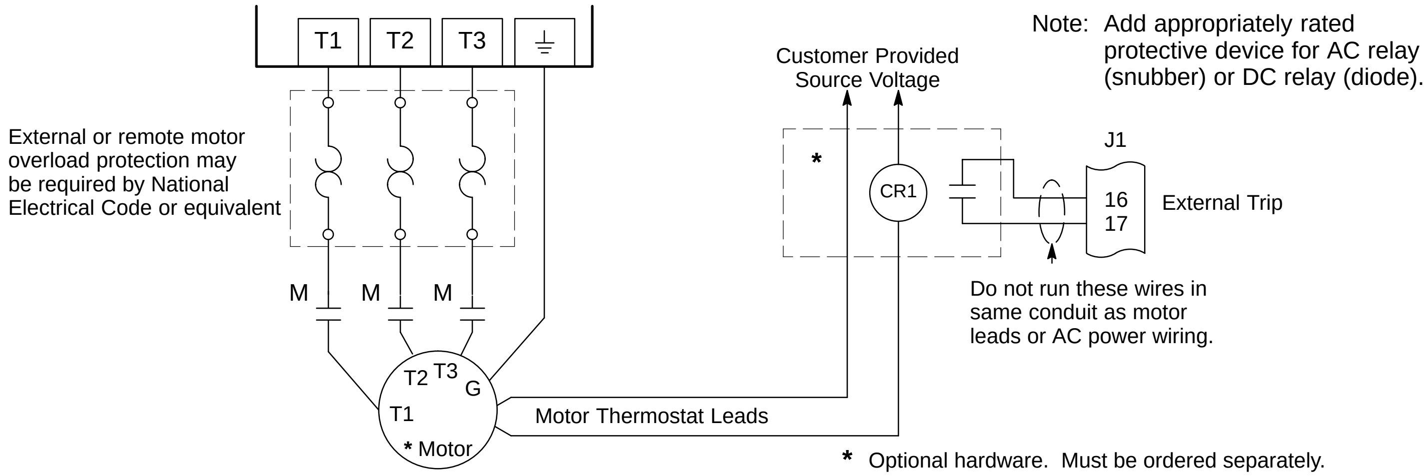
External Trip Input

Terminal J1-16 is available for connection to a normally closed thermostat or overload relay in all operating modes as shown in Figure 3-32. The thermostat or overload relay should be a dry contact type with no power available from the contact. If the motor thermostat or overload relay activates the control will automatically shut down and give an External Trip fault. The optional relay (CR1) shown provides the isolation required and the N.O. contact is closed when power is applied to the relay and the motor is cold.

Connect the External Trip Input wires to J1-16 and J1-17. Do not place these wires in the same conduit as the motor power leads.

To activate the External Trip input, the External Trip parameter in the Level 2 Protection Block must be set to "ON".

Figure 3-32 Motor Temperature Relay



Opto-Isolated Inputs

The equivalent circuit for the nine Opto inputs is shown in Figure 3-33. The function of each input depends on the operating mode selected. Refer to the operating mode connection diagrams shown previously in this section.

Figure 3-33 Opto-Input Equivalent Circuit (Using Internal Supply)

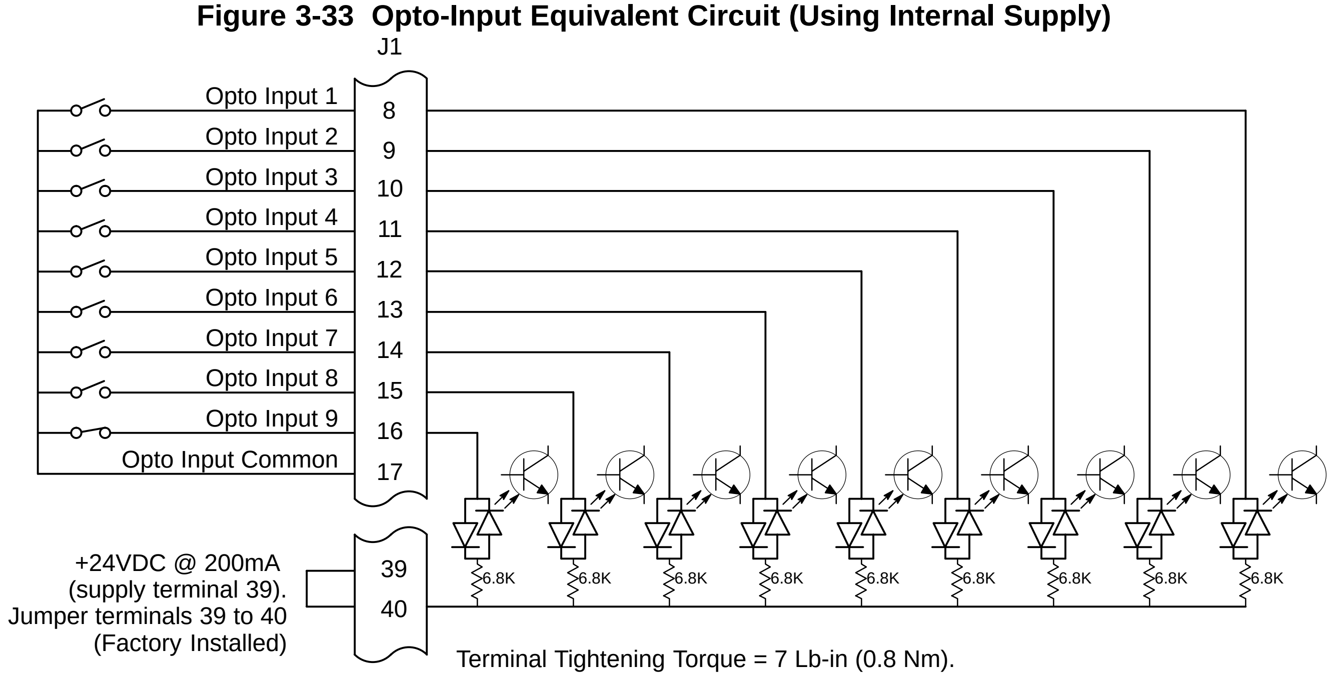
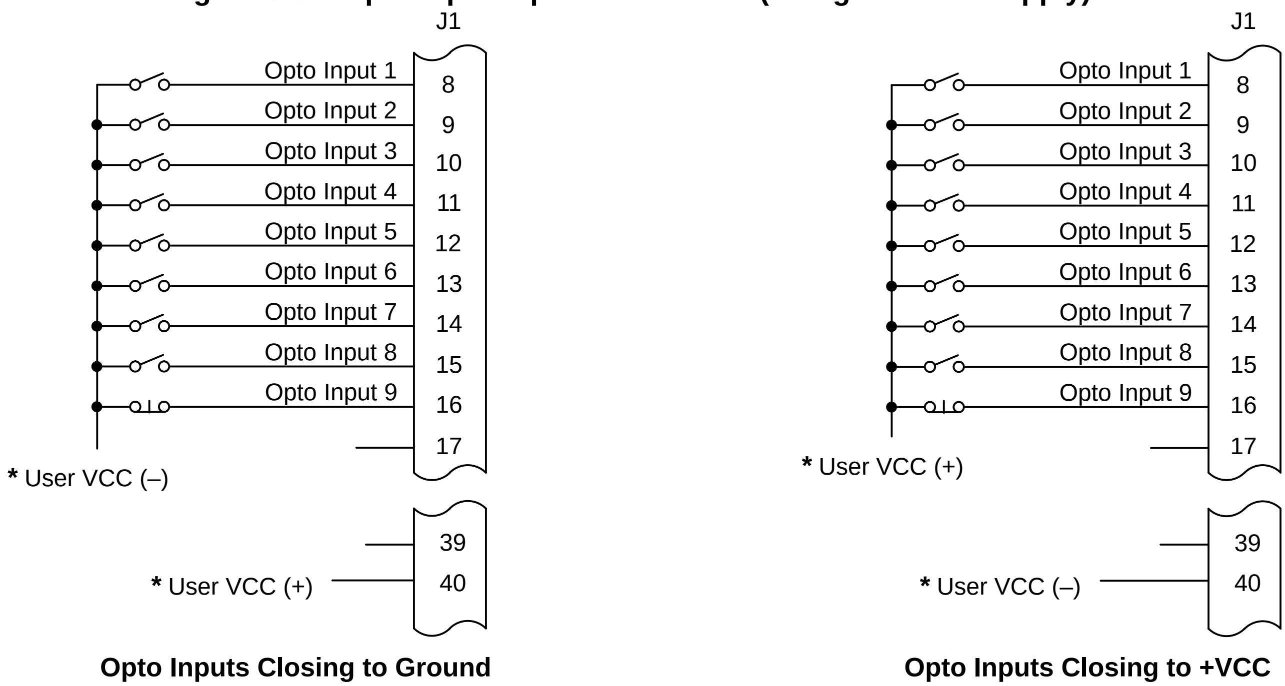


Figure 3-34 Opto-Input Equivalent Circuit (Using External Supply)



* User VCC = 10 - 30VDC
External Power Source

Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

Opto-Isolated Outputs

Four programmable Opto-isolated outputs are available at terminals J1-19 through J1-22. See Figure 3-35. Each output may be programmed to represent one output condition. The output conditions are defined in Table NO TAG of Section 4 of this manual.

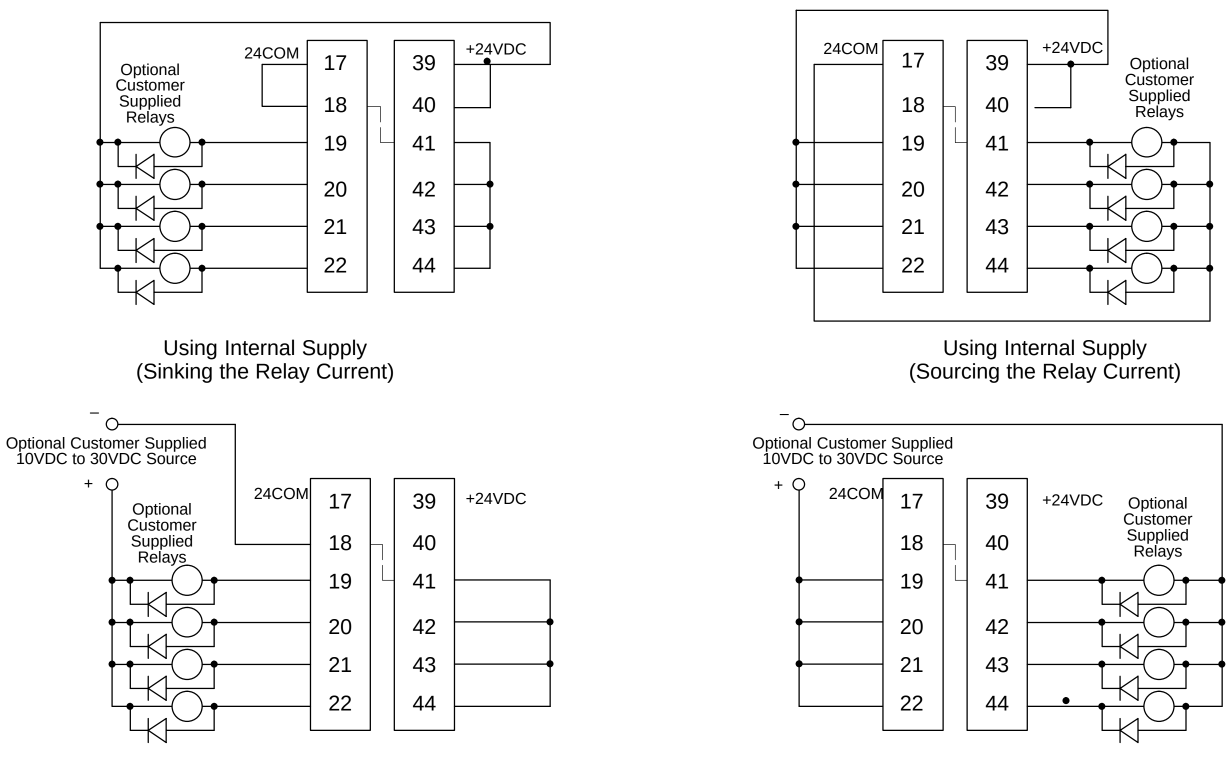
The Opto-isolated outputs may be configured for sinking or sourcing 60 mA each. However, all must be configured the same. The maximum voltage from opto output to common when active is 1.0 VDC (TTL compatible). The Opto-isolated outputs may be connected in different ways as shown in Figure 3-35. The equivalent circuit for the Opto-isolated outputs is shown in Figure 3-36.

If the opto outputs are used to directly drive a relay, a flyback diode rated at 1A, 100 V (IN4002) minimum should be connected across the relay coil. See Electrical Noise Considerations in Section 5 of this manual.

1. Connect OPTO OUT #1 wires to J1-19 and J1-41.
2. Connect OPTO OUT #2 wires to J1-20 and J1-42.
3. Connect OPTO OUT #3 wires to J1-21 and J1-43.
4. Connect OPTO OUT #4 wires to J1-22 and J1-44.

Each Opto Output is programmed in the Output programming block.

Figure 3-35 Opto-isolated Output Configurations



Using Internal Supply (Sinking the Relay Current)

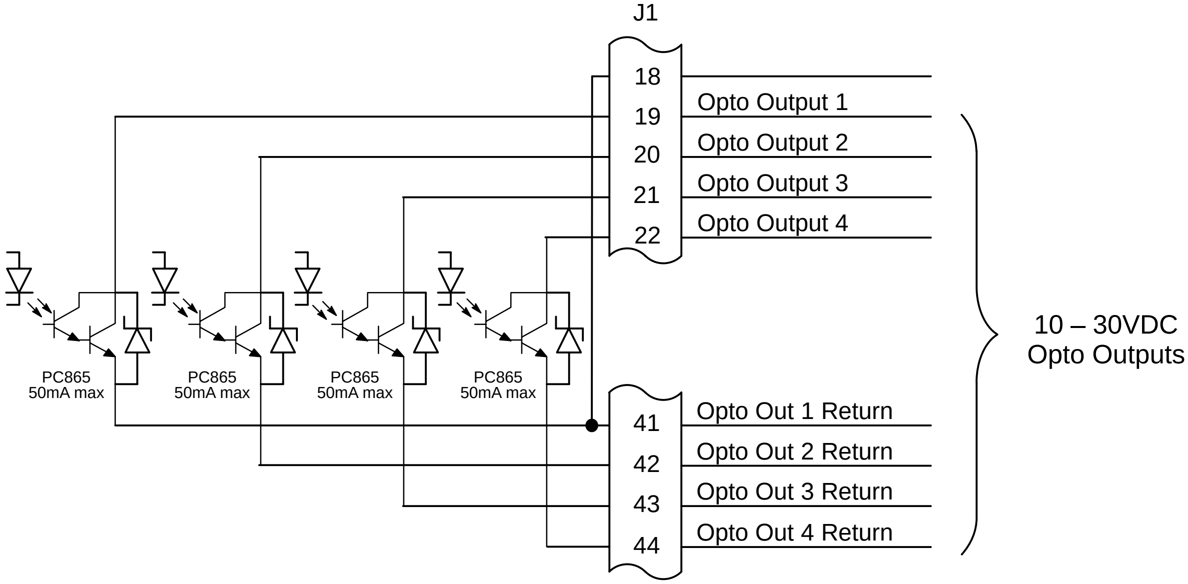
Using Internal Supply (Sourcing the Relay Current)

Using External Supply (Sinking the Relay Current)

Using External Supply (Sourcing the Relay Current)

Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

Figure 3-36 Opto-Output Equivalent Circuit



Terminal Tightening Torque = 7 Lb-in (0.8 Nm).

Pre-Operation Checklist

Check of Electrical Items

⚠ **CAUTION: After completing the installation but before you apply power, be sure to check the following items.**

1. Verify AC line voltage at source matches control rating.
2. Inspect all power connections for accuracy, workmanship and tightness and compliance to codes.
3. Verify control and motor are grounded to each other and the control is connected to earth ground.
4. Check all signal wiring for accuracy.
5. Be certain all brake coils, contactors and relay coils have noise suppression. This should be an R-C filter for AC coils and reverse polarity diodes for DC coils. MOV type transient suppression is not adequate.

⚠ **WARNING: Make sure that unexpected operation of the motor shaft during start up will not cause injury to personnel or damage to equipment.**

Check of Motors and Couplings

1. Verify freedom of motion for all motor shafts and that all motor couplings are tight without backlash.
2. Verify the holding brakes if any, are properly adjusted to fully release and set to the desired torque value.

Power-Up Procedure

This procedure will help get your system up and running in the keypad mode quickly. This will allow you to prove the motor and control operation. This procedure assumes that the Control, Motor and Dynamic Brake hardware are correctly installed (see Section 3 for procedures) and that you have an understanding of the keypad programming & operation procedures. It is not necessary to wire the terminal strip to operate the motor in Keypad mode.

Initial Conditions

Be sure the Control, Motor and Dynamic Brake hardware are wired according to the procedures described previously in this manual. Become familiar with the keypad programming and keypad operation of the control as described in Section 4 of this manual.

1. Verify that any enable inputs to J1-8 are open.
2. Turn power on. Be sure there are no faults.
3. Set the Level 1 Input block, Operating Mode to “KEYPAD”.
4. Be sure the Level 2 Protection block, Local Enable INP parameter is OFF and the Level 2 Protection block, External Trip parameter is OFF.
5. Set the Level 2 Output Limits block, “OPERATING ZONE” parameter as desired (STD CONST TQ, STD VAR TQ, QUIET CONST TQ or QUIET VAR TQ).
6. Enter the following motor data in the Level 2 Motor Data block parameters:
   Motor Voltage (input)
   Motor Rated Amps (FLA)
   Motor Rated Speed (base speed)
   Motor Rated Frequency
   Motor Mag Amps (no load current)
   Encoder Counts
7. Go to Level 2 Motor Data block, press ENTER, at CALC PRESETS select YES (using the ▲ key) and let the control calculate preset values for the parameters that are necessary for control operation.
8. Disconnect the motor from the load (including coupling or inertia wheels). If the load cannot be disconnected, refer to Section 6 and manually tune the control. After manual tuning, perform steps 10, 11, 15, 16 and 17.

⚠ **WARNING: The motor shaft will rotate during this procedure. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment.**

9. Go to Level 2 Autotune block, and do the following tests:
   CMD OFFSET TRIM
   CUR LOOP COMP
   STATOR R1
   FLUX CUR SETTING
   ENCODER TESTS
   SLIP FREQ TEST
10. Set the Level 2 Output Limits block, “MIN OUTPUT SPEED” parameter.
11. Set the Level 2 Output Limits block, “MAX OUTPUT SPEED” parameter.
12. Remove all power from the control.
13. Couple the motor to its load.
14. Turn power on. Be sure no errors are displayed.
15. Go to Level 2 Autotune block and perform the SPD CNTRLR CALC test.
16. Run the drive from the keypad using one of the following: the arrow keys for direct speed control, a keypad entered speed or the JOG mode.
17. Select and program additional parameters to suit your application.

The control is now ready for use the in keypad mode. If a different operating mode is desired, refer to Section 3 Control Connections and Section 4 Programming and Operation.

Section 4
Programming and Operation

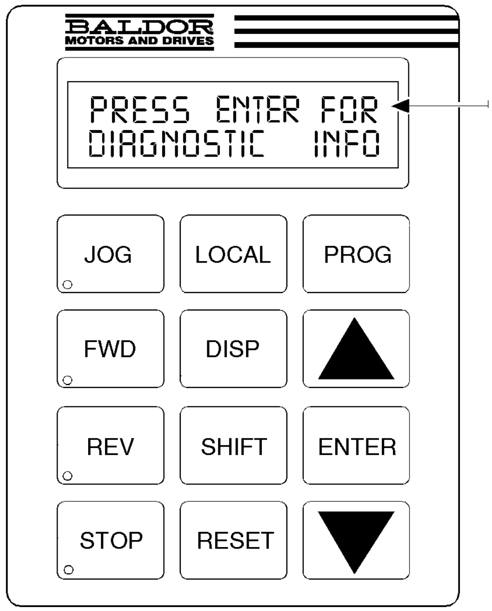
Overview

The keypad is used to program the control parameters, operate the motor and monitor the status and outputs of the control by accessing the display options, diagnostic menus and the fault log.

Figure 4-1 Keypad

JOG - (Green) lights when Jog is active.
FWD - (Green) lights when FWD direction is commanded.
REV - (Green) lights when REV direction is commanded.
STOP - (Red) lights when motor STOP is commanded.

Indicator Lights



JOG - Press JOG to select the preprogrammed jog speed. After the jog key has been pressed, use the FWD or REV keys to run the motor in the direction that is needed. The JOG key is only active in the local mode.

FWD - Press FWD to initiate forward rotation of the motor. This key is only active in the Keypad or local mode.

REV - Press REV to initiate reverse rotation of the motor. This key is active only in the Keypad or local mode.

STOP - Press STOP one time to initiate a stop sequence. Depending on the setup of the control, the motor will either ramp or coast to a stop. This key is operational in all modes of operation unless it has been disabled by the Keypad Stop parameter in the Keypad (programming) Setup Block. Press STOP twice to disable control (coast to stop).

Note: If the control is operating in remote mode and the stop key is pressed the control will change to the local mode when the stop command is initiated. To resume operation in the remote mode, press the LOCAL key.

LOCAL - Press LOCAL to change between the local (keypad) and remote operation. When the control is in the local mode all other external commands to the J1 terminal strip will be ignored with the exception of the external trip input.

DISP - Press DISP to return to display mode from programming mode. Provides operational status and advances to the next display menu item including the diagnostic screens.

SHIFT - Press SHIFT in the program mode to control cursor movement. Pressing the SHIFT key once moves the blinking cursor one character position to the right. While in program mode, a parameter value may be reset to the factory preset value by pressing the SHIFT key until the arrow symbols at the far left of the keypad display are flashing, then press an arrow key. In the display mode the SHIFT key is used to adjust the keypad contrast.

RESET - Press RESET to clear all fault messages (in local mode). Can also be used to return to the top of the block programming menu without saving any parameter value changes.

Keypad Display - Displays status information during Local or Remote operation. It also displays information during parameter setup and fault or Diagnostic Information.

PROG - Press PROG to enter the program mode. While in the program mode the PROG key is used to edit a parameter setting.

▲ - (UP Arrow).
Press ▲ to change the value of the parameter being displayed. Pressing ▲ increments the value to the next greater value. Also, when the fault log or parameter list is displayed, the ▲ key will scroll upward through the list. In the local mode pressing the ▲ key will increase motor speed to the next greater value.

ENTER - Press ENTER to save parameter value changes and move back to the previous level in the programming menu. In the display mode the ENTER key is used to directly set the local speed reference. It is also used to select other operations when prompted by the keypad display.

▼ - (Down Arrow)
Press ▼ to change the value of the parameter being displayed. Pressing ▼ decrements the value to the next lesser value. Also, when the fault log or parameter list is displayed, the ▼ key will scroll downward through the list. In the local mode pressing the ▼ key will decrease motor speed to the next lower value.

Display Mode

The control is in the DISPLAY MODE at all times except when parameter values are changed (Programming mode). The Keypad Display shows the status of the control as in the following example.

```
Motor Status      →  STOP  MOTOR SPEED  ←  Output Condition
Control Operation →  LOCAL        0 RPM  ←  Value and Units
```

The DISPLAY MODE is used to view DIAGNOSTIC INFO and the FAULT LOG. The description of how to do these tasks are described on the following pages.

Adjusting Display Contrast

When AC power is applied to the control the keypad should display the status of the control. If there is no visible display, use the following procedure to adjust the contrast of the display.

(Contrast may be adjusted in display mode when motor is stopped or running)

Action	Description	Display	Comments
Apply Power	No visible display	BLANK	
Press DISP Key	Places control in display mode	BLANK	
Press SHIFT SHIFT	Allows display contrast adjustment	ADJUST CONTRAST ⇕ [ENTER] TO SAVE	
Press ▲ or ▼ Key	Adjusts display intensity	ADJUST CONTRAST ⇕ [ENTER] TO SAVE	
Press ENTER	Saves level of contrast and exits to display mode	STOP MOTOR SPEED LOCAL 0 RPM	Typical display

Display Mode Continued

Display Mode Screens

Action	Description	Display	Comments
Apply Power		BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	Display mode showing motor speed.	STOP MOTOR SPEED LOCAL 0 RPM	No faults present. Local keypad mode. If in remote/serial mode, press local for this display.
Press DISP key	Display mode custom unit output rate (only if Level 2 Custom Units block parameters are set).	STOP OUTPUT RATE LOCAL 00000 XXXX	
Press DISP key	Display Frequency	STOP FREQUENCY LOCAL 0.00 HZ	First Display Mode Screen.
Press DISP key	DIsplay Current	STOP CURRENT OUT LOCAL 0.00 A	
Press DISP key	DIsplay Voltage	STOP VOLTAGE OUT LOCAL 0 V	
Press DISP key	Combined DIsplay	STP 0V 0 RPM LOC 0.0A 0.0 HZ	
Press DISP key	Screen to enter Fault Log	PRESS ENTER FOR FAULT LOG	
Press DISP key	Screen to enter Diagnostic Menu	PRESS ENTER FOR DIAGNOSTIC INFO	
Press DISP key	Exit Display mode and return to Motor Speed display	STOP MOTOR SPEED LOCAL 0 RPM	

Display Screens & Diagnostic Information Access

Action	Description	Display	Comments
Apply Power		BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	Display mode showing motor speed.	STOP MOTOR SPEED LOCAL 0 RPM	No faults present. Local keypad mode. If in remote/serial mode, press local for this display.
Press DISP key 6 times	Scroll to Diagnostic Information screen	PRESS ENTER FOR DIAGNOSTIC INFO	Diagnostic Access screen.
Press ENTER key	Access diagnostic information.	STOP SPEED REF LOCAL 0 RPM	First Diagnostic Information screen.
Press DISP key	Display mode showing control temperature.	STOP CONTROL TEMP LOCAL 0.0° C	
Press DISP key	Display mode showing bus voltage.	STOP BUS VOLTAGE LOCAL XXXV	
Press DISP key	Display mode showing % overload current remaining.	STOP OVRLD LEFT LOCAL 100.00%	
Press DISP key	Display mode showing opto inputs & outputs states.	DIGITAL I/O 000000000 0000	Opto Inputs states (Left); Opto Outputs states (Right).
Press DISP key	Display mode showing actual drive running time.	TIME FROM PWR UP 0000000.01.43	HR.MIN.SEC format.
Press DISP key	Display mode showing operating zone, voltage and control type.	QUIET VAR TQ XXXV FLUX VECTOR	Typical display.
Press DISP key	Display mode showing continuous amps; PK amps rating; amps/volt scale of feedback, power base ID.	X.XA X.X APK X.XX A/V ID:XXX	ID is displayed as a hexadecimal value.
Press DISP key	Display mode showing which Group1 or 2 expansion boards are installed.	G1 NOT INSTALLED G2 NOT INSTALLED	
Press DISP key	Display mode showing motor shaft revolutions from the REV home set point.	POSITION COUNTER + 000.00000 REV	
Press DISP key	Display mode showing parameter table selected.	STOP TABLE LOCAL 0	
Press DISP key	Display mode showing firmware version and revision installed in the control.	SOFTWARE VERSION SXX-X.XX	
Press DISP key	Displays exit choice.	PRESS ENTER FOR DIAGNOSTIC EXIT	Press ENTER to exit diagnostic information.

Fault Log Access

When a fault condition occurs, motor operation stops and a fault code is displayed on the Keypad display. The control keeps a log of up to the last 31 faults. If more than 31 faults have occurred the oldest fault will be deleted from the fault log to make room for the newest fault. To access the fault log perform the following procedure:

Action	Description	Display	Comments
Apply Power		BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	Display mode showing motor speed.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode.
Press DISP key 5 times	Scroll to the Fault Log screen	PRESS ENTER FOR FAULT LOG	Fault Log access screen.
Press ENTER key	Display first fault type and time fault occurred.	EXTERNAL TRIP 1: 0:00:30	Most recent fault displayed.
Press ▲ key	Scroll through fault messages.	PRESS ENTER FOR FAULT LOG EXIT	If no messages, the fault log exit choice is displayed.
Press ENTER key	Return to display mode.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode stop key LED is on.

Program Mode

The Program Mode is used to:

1. Enter motor data.
2. Autotune the motor.
3. Customize the drive (Control and Motor) parameters to your application.

From the Display Mode press the PROG key to access the Program Mode.

Note: When a parameter is selected, alternately pressing the Disp and Prog keys will toggle between the Display Mode and the selected parameter. When a parameter is selected for programming, the keypad display gives you the following information:

Parameter →	PRESET SPEED 1	
Parameter Status →	P: 100 RPM	← Value and Units

Parameter Status. All programmable parameters are displayed with a "P:" in the lower left corner of the keypad display. If a parameter is displayed with a "V:", the parameter value may be viewed but not changed while the motor is operating. If the parameter is displayed with an "L:", the value is locked and the security access code must be entered before its' value can be changed.

Parameter Blocks Access for Programming

Use the following procedure to access parameter blocks to program the control.

Action	Description	Display	Comments
Apply Power	Keypad Display shows this opening message.	BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	If no faults and programmed for LOCAL operation.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode.
	If no faults and programmed for REMOTE operation.	STOP MOTOR SPEED REMOTE 0 RPM	If fault is displayed, refer to the Troubleshooting section of this manual.
Press PROG key		PRESS ENTER FOR PRESET SPEEDS	Press ENTER to access Preset Speed parameters.
Press ▲ or ▼ key	Scroll to the ACCEL/DECEL block.	PRESS ENTER FOR ACCEL/DECEL RATE	Press ENTER to access Accel and Decel rate parameters.
Press ▲ or ▼ key	Scroll to the Level 2 Block.	PRESS ENTER FOR LEVEL 2 BLOCKS	Press ENTER to access Level 2 Blocks.
Press ENTER key	First Level 2 block display.	PRESS ENTER FOR OUTPUT LIMITS	
Press ▲ or ▼ key	Scroll to Programming Exit menu.	PRESS ENTER FOR PROGRAMMING EXIT	Press ENTER to return to Display mode.
Press ENTER key	Return to display mode.	STOP MOTOR SPEED LOCAL 0 RPM	

Program Mode Continued

Changing Parameter Values when Security Code Not Used

Use the following procedure to program or change a parameter already programmed into the control when a security code is not being used.

The example shown changes the operating mode from Keypad to Bipolar.

Action	Description	Display	Comments
Apply Power	Keypad Display shows this opening message.	BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	If no faults and programmed for LOCAL operation.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode. Stop LED on.
Press PROG key	Access programming mode.	PRESS ENTER FOR PRESET SPEEDS	
Press ▲ or ▼ key	Scroll to Level 1 Input Block.	PRESS ENTER FOR INPUT	Press ENTER to access INPUT block parameter.
Press ENTER key	Access Input Block.	OPERATING MODE P: KEYPAD	Keypad mode shown is the factory setting.
Press ENTER key	Access Operating Mode parameter.	OPERATING MODE ⇕ □ KEYPAD	Keypad mode shown is the factory setting.
Press ▲ key	Scroll to change selection.	OPERATING MODE ⇕ □ BIPOLAR	At flashing cursor, select desired mode, BIPOLAR in this case.
Press ENTER	Save selection to memory.	OPERATING MODE P: BIPOLAR	Press ENTER to save selection.
Press ▲ key	Scroll to menu exit.	PRESS ENTER FOR MENU EXIT	
Press ENTER key	Return to Input Block.	PRESS ENTER FOR INPUT	
Press DISP key	Return to Display Mode.	STOP MOTOR SPEED LOCAL 0 RPM	Typical display mode.

Program Mode Continued

Reset Parameters to Factory Settings

Sometimes it is necessary to restore the parameter values to the factory settings. Follow this procedure to do so. Be sure to change the Level 2 Motor Data block “Motor Rated Amps” to the correct value after this procedure (restored factory setting is 999).

Note: All specific application parameters already programmed will be lost when resetting the control to factory settings.

Note: After factory settings are restored, the drive must be auto tuned.

Action	Description	Display	Comments
Apply Power	Keypad Display shows this opening message.	BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	If no faults and programmed for LOCAL operation.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode. Stop LED on.
Press PROG key	Enter program mode.	PRESS ENTER FOR PRESET SPEEDS	
Press ▲ or ▼ key	Scroll to Level 2 Blocks.	PRESS ENTER FOR LEVEL 2 BLOCKS	
Press ENTER key	Select Level 2 Blocks.	PRESS ENTER FOR OUTPUT LIMITS	
Press ▲ or ▼ key	Scroll to the Miscellaneous block.	PRESS ENTER FOR MISCELLANEOUS	
Press ENTER key	Select Miscellaneous block.	RESTART AUTO/MAN P: MANUAL	
Press ▲ key	Scroll to Factory Settings parameter.	FACTORY SETTINGS P: NO	
Press ENTER key	Access Factory Settings parameter.	FACTORY SETTINGS ⇕ ☐ NO	☐ represents blinking cursor.
Press ▲ key	Scroll to YES, to choose original factory settings.	FACTORY SETTINGS ⇕ ☐ YES	
Press ENTER key	Restores factory settings.	FACTORY SETTINGS P:LOADING PRESETS	“Loading Presets” is first message “Operation Done” is next “No” is displayed last.
Press ▲ key	Scroll to menu exit.	PRESS ENTER FOR MENU EXIT	Exit Level 2 blocks.
Press ▲ or ▼ key	Scroll to Programming exit.	PRESS ENTER FOR PROGRAMMING EXIT	Exit Programming mode and return to Display mode.
Press ENTER key	Return to display mode.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode. Stop LED on.

Program Mode Continued

Initialize New Firmware

After new firmware is installed, the control must be initialized to the new firmware version and memory locations. Use the following procedure to Initialize the firmware.

Action	Description	Display	Comments
Apply Power	Keypad Display shows this opening message.	BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	If no faults and programmed for LOCAL operation.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode. Stop LED on.
Press PROG key	Enter program mode.	PRESS ENTER FOR PRESET SPEEDS	
Press ▲ or ▼ key	Scroll to Level 2 Blocks.	PRESS ENTER FOR LEVEL 2 BLOCKS	
Press ENTER key	Select Level 2 Blocks.	PRESS ENTER FOR OUTPUT LIMITS	
Press ▲ or ▼ key	Scroll to the Miscellaneous block.	PRESS ENTER FOR MISCELLANEOUS	
Press ENTER key	Select Miscellaneous block.	RESTART AUTO/MAN P: MANUAL	
Press ▲ key	Scroll to Factory Settings parameter.	FACTORY SETTINGS P: NO	
Press ENTER key	Access Factory Settings parameter.	FACTORY SETTINGS ⇕ □ NO	□ represents blinking cursor.
Press ▲ key	Scroll to YES, to choose original factory settings.	FACTORY SETTINGS ⇕ □ YES	
Press ENTER key	Restores factory settings.	FACTORY SETTINGS P:LOADING PRESETS	"Loading Presets" is first message "Operation Done" is next "No" is displayed last.
Press ▲ key	Scroll to menu exit.	PRESS ENTER FOR MENU EXIT	
Press ENTER key	Return to display mode.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode. Stop LED on.
Press DISP key several times	Scroll to diagnostic information screen.	PRESS ENTER FOR DIAGNOSTIC INFO	If you wish to verify the firmware version, enter diagnostic info.
Press ENTER key	Access diagnostic information.	STOP SPEED REF LOCAL 0 RPM	Displays commanded speed, direction of rotation, Local/ Remote and motor speed.
Press DISP key	Display mode showing firmware version and revision installed in the control.	SOFTWARE VERSION SXX-X.XX	Verify new firmware version.
Press DISP key	Displays exit choice.	PRESS ENTER FOR DIAGNOSTIC EXIT	Press ENTER to exit diagnostic information.

Parameter Definitions

To make programming easier, parameters have been arranged as shown in Table 4-1. Press the PROG key to enter the programming mode and the “Preset Speeds” programming block will be displayed. Use the Up (▲) and Down (▼) arrows to scroll through the parameter blocks. Press ENTER to access parameters within a programing block.

Tables 4-2 and 4-3 provide an explanation of each parameter. A complete Parameter Block Values list is located at the end of this manual. This list defines the programmable range and preset value for each parameter and has space to record your settings for future reference.

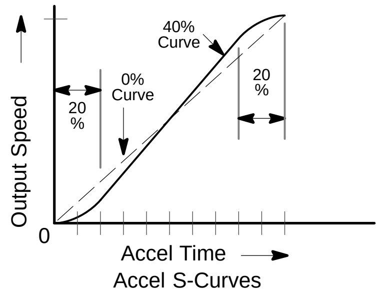
Table 4-1 List of Parameters

LEVEL 1 BLOCKS		LEVEL 2 BLOCKS	
Preset Speeds	**Input**	**Output Limits**	**Brake Adjust**
Preset Speed #1	Operating Mode	Operating Zone	Resistor Ohms
Preset Speed #2	Command Select	Min Output Speed	Resistor Watts
Preset Speed #3	ANA CMD Inverse	Max Output Speed	DC Brake Current
Preset Speed #4	ANA CMD Offset	PK Current Limit	
Preset Speed #5	ANA 2 Deadband	PWM Frequency	**Process Control**
Preset Speed #6	ANA1 CUR Limit	Current Rate Limit	Process Feedback
Preset Speed #7			Process Inverse
Preset Speed #8	**Output**	**Custom Units**	Setpoint Source
Preset Speed #9	Opto Output #1	Decimal Places	Setpoint Command
Preset Speed #10	Opto Output #2	Value at Speed	Set PT ADJ Limit
Preset Speed #11	Opto Output #3	Units of Measure	Process ERR TOL
Preset Speed #12	Opto Output #4		Process PROP Gain
Preset Speed #13	Zero SPD Set PT	**Protection**	Process INT Gain
Preset Speed #14	At Speed Band	Overload	Process DIFF Gain
Preset Speed #15	Set Speed	External Trip	Follow I:O Ratio
	Analog Out #1	Local Enable INP	Follow I:O Out
Accel / Decel Rate	Analog Out #2	Following Error	Master Encoder
Accel Time #1	Analog #1 Scale	Torque Proving	
Decel Time #1	Analog #2 Scale		**Communications**
S-Curve #1	Position Band	**Miscellaneous**	Protocol
Accel Time #2		Restart Auto/Man	Baud Rate
Decel Time #2	**Vector Control**	Restart Fault/Hr	Drive Address
S-Curve #2	Ctrl Base Speed	Restart Delay	
	Feedback Filter	Factory Settings	**Auto-Tuning**
Jog Settings	Feedback Align	Homing Speed	CALC Presets
Jog Speed	Current PROP Gain	Homing Offset	CMD Offset Trim
Jog Accel Time	Current INT Gain		CUR Loop Comp
Jog Decel Time	Speed PROP Gain	**Security Control**	Stator R1
Jog S-Curve Time	Speed INT Gain	Security State	Flux CUR Setting
	Speed DIFF Gain	Access Timeout	Feedback Test
Keypad Setup	Position Gain	Access Code	Slip Freq Test
Keypad Stop Key	Slip Frequency		SPD CNTRLR CALC
Keypad Stop Mode	Stator R1	**Motor Data**	
Keypad Run Fwd	Stator X1	Motor Voltage	
Keypad Run Rev		Motor Rated Amps	
Keypad Jog Fwd		Motor Rated SPD	
Keypad Jog Rev		Motor Rated Freq	
		Motor Mag Amps	
		Encoder Counts	
		Resolver Speeds	
		CALC Presets	

Table 4-2 Level 1 Parameter Block Definitions

Block Title	Parameter	Description
PRESET SPEEDS	Preset Speeds #1 – #15	Allows selection of 15 predefined motor operating speeds. Each speed may be selected using external switches connected to J1-11, J1-12, J1-13 and J1-14 when Operating Mode is set to 15 Speed. For motor operation, a motor direction command must be given along with a preset speed command.
ACCEL/DECEL RATE	Accel Time #1,2	Accel time is the number of seconds required for the motor to increase at a linear rate from 0 RPM to the RPM specified in the “Max Output Speed” parameter in the Level 2 Output Limits block.
	Decel Time #1,2	Decel time is the number of seconds required for the motor to decrease at a linear rate from the speed specified in the “Max Output Speed” parameter to 0 RPM.
	S-Curve #1,2	S-Curve is a percentage of the total Accel and Decel time and provides smooth starts and stops. Half of programmed S-Curve % applies to Accel and half to Decel ramps. 0% represents no “S” and 100% represents full “S” with no linear segment. Note: Accel #1, Decel #1 and S-Curve #1 are associated together. Likewise, Accel #2, Decel #2 and S-Curve #2 are associated together. These associations can be used to control any Preset Speed or External Speed command. Note: If drive faults occur during rapid Accel or Decel, selecting an S-curve may eliminate the faults.
JOG SETTINGS	Jog Speed	Jog Speed is the programmed speed used during for jog. Jog can be initiated from the keypad or terminal strip. At the Keypad, press the JOG key then press and hold the direction (FWD or REV). For Standard Run mode, close the JOG input (J1-12) at the terminal strip then close and maintain the direction input (J1-9 or J1-10). Process Control mode operation is different. If the terminal strip Process Mode Enable input (J1-13) is closed, pressing the Keypad JOG key (or closing J1-14) will cause the drive to move in the direction of the error (without pressing FWD or REV).
	Jog Accel Time	Jog Accel Time changes the Accel Time to a new preset value for jog mode.
	Jog Decel Time	Jog Decel Time changes the Decel Time to a new preset value for jog mode.
	Jog S-Curve	Jog S-Curve changes the S-Curve to a new preset value for jog mode.

Figure 4-2 40% S-Curve Example



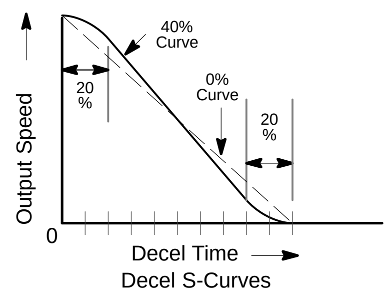


Table 4-2 Level 1 Parameter Block Definitions - Continued

Block Title	Parameter	Description
KEYPAD SETUP	Keypad Stop Key	Stop Key - Allows keypad "STOP" key to initiate motor stop during remote or serial operation (if Stop key is set to Remote ON). If active, pressing "STOP" automatically selects Local mode and initiates the stop command.
	Keypad Stop Mode	Stop Mode - Selects if the Stop command causes the motor to "COAST" to a stop or "REGEN" to a stop. In COAST, the motor is turned off and allowed to coast to a stop. In REGEN, the voltage and frequency to the motor is reduced at a rate set by "Decel Time".
	Keypad Run FWD	Run FWD - ON makes the keypad "FWD" key active in Local mode.
	Keypad Run REV	Run REV - ON makes the keypad "REV" key active in Local mode.
	Keypad Jog FWD	Jog FWD - ON makes the keypad "FWD" key active in Local Jog mode.
	Keypad Jog REV	Jog REV - ON makes the keypad "REV" key active in Local Jog mode.
INPUT	Operating Mode	Eight "Operating Modes" are available. Choices are: Keypad, Standard Run, 15SPD, Fan Pump 2 Wire, Fan Pump 3 Wire, Serial, Bipolar, and Process. External connections to the control are made at the J1 terminal strip (wiring diagrams are shown in Section 3 "Control Circuit Connections").
	Command Select	Selects the external speed reference to be used. The easiest method of speed control is to select POTENTIOMETER and connect a 5KΩ pot to J1-1, J1-2, and J1-3. ±5 or ±10VDC input command can be applied to J1-4 and J1-5. If long distance is required between the external speed control and the control, the 4-20mA selections at J1-4 and J1-5 should be considered. Current loop allows long cable lengths without attenuation of the command signal. 10 VOLT W/TORQ FF - when a differential command is present at J1-4 and 5, allows additional 5V torque feedforward input at J1-1, 2 and 3 to set a predetermined amount of torque inside the rate loop with high gain settings. EXB PULSE FOL - selects optional Master Pulse Reference/Isolated Pulse Follower expansion board if installed. 5VOLT EXB - selects optional High Resolution I/O expansion board if installed. 10VOLT EXB - selects optional High Resolution I/O expansion board if installed. 3-15 PSI EXB selects optional 3-15 PSI expansion board if installed. Tachometer EXB- selects optional DC Tachometer expansion board if installed. Serial -selects optional Serial Communications expansion board if installed. Note: When using the 4-20mA input, the JP1 jumper on the main control board must be moved to pins 2 and 3.
	ANA CMD Inverse	"OFF" will cause a low input voltage (e.g. 0VDC) to be a low motor speed command and a maximum input voltage (e.g. 10VDC) to be a maximum motor speed command. "ON" will cause a low input voltage (e.g. 0VDC) to be a maximum motor speed command and a maximum input voltage (e.g. 10VDC) to be a low motor speed command.
	ANA CMD Offset	Provides an offset to the Analog Input to minimize signal drift. For example, if the minimum speed signal is 1VDC (instead of 0VDC) the ANA CMD Offset can be set to -10% so the minimum voltage input is seen by control as 0VDC.
	ANA 2 Deadband	Allows a defined range of voltage to be a deadband. A command signal within this range will not affect the control output. The deadband value is the voltage above and below the zero command signal level.
	ANA 1 CUR Limit	Allows the 5V input at J1-2 (referenced to J1-1) to be used for reduction of the programmed current limit parameter for torque trimming during operation.

Table 4-2 Level 1 Parameter Block Definitions - Continued

Block Title	Parameter	Description
OUTPUT	OPTO OUTPUT #1 – #4	Four optically isolated digital outputs that have two operating states, logical High or Low. Each output may be configured to any of the following conditions: **Condition** – **Description** Ready - Active when power is applied and no faults are present. Zero Speed - Active when output frequency to motor is below the value of the Level 1 Output “Zero SPD Set Pt” parameter. At Speed - Active when output speed is within the speed range defined by the Level 1 Output “At Speed Band” parameter. At Set Speed - Active when output speed is at or above the Level 1 Output “Set Speed” parameter. Overload - A normally closed contact that is active (opens) during an Overload fault caused by a time out when output current is greater than Rated Current. Keypad Control - Active when control is in Local keypad control. Fault - Active when a fault condition is present. Following ERR - Active when the motor speed is outside the user specified tolerance band defined by the At Speed Band parameter. Motor Direction - Active High when REV direction command received. Active Low when FWD direction command received. Drive On - Active when control is “Ready” (has reached excitation level and capable of producing torque). CMD Direction - Active at all times. Logical output state indicates Forward or Reverse direction. AT Position - Active during a positioning command when control is within the position band parameter tolerance. Over Temp Warn - Active when control heat sink is within 3°C of Int Overtemp. Process Error - Active when process feedback signal is outside the range specified by the Level 2 Process Control block, AT Setpoint Band parameter. Turns off when process feedback error is eliminated. Drive Run - Active when drive is Ready, Enabled, Speed or Torque command received with FWD/REV direction issued.
	Zero SPD Set PT	Sets the speed at which the Zero Speed opto output becomes active (turns on). When the speed is less than the ZERO SPD SET PT, the Opto Output becomes active. This is useful when a motor brake is to interlock operation with a motor.
	At Speed Band	The At Speed Band serves two Opto Output Conditions and the Level 2 Protection block Following Error: Sets the speed range in RPM at which the At Speed opto output turns on and remains active within the range. Sets the Following Error Tolerance Band for the Level 1 OUTPUT, Opto Output condition Following ERR. The opto output is active if the motor speed is outside this band. Sets the no fault operating speed range of the drive. This value is used by the Level 2 Protection block, Following Error parameter (if it is set to ON). If the drive speed falls out of this band, the Level 2 Protection block, Following Error parameter will shut down the drive (if it is set to ON).
	Set Speed	Sets the speed that the AT Set Speed opto output becomes active (turns on). When the speed is greater than the Level 1 Output SET SPEED parameter, the Opto Output becomes active. This is useful when another machine must not start or stop until the motor exceeds a predetermined speed.

Table 4-2 Level 1 Parameter Block Definitions - Continued

Block Title	Parameter	Description
OUTPUT (Continued)	Analog Output #1 and #2	Two Analog 0-5VDC linear outputs may be configured to represent any of 19 conditions as follows: **Condition** **Description** ABS Speed - Represents the absolute motor speed where 0VDC = 0 RPM and +5VDC = MAX RPM. ABS Torque - Represents the absolute value of torque where +5VDC = Torque at CURRENT LIMIT. Speed Command - Represents the absolute value of commanded speed where +5VDC = MAX RPM. PWM Voltage - Represents the amplitude of PWM voltage where +5VDC = MAX AC Voltage. Flux Current - Represents the actual portion of total current used for excitation. 5VDC= MAX flux current. CMD Flux CUR - Represents the calculated value for flux current. 5VDC= MAX commanded flux current. Load Current - Represents the actual portion of total current used to produce torque (CW and CCW torque). 5V = Max. CW torque, 0V = Max. CCW torque. CMD Load Current - Represents the calculated value of load current. 5V = Max. commanded load current. Motor Current - Amplitude of continuous current including motor excitation current. 5VDC = Rated Current. Load Component - Amplitude of load current not including the motor excitation current. 5VDC = Rated Current. Quad Voltage - Load controller output. Used to diagnose control problems. Direct Voltage - Flux controller output. Used to diagnose control problems. AC Voltage - A scaled AC waveform that represents the AC line to line motor terminal voltage. 0V = Neg Peak PWM voltage. 2.5V centered. 5V = Pos Peak PWM voltage. At rated motor voltage, a full 0 to 5V sinusoidal waveform should be present. This waveform should be at or greater than the motor base frequency. (At half the motor base frequency, a 1.25V to 3.75 sine wave is present.) Bus Voltage - Bus voltage scaled to 0-5VDC. 5V = 1000VDC. Torque - Bipolar torque output. 2.5V centered, 5V = Max Positive Torque, 0V = Max negative torque. Power - Bipolar power output. 2.5V = Zero Power, 0V = negative rated peak power, +5V = Positive rated peak power. Velocity - Represents motor speed scaled to 0V = negative max RPM, +2.5V = Zero Speed, +5V = positive max RPM. Overload - (Accumulated current)^2 x (time), Overload occurs at +5V. PH 2 Current - Sampled AC phase 2 motor current. 2.5V = zero amps, 0V = negative rated peak amps, +5V = positive rated peak amps. PH 1 Current - Sampled AC phase 1 motor current. 2.5V = zero amps, 0V = negative rated peak amps, +5V = positive rated peak amps. Process Feedback - Represents the selected Process Feedback signal. 2.5V centered, 5V = 100%, 0V = –100%. Position - Position within a single revolution. +5V = 1 complete revolution. The counter will reset to 0 every revolution. Setpoint Command - Represents the selected Setpoint Command signal. 2.5V centered, 5V = 100%, 0V = –100%.
	Analog Scale #1 & #2	Scale factor for the Analog Output voltage. Useful to set the zero value or full scale range for external meters.
	Position Band	Sets the acceptable range in digital counts (pulses) at which the AT Position Opto becomes active (turns on).

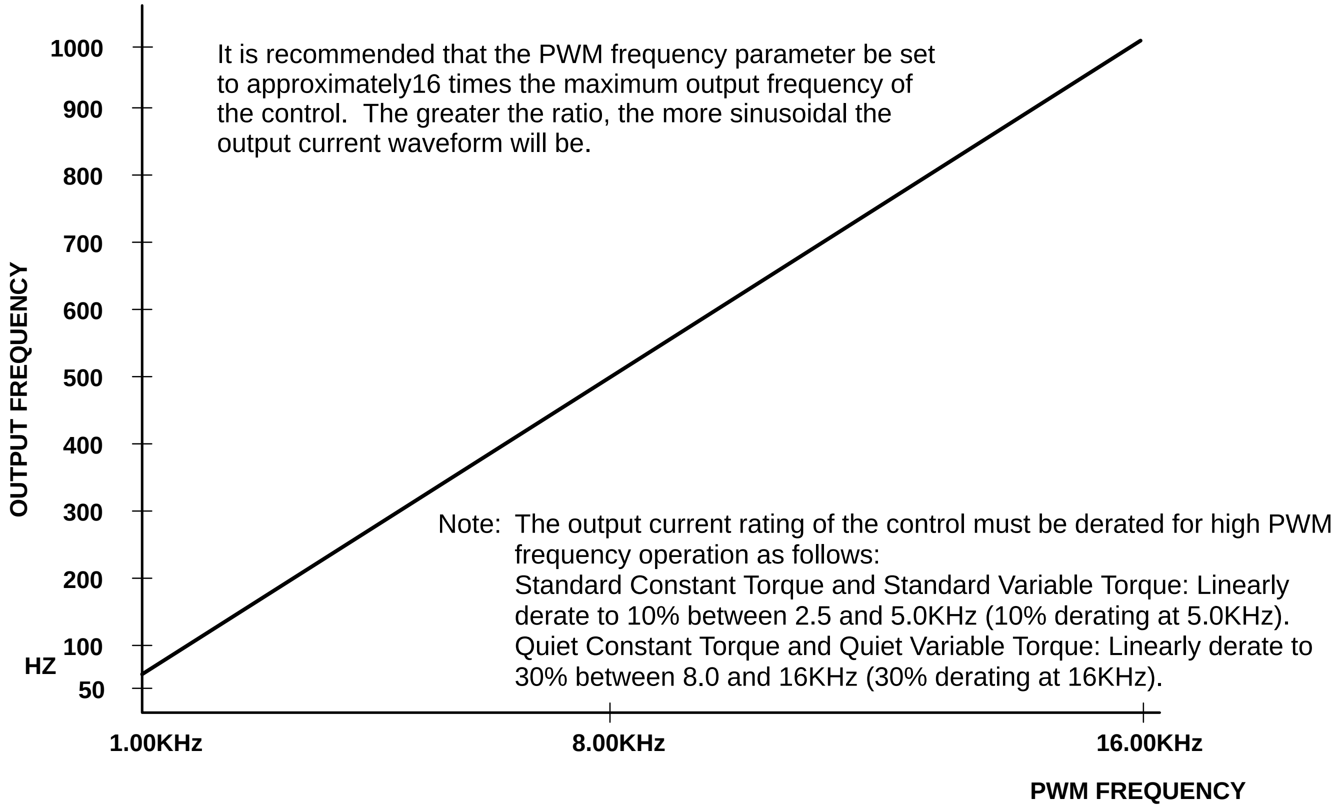
Table 4-2 Level 1 Parameter Block Definitions - Continued

Block Title	Parameter	Description
VECTOR CONTROL	CTRL BASE Speed	Sets the speed in RPM at which the saturation voltage of the control is reached. Above this RPM value the control will output constant voltage and variable frequency.
	Feedback Filter	A larger value provides a more filtered signal but at the cost of reduced bandwidth.
	Feedback Align	Sets the encoder's electrical direction of rotation to match that of the motor.
	Current PROP Gain	Sets the current loop proportional gain.
	Current INT Gain	Sets the current loop integral gain.
	Speed PROP Gain	Sets the speed (velocity) loop proportional gain.
	Speed INT Gain	Sets the speed (velocity) loop integral gain.
	Speed DIFF Gain	Sets the speed (velocity) loop differential gain.
	Position Gain	Sets the position loop proportional gain.
	Slip Frequency	Sets the rated slip frequency of the motor.
	Stator R1	Stator resistance in ohms. If set too high, the motor will tend to stall at zero speed when reversing or accelerating from low speed. Reducing this value will eliminate the problem. When too low, speed regulation may suffer.
	Stator X1	Stator leakage reactance, in ohms at 60Hz. This parameter has most impact when reversing motor rotation at full current limit. If set too low, the true decel time will tend to increase.
LEVEL 2 BLOCK		ENTERS LEVEL 2 MENU

Table 4-3 Level 2 Parameter Block Definitions

Block Title	Parameter	Description
OUTPUT LIMITS	Operating Zone	Sets the PWM operating zone to Standard 2.5KHz or Quiet 8.0KHz output carrier frequency. Two operating modes are also selectable: Constant Torque and Variable Torque. Constant Torque allows 170 - 200% for 3 seconds overload or 150% for 60 seconds overload. Variable Torque allows 115% peak overload for 60 seconds.
	MIN Output Speed	Sets the minimum motor speed in RPM. During operation, the motor speed will not be allowed to go below this value except for motor starts from 0 RPM or during dynamic braking to a stop.
	MAX Output Speed	Sets the maximum motor speed in RPM.
	PK Current Limit	The maximum output peak current to the motor. Values above 100% of the rated current are available depending upon the operating zone selected.
	PWM Frequency	The frequency that the output transistors are switched. PWM frequency is also referred to as "Carrier" frequency. PWM should be as low as possible to minimize stress on the output transistors and motor windings. It is recommended that the PWM frequency be set to approximately 15 times the maximum output frequency of the control. Ratios less than 15 will result in non-Sinusoidal current waveforms. See Figure 4-3.
	Current Rate Limit	Limits the rate of torque change in response to a torque command.
CUSTOM UNITS	Decimal Places	The number of decimal places of the Output Rate display on the Keypad display. This value will be automatically reduced for large values. The output rate display is only available if the Value At Speed parameter value is non zero.
	Value At Speed	Sets the desired output rate per RPM of motor speed. Two numbers are displayed on the keypad display (separated by a slash "/"). The first number (left most) is the value you want the keypad to display at a specific motor speed. The second number (right most) is the motor RPM corresponding to the units in the first number. A decimal may be inserted into the numbers by placing the flashing cursor over the up/down arrow.
	Units of Measure	Allows user specified units of measure to be displayed on the Output Rate display. Use the shift and arrow keys to scroll to the first and successive characters. If the character you want is not displayed, move the flashing cursor over the special up/down character arrow on the left side of the display. Use the up/down arrows and the shift key to scroll through all 9 character sets. Use the ENTER key to save your selection.
PROTECTION	Overload	Sets the protection mode to Fault (trip off during overload condition) or to Foldback (automatically reduce the output current below the continuous output level) during an overload. Foldback is the choice if continuous operation is desired. Fault will require the control be "Reset" after an overload. Note: The "Foldback" selection may not be available on some early versions of the firmware.
	External Trip	OFF - External Trip is Disabled. ON - External Trip is enabled. If a normally closed contact at J1-16 is opened, an External Trip fault will occur and cause the drive to shut down.
	Local Enable INP	OFF - Ignores J1-8 switched input when in the "LOCAL" mode. ON - Requires J1-8 Enable input to be closed to enable the control when in the "LOCAL" mode.
	Following Error	This parameter determines if the control is to monitor the amount of following error that occurs in an application. Following Error is the programmable tolerance for the AT Speed Opto output as defined by the Level 1 Output block, AT Speed Band parameter. Operation outside the speed range will cause a fault and the drive will shut down.
	Torque Proving	When this parameter is set to ON the control looks for balanced output current in all three phases to the motor. If output current is unbalanced, the control will trip off generating a torque proving fault. In a hoist application, for example, this is useful to ensure that motor torque exists before the fail safe brake is released. "Drive On" output, if programmed, will occur if torque proving fails.

Figure 4-3 Maximum Output Frequency vs PWM Frequency



⚠ **Caution: If an automatic restart of the motor control could cause injury to personnel, the automatic restart feature should be disabled by changing the Level 2 Miscellaneous block, Restart Auto/Man parameter to manual.**

Table 4-3 Level 2 Parameter Block Definitions Continued

Block Title	Parameter	Description
MISCELLANEOUS	Restart Auto/Man	Manual - If a fault or power loss occurs, the control must be manually reset to resume operation. Automatic - If a fault or power loss occurs, the control will automatically reset to resume operation.
	Restart Fault/Hr	The maximum number of automatic restart attempts before requiring a manual restart. After one hour without reaching the maximum number of faults or if power is turned off and on again, the fault count is rest to zero.
	Restart Delay	The amount of time allowed after a fault condition for an automatic restart to occur. Useful to allow sufficient time to clear a fault before restart is attempted.
	Factory Settings	Restores factory settings for all parameter values. Select YES and press “ENTER” key to restore factory parameter values. The keypad Display will show “Operation Done” then return to “NO” when completed. Note: When factory settings are reset, the Motor Rated Amps value is reset to 999.9 amps. This Level 2 Motor Data block parameter value must be changed to the correct value (located on the motor rating plate) before attempting to start the drive.

Table 4-3 Level 2 Parameter Block Definitions Continued

Block Title	Parameter	Description
MISCELLANEOUS continued	Homing Speed	In Bipolar and Serial modes, this parameter sets the speed that the motor shaft will rotate to a “Home” position when the orient input switch is closed (J1-11).
	Homing Offset	In Bipolar and Serial modes, this parameter sets the number of digital encoder counts past home at which the motor stop command is issued. Quadrature encoder pulses are 4 times the number of encoder lines per revolution. The recommended minimum number is 100 encoder counts to allow for deceleration distance to allow the motor to stop smoothly. Note: Homing direction is always forward.
SECURITY CONTROL	Security State	Off - No security Access Code required to change parameter values. Local - Requires security Access Code to be entered before changes can be made using the Keypad. Serial - Requires security Access Code to be entered before changes can be made using the Serial Link. Total - Requires security Access Code to be entered before changes can be made using the Keypad or serial link. Note: If security is set to Local, Serial or Total you can press PROG and scroll through the parameter values that are programmed but you are not allowed to change them unless you enter the correct access code.
	Access Timeout	The time in seconds the security access remains enabled after leaving the programming mode. If you exit and go back into the program Mode within this time limit, the security Access Code does not have to be re-entered. This timer starts when leaving the Program Mode (by pressing DISP).
	Access Code	A 4 digit number code. Only persons that know the code can change secured Level 1 and Level 2 parameter values. Note: Please record your access code and store it in a safe place. If you cannot gain entry into parameter values to change a protected parameter, please contact Baldor. Be prepared to give the 5 digit code shown on the lower right side of the Keypad Display at the Security Control Access Code parameter prompt.
MOTOR DATA	Motor Voltage	The rated voltage of the motor (listed on the motor nameplate).
	Motor Rated Amps	The rated current of the motor (listed on the motor nameplate). If the motor current exceeds this value for a period of time, an Overload fault will occur.
	Motor Rated SPD	The rated speed of the motor (listed on the motor nameplate). If Motor Rated SPD = 1750 RPM and Motor Rated Freq = 60 Hz, the Keypad Display will show 1750 RPM at 60 Hz and 875 RPM at 30Hz.
	Motor Rated Freq	The rated frequency of the motor (listed on the motor nameplate).
	Motor Mag Amps	The motor magnetizing current value (listed on the motor nameplate). Also called no load current. Measure using a clamp on amp meter at the AC power line while the motor is running at line frequency with no load connected to the motor shaft.
	Encoder Counts	The number of encoder feedback counts (lines per revolution).
	Resolver Speed	The speed of the resolver, if a resolver is used for feedback.
	CALC Presets	This procedure loads preset values into memory that are required to perform Auto Tune. Always run CALC Presets as the first step of Auto Tune.

Table 4-3 Level 2 Parameter Block Definitions Continued

Block Title	Parameter	Description
BRAKE ADJUST	Resistor Ohms	The dynamic braking resistor value in ohms. Refer to dynamic braking manual or call Baldor for additional information.
	Resistor Watts	The dynamic braking resistor watts rating. Refer to dynamic braking manual or call Baldor for additional information.
	DC Brake Current	The amount of DC injection brake current. 0% = Flux current, 100% = Motor rated current.
PROCESS CONTROL	Process Feedback	Sets the type of signal used for the process feedback signal.
	Process Inverse	Causes the process feedback signal to be inverted. Used with reverse acting processes that use a unipolar signal such as 4-20mA. If "ON", 20mA will decrease motor speed and 4mA will increase motor speed.
	Setpoint Source	Sets the source input signal type to which the process feedback will be compared. If "Setpoint CMD" is selected, the fixed value of the set point is entered in the Setpoint Command parameter value.
	Setpoint Command	Sets the value of the setpoint the control will try to maintain by adjusting motor speed. This is only used when the Setpoint Source is a fixed value "Setpoint CMD" under Setpoint Source.
	Set PT ADJ Limit	Sets the maximum speed correction value to be applied to the motor (in response to the maximum feedback setpoint error). For example, if the max motor speed is 1750 RPM, the setpoint feedback error is 100% and the setpoint adjustment limit is 10%, the maximum speed the motor will run in response to the setpoint feedback error is ±175 RPM. If at the process setpoint, the motor speed is 1500 RPM, the maximum speed adj limits is then 1325 to 1675 RPM.
	Process ERR TOL	Sets the width of the comparison band (% of setpoint) with which the process input is compared. The result is that if the process input is within the comparison band the corresponding Opto Output will become active.
	Process PROP Gain	Sets the PID loop proportional gain. This determines how much adjustment to motor speed (within the Set PT ADJ Limit) is made to move the analog input to the setpoint.
	Process INT Gain	Sets the PID loop Integral gain. This determines how quickly the motor speed is adjusted to correct long term error.
	Process DIFF Gain	Sets the PID loop differential gain. This determines how much adjustment to motor speed (within the Set PT ADJ Limit) is made for transient error.
	Follow I:O Ratio	Sets the ratio of the Master to the Follower in Master/Follower configurations. Requires the Master Pulse Reference/ Isolated Pulse Follower expansion board. For example, the master encoder you want to follow is a 1024 count encoder. The follower motor you wish to control also has a 1024 count encoder on it. If you wish the follower to run twice the speed of the master, a 1:2 ratio is entered. Fractional ratios such as 0.5:1 are entered as 1:2. Master:Follower ratio limits are (1-65,535) : (1-20). Note: The Master Encoder parameter must be defined if a value is entered in the Follow I:O Ratio parameter. Note: When using Serial Communications to operate the control, this value is the MASTER portion of the ratio. The FOLLOWER portion of the ratio is set in the Follow I:O Out parameter.
	Follow I:O Out	This parameter is used only when Serial Communications is used to operate the control. A Master Pulse Reference/ Isolated Pulse Follower expansion board is required. This parameter represents the FOLLOWER portion of the ratio. The MASTER portion of the ratio is set in the Follow I:O Ratio parameter.
	Master Encoder	Only used if an optional Master Pulse Reference/Isolated Pulse Follower expansion board is installed. Defines the number of pulses per revolution of the master encoder. Only used for follower drives.
COMMUNICATIONS	Protocol	Sets the type of communication the control is to use, RS-232 or RS-485 ASCII (text) protocol.
	Baud Rate	Sets the speed at which communication is to occur.
	Drive Address	Sets the address of the control for communication.

Table 4-3 Level 2 Parameter Block Definitions Continued

Block Title	Parameter	Description
AUTO TUNING		The Auto Tune procedure is used to automatically measure and calculate certain parameter values. Dynamic Brake Hardware is required to perform “Slip Freq Test” and “Spd Cntrlr Calc” autotuning test. Occasionally, the Auto Tune procedure cannot be run due to various circumstances such as the load cannot be uncoupled from the motor. The control can be manually tuned by entering the parameter values based on calculations you have made. Refer to “Manually Tuning the Control” in the Troubleshooting section of this manual.
	CALC Presets	This procedure loads preset values into memory that are required to perform Auto Tune. Always run CALC Presets as the first step of Auto Tune.
	CMD Offset Trim	This procedure trims out voltage offsets for the differential analog input at J1-4 and J1-5.
	CUR Loop COMP	Measures current response to pulses of one half the rated motor current.
	Stator R1	Measures motor stator resistance.
	Flux CUR Setting	Sets motor magnetizing current by running motor at near rated speed.
	Feedback Tests	Checks the values for Encoder Lines per revolution and encoder alignment parameters while the motor is running at near full rated speed. Test will automatically switch encoder phasing to match motor rotational direction.
	Slip FREQ Test	Calculates motor Slip Frequency during repeated motor accelerations.
	SPD CNTRLR CALC	Should be performed with the load coupled to the motor shaft. Sets the motor current to acceleration ratio, Speed INT gain and Speed PROP gain values. If done under no load, the Integral gain will be too large for high inertia loads if the PK Current Limit is set too low. If the control is too responsive when the drive is loaded, adjust the PK Current Limit parameter to a greater value and repeat this test.
LEVEL 1 BLOCK		ENTERS LEVEL 1 MENU

The Baldor Series 18H Control requires very little maintenance and should provide years of trouble free operation when installed and applied correctly. Occasional visual inspection should be considered to ensure tight wiring connections and to avoid the build up of any dust, dirt, or foreign debris which can reduce heat dissipation.

Before attempting to service this equipment, all input power must be removed from the control to avoid the possibility of electrical shock. The servicing of this equipment should be handled by a qualified electrical service technician experienced in the area of high power electronics.

It is important to familiarize yourself with the following information before attempting any troubleshooting or service of the control. Most troubleshooting can be performed using only a digital voltmeter having an input impedance exceeding 1 meg Ohm. In some cases, an oscilloscope with 5 MHZ minimum bandwidth may be useful. Before consulting the factory, check that all power and control wiring is correct and installed per the recommendations given in this manual.

No Keypad Display - Display Contrast Adjustment

If there is no visible display, use the following procedure to adjust the contrast of the display.

Action	Description	Display	Comments
Apply Power	No visible display.	BLANK	
Press DISP key	Ensures control in Display mode.	BLANK	Display mode.
Press SHIFT key 2 times	Allows display contrast adjustment.	ADJUST CONTRAST ⇕ [ENTER] TO SAVE	
Press ▲ or ▼ key	Adjusts display contrast (intensity).	ADJUST CONTRAST ⇕ [ENTER] TO SAVE	
Press ENTER key	Saves display contrast adjustment level and exits to display mode.	STOP FREQUENCY LOCAL 0.00 HZ	

Table 5-1 Fault Messages

FAULT MESSAGE	DESCRIPTION
Current Sens FLT	Defective phase current sensor or open circuit detected between control board and current sensor.
DC Bus High	Bus over voltage condition occurred.
DC Bus Low	Bus under voltage condition occurred.
Encoder Loss	Encoder coupling slipping or broken; noise on encoder lines, encoder power supply loss or defective encoder.
External Trip	An external over temperature condition occurred or open circuit on J1-16.
Following Error	Excessive following error detected between command and feedback signals.
GND FLT	Low impedance path detected between an output phase and ground.
INT Over-Temp	Temperature of control heatsink exceeded safe level.
Invalid Base ID	Control does not recognize power base ID.
Inverter Base ID	Control board installed on power base without current feedback.
Line Regen FLT	Only applies to Series 21H and 22H Line Regen controls.
Logic Supply FLT	Logic power supply not working properly.
Lost User Data	Battery backed RAM parameters have been lost or corrupted. When fault cleared (Reset), the control will reset to factory preset values.
Low INIT Bus V	Insufficient bus voltage on startup.
Memory Error	EEPROM error occurred. Contact Baldor.
New Base ID	Control board was changed since last operation.
No Faults	Fault log is empty.
No EXB Installed	Programmed operating mode requires an expansion board.
Over Current FLT	Instantaneous over current condition detected by bus current sensor.
Overload - 1 min	Output current exceeded 1 minute rating.
Overload - 3 sec	Output current exceeded 3 second rating.
Over speed	Motor RPM exceeded 110% of programmed MAX Motor Speed.
μP Reset	Power cycled before the residual Bus voltage reached 0VDC.
PWR Base FLT	Desaturation of power device occurred or bus current threshold exceeded.
Regen R PWR FLT	Regen power exceeded DB resistor rating.
Resolver Loss	Resolver feedback problem is indicated (if resolver used).
Torque Prove FLT	Unbalanced current between all 3 motor phases.
User Fault Text	Custom software operating fault occurred.

How to Access the Fault Log

When a fault condition occurs, motor operation stops and a fault code is displayed on the Keypad display. The control keeps a log of up to the last 31 faults. If more than 31 faults have occurred the oldest fault will be deleted from the fault log to make room for the newest fault. To access the fault log use the following procedure:

Action	Description	Display	Comments
Apply Power		BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	Display mode showing output frequency	STOP MOTOR SPEED LOCAL 0 RPM	Display mode.
Press DISP key 5 times	Use DISP key to scroll to the Fault Log entry point.	PRESS ENTER FOR FAULT LOG	
Press ENTER key	Display first fault type and time fault occurred.	EXTERNAL TRIP 1: 0:00:30	Typical display.
Press ▲ key	Scroll through fault messages.	PRESS ENTER FOR FAULT LOG EXIT	If no messages, the fault log exit choice is displayed.
Press ENTER key	Return to display mode.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode stop key LED is on.

How to Clear the Fault Log

Use the following procedure to clear the fault log.

Action	Description	Display	Comments
Apply Power		BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	Display mode showing output frequency.	STOP MOTOR SPEED LOCAL 0 RPM	Display mode.
Press DISP key	Press DISP to scroll to the Fault Log entry point.	PRESS ENTER FOR FAULT LOG	
Press ENTER key	Displays most recent message.	EXTERNAL TRIP 1: 00000:00:30	
Press SHIFT key		EXTERNAL TRIP 1: 00000:00:30	
Press RESET key		EXTERNAL TRIP 1: 00000:00:30	
Press SHIFT key		EXTERNAL TRIP 1: 00000:00:30	
Press ENTER key	Fault log is cleared.	FAULT LOG NO FAULTS	No faults in fault log.
Press ▲ or ▼ key	Scroll Fault Log Exit.	PRESS ENTER FOR FAULT LOG EXIT	
Press ENTER key	Return to display mode.	STOP MOTOR SPEED LOCAL 0 RPM	

How to Access Diagnostic Information

Action	Description	Display	Comments
Apply Power		BALDOR MOTORS & DRIVES	Logo display for 5 seconds.
	Display mode showing motor speed.	STOP MOTOR SPEED LOCAL 0 RPM	No faults present. Local keypad mode. If in remote/serial mode, press local for this display.
Press DISP key 6 times	Scroll to Diagnostic Information screen	PRESS ENTER FOR DIAGNOSTIC INFO	Diagnostic Access screen.
Press ENTER key	Access diagnostic information.	STOP SPEED REF LOCAL 0 RPM	First Diagnostic Information screen.
Press DISP key	Display showing control temperature.	STOP CONTROL TEMP LOCAL 0.0° C	
Press DISP key	Display showing bus voltage.	STOP BUS VOLTAGE LOCAL XXXV	
Press DISP key	Display showing % overload current remaining.	STOP OVRLD LEFT LOCAL 100.00%	
Press DISP key	Display showing opto inputs & outputs states.	DIGITAL I/O 000000000 0000	Opto Inputs states (Left); Opto Outputs states (Right).
Press DISP key	Display showing actual drive running time.	TIME FROM PWR UP 0000000.01.43	HR.MIN.SEC format.
Press DISP key	Display showing operating zone, voltage and control type.	QUIET VAR TQ XXXV FLUX VECTOR	
Press DISP key	Display showing continuous amps; PK amps rating; amps/volt scale of feedback, power base ID.	X.XA X.X APK X.XX A/V ID:XXX	ID is displayed as a hexadecimal value.
Press DISP key	Display showing which Group1 or 2 expansion boards are installed.	G1 NOT INSTALLED G2 NOT INSTALLED	
Press DISP key	Display showing motor shaft revolutions from the REV home set point.	POSITION COUNTER + 000.00000 REV	
Press DISP key	Display mode showing parameter table selected.	STOP TABLE LOCAL 0	
Press DISP key	Display showing software version and revision installed in the control.	SOFTWARE VERSION SXX-X.XX	
Press DISP key	Displays exit choice.	PRESS ENTER FOR DIAGNOSTIC EXIT	Press ENTER to exit diagnostic information.

Table 5-2 Troubleshooting

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
No Display	Lack of input voltage.	Check input power for proper voltage. Verify fuses are good (or breaker is not tripped).
	Loose connections.	Check input power termination. Verify connection of operator keypad.
	Adjust display contrast.	See Adjust Display Contrast in Sec. 4.
Auto Tune Encoder Test failed	Encoder miswired.	Correct wiring problems.
	Encoder coupling slipping, broken or misaligned.	Correct encoder to motor coupling.
	Excessive noise on encoder lines.	Check the position counter in the Diagnostic Information for jittering which will confirm an encoder problem. Use recommended encoder cable. Check encoder connections including shields. Separate encoder leads from power wiring. Cross encoder wires and power leads at 90°. Electrically isolate encoder from motor. Install optional Isolated Encoder Feedback expansion board.
Current Sense FLT	Open circuit between control board and current sensor.	Check connections between control board and current sensor.
	Defective current sensor.	Replace current sensor.
DC Bus High	Excessive dynamic braking power.	Increase the DECEL time. Check dynamic brake watt and resistance parameter values. Add optional dynamic braking hardware.
	Dynamic brake wiring problem.	Check dynamic brake hardware wiring.
	Input voltage too high.	Verify proper AC line voltage. Use step down isolation transformer if needed. Use line reactor to minimize spikes.
DC Bus Low	Input voltage too low.	Disconnect dynamic brake hardware and repeat operation. Verify proper AC line voltage. Use step up isolation transformer if needed. Check power line disturbances (sags caused by start up of other equipment). Monitor power line fluctuations with date and time imprint to isolate power problem.
Encoder Loss	Encoder power supply failure.	Check 5VDC at J1-29 and J1-30. Also check at encoder end pins D and F.
	Encoder coupling slipping, broken or misaligned	Correct or replace encoder to motor coupling.
	Excessive noise on encoder lines.	Check the position counter in the Diagnostic Information for jittering which will confirm an encoder problem. Check encoder connections. Separate encoder leads from power wiring. Cross encoder wires and power leads at 90°. Electrically isolate encoder from motor. Install optional Isolated Encoder Feedback expansion board.

Table 5-2 Troubleshooting Continued

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
External Trip	Motor ventilation insufficient.	Clean motor air intake and exhaust. Check external blower for operation. Verify motor's internal fan is coupled securely.
	Motor draws excessive current.	Check motor for overloading. Verify proper sizing of control and motor.
	No thermostat connected.	Connect thermostat. Verify connection of all external trip circuits used with thermostat. Disable thermostat input at J1-16 (External Trip Input).
	Poor thermostat connections.	Check thermostat connections.
	External trip parameter incorrect.	Verify connection of external trip circuit at J1-16. Set external trip parameter to "OFF" if no connection made at J1-16.
Following ERR	Speed proportional gain set too low.	Following error tolerance band set too narrow. Increase Speed PROP Gain parameter value.
	Current limit set too low.	Increase Current Limit parameter value.
	ACCEL/DECEL time too short.	Increase ACCEL/DECEL parameter time
	Excessive load.	Verify proper sizing of control and motor.
GND FLT	Improper wiring. Wiring shorted in conduit. Motor winding shorted.	Disconnect wiring between control and motor. Retry test. If GND FLT is cleared, reconnect motor leads and retry the test. Rewire as necessary. Repair motor. If GND FLT remains, contact Baldor.
INT Over-Temp	Motor Overloaded.	Correct motor loading. Verify proper sizing of control and motor.
	Ambient temperature too high.	Relocate control to cooler operating area. Add cooling fans or air conditioner to control cabinet.
Invalid Base ID	Control does not recognize HP and Voltage configuration.	Press "RESET" key on keypad. If fault remains, call Baldor.
Inverter Base ID	Power base with no output phase current sensors being used.	Replace power base with one that has output leg current feedback. Contact Baldor.
Logic Supply FLT	Power supply malfunctioned.	Replace logic power supply.
Lost User Data	Battery backed memory failure.	Parameter data was erased. Disconnect power to control and apply power (cycle power). Enter all parameters. Cycle power. If problem persists, contact Baldor.
Low INIT Bus V	Improper AC line voltage.	Disconnect Dynamic Brake hardware and retry test. Check input AC voltage level.
Memory Error	EEPROM memory fault occurred.	Press "RESET" key on keypad. If fault remains, call Baldor.
μP Reset	Power was cycled before Bus voltage reached 0VDC.	Press "RESET" key on keypad. Disconnect power and allow at least 5 minutes for Bus capacitors to discharge before applying power. If fault remains, call Baldor.

Table 5-2 Troubleshooting Continued

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
Motor has wrong response to Speed Command	Analog input common mode voltage may be excessive.	Connect control input source common to control common to minimize common mode voltage. Maximum common mode voltage at terminals J1-4 and J1-5 is ±15VDC referenced to chassis common.
Motor Shaft Oscillates back and forth	Incorrect encoder alignment direction.	Change the Feedback Align parameter in the Level 1 Vector Control block. If it is Reverse, change it to Forward. If it is Forward, change it to Reverse.
Motor Shaft rotates at low speed regardless of commanded speed	Incorrect encoder alignment direction.	Check encoder connections. Change the Feedback Align parameter in the Level 1 Vector Control block. If it is Reverse, change it to Forward. If it is Forward, change it to Reverse.
Motor Shaft rotates in wrong direction	Incorrect encoder wiring.	Reverse the A and $\overline{A}$ or B and $\overline{B}$ encoder wires at the J1 input to control and change encoder direction in the Feedback Align parameter in the Level 1 Vector Control block.
Motor Will Not Start	Not enough starting torque.	Increase Current Limit setting.
	Motor overloaded.	Check for proper motor loading. Check couplings for binding. Verify proper sizing of control and motor.
	Control not in local mode of operation.	Place control in local mode.
	Motor may be commanded to run below minimum frequency setting.	Increase speed command or lower minimum frequency setting.
	Incorrect Command Select parameter.	Change Command Select parameter to match wiring at J1.
	Incorrect speed command.	Verify control is receiving proper command signal at J1.
Motor Will Not Reach Maximum Speed	Max Output Speed set too low.	Adjust MAX Output Speed parameter value.
	Motor overloaded.	Check for mechanical overload. If unloaded motor shaft does not rotate freely, check motor bearings.
	Improper speed command.	Verify control is set to proper operating mode to receive speed command. Verify control is receiving proper command signal at input terminals. Check velocity loop gains.
	Speed potentiometer failure.	Replace potentiometer.
Motor Will Not Stop Rotation	MIN Output Speed parameter set too high.	Adjust MIN Output Speed parameter value.
	Improper speed command.	Verify control is receiving proper command signal at input terminals. Verify control is set to receive speed command.
	Speed potentiometer failure.	Replace potentiometer.

Table 5-2 Troubleshooting Continued

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
New Base ID	Software parameters are not initialized on newly installed control board.	Press “RESET” key on keypad to clear the fault condition. Cycle power (turn power OFF then ON). Reset parameter values to factory settings. Access diagnostics and compare power base ID number to list in Table 5-3 to ensure a match. Re-enter the Parameter Block Values you recorded in the User Settings at the end of this manual. Autotune the control.
No EXB Installed	Incorrect operating mode programmed.	Change Operating Mode in the Level 1 Input block to one that does not require the expansion board.
	Need expansion board.	Install the correct expansion board for selected operating mode.
Over Current FLT	Current Limit parameter set lower than drive rating.	Increase PK Current Limit parameter in the Level 2 Output Limits block, not to exceed drive rating.
	ACCEL/DECEL time too short.	Increase ACCEL/DEC parameters in the Level 1 ACCEL/DECEL Rate block.
	Encoder coupling slipping, broken or misaligned.	Correct or replace encoder to motor coupling.
	Encoder bearing failure.	Replace and align encoder.
	Excessive noise on encoder lines.	Check the position counter in the Diagnostic Information for jittering which will confirm an encoder problem. Check encoder connections. Separate encoder leads from power wiring. Cross encoder wires and power leads at 90°. Electrically isolate encoder from motor. Install optional Isolated Encoder Feedback expansion board.
	Electrical noise from external DC coils.	Install reverse biased diodes across all external DC relay coils as shown in the Opto Output circuit examples of this manual. See Electrical Noise Considerations in Section 5 of this manual.
	Electrical noise from external AC coils.	Install RC snubbers on all external AC coils. See Electrical Noise Considerations in Section 5 of this manual.
	Excessive load.	Reduce the motor load. Verify proper sizing of control and motor.
Overload - 3 Sec FLT	Peak output current exceeded 3 second rating.	Check PK Current Limit parameter in the Level 2 Output Limits block. Change Overload parameter In the Level 2 Protection block from Trip to Foldback. Check motor for overloading. Increase ACCEL time. Reduce motor load. Verify proper sizing of control and motor.
	Encoder coupling slipping, broken or misaligned.	Correct or replace encoder to motor coupling.
	Encoder bearing failure.	Replace and align encoder.
Overload - 1 Min FLT	Peak output current exceeded 1 minute rating.	Check PK Current Limit parameter in the Level 2 Output Limits block. Change Overload parameter In the Level 2 Protection block from Trip to Foldback. Check motor for overloading. Increase ACCEL/DECEL times. Reduce motor load. Verify proper sizing of control and motor.
	Encoder coupling slipping, broken or misaligned.	Correct or replace encoder to motor coupling.
	Encoder bearing failure.	Replace and align encoder.
Over Speed	Motor exceeded 110% of MAX Speed parameter value.	Check Max Output Speed in the Level 2 Output Limits block. Increase Speed PROP Gain in the Level 1 Vector Control block.

Table 5-2 Troubleshooting Continued

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
Power Module	Power supply failure.	Press “RESET” key on keypad. If fault remains, call Baldor.
PWR Base FLT	Improper ground Excessive current usage.	Be sure control has separate ground wire to earth ground. Panel grounding or conduit connections is not sufficient. Disconnect motor leads from control and retry test. If fault remains, call Baldor.
	Encoder coupling slipping, broken or misaligned.	Correct or replace encoder to motor coupling.
	Encoder bearing failure.	Replace and align encoder.
	Excessive noise on encoder lines.	Check encoder connections. Separate encoder leads from power wiring. Cross encoder wires and power leads at 90°. Electrically isolate encoder from motor. Install optional Isolated Encoder Feedback expansion board.
	Electrical noise from external DC coils.	Install reverse biased diodes across all external DC relay coils as shown in the Opto Output circuit examples of this manual. See Electrical Noise Considerations in Section 7 of this manual.
	Electrical noise from external AC coils.	Install RC snubbers on all external AC coils. See Electrical Noise Considerations in Section 7 of this manual.
	Excessive load.	Correct motor load. Verify proper sizing of control and motor.
	Excessive power in dynamic brake circuit.	Verify proper Ohm and Watt parameters of DC Injection Braking. Increase decel time. Add optional dynamic braking hardware.
Regen R PWR FLT	Incorrect dynamic brake parameter.	Check Resistor Ohms and Resistor Watts parameters in the Level 2 Brake Adjust block.
	Regen power exceeded dynamic brake resistor rating.	Add optional dynamic braking hardware.
	Input voltage too high.	Verify proper AC line voltage. Use step down transformer if needed. Use line reactor to minimize spikes.
Resolver Loss	Resolver defect.	Check resolver to motor coupling (align or replace if needed). Verify correct wiring. Refer to the Resolver to Digital expansion board manual. Electrically isolate resolver from motor.
Torque Prove FLT	Unbalanced current in 3 motor phases.	Check continuity from control to motor windings and verify motor connections.
Unknown Fault	Fault occurred but cleared before its source could be identified.	Check AC line for high frequency noise. Check input switch connections and switching noise.
User Fault Text	Fault detected by custom software.	Refer to custom software fault list.

Table 5-3 Power Base ID - Series 18H

230VAC Catalog No.	Power Base ID FIF10 / FIF40 Bus Cur	FIF10 / FIF40 Phase Cur	FIF20 / FIF24 Bus Cur	FIF20 / FIF24 Phase Cur
201–E	002	802	023	823
201–W	002	802	023	823
202–E	003	803	024	824
202–W	003	803	024	824
203–E	004	804	025	825
203–W	004	804	025	825
205–E	005	805	026	826
205–W	005	805	02A	82A
207–E	006	806	027	827
207–W	006	806	027	827
207L–E			001	801
210–E	007	807	028	828
210–W			028	828
210L–E			02B	82B
215–E	01A	81A	01A	81A
215–W			01A	81A
210L–ER	00C	80C		
215V	008	808		
215L	00A	80D		
220	011	811		
220L	00E	80E		
225	01D	81D		
225V	009	809		
225L	00F	80F		
230	013	813		
230V	016	816		
230L	017	817		
240	014	814		
240L	018	818		
250	015	815		
250V	00A	80A		
250L	01C	81C		
275	829			

460VAC Catalog No.	Power Base ID FIF10 / FIF40 Bus Cur	FIF10 / FIF40 Phase Cur	FIF20 / FIF24 Bus Cur	FIF20 / FIF24 Phase Cur
401–E	202	A02	23B	A3B
401–W	202	A02	23B	A3B
402–E	203	A03	23C	A3C
402–W	203	A03	23C	A3C
403–E	204	A04	23D	A3D
403–W	204	A04	23D	A3D
405–E	205	A05	241	A41
405–W	205	A05	241	A41
407–E	206	A06	23E	A3E
407–W	206	A06	23E	A3E
407L–E			201	A01
410–E	207	A07	207	A07
410–W			207	A07
410L–E			23F	A3F
415–E	22C	A2C	242	A42
415–W			242	A42
410L–ER	208	A08		
415V	20E	A0E		
415L	20F	A0F		
420	211	A11		
420L	220	A20		
425	212	A12		
425V	20B	A0B		
425L	221	A21		
430	213	A13		
430V	20C	A0C		
430L	222	A22		
440	214	A14		
440L	223	A23		
450	215	A15		
450L	21C	A1C		
460	216	A16		
460V	20A	A0A		
460L	224	A24		
475	217	A17		
475L	21D	A1D		
4100	218	A18		
4100L		A2F		
4125L		A30		
4150		A9A		
4150V	219	A19		
4200		A9B		
4250		AA5		
4300		AAE		
4350		AA6		
4400		AA7		
4450		AA9		

575VAC Catalog No.	Power Base ID FIF10 / FIF40 Bus Cur	FIF10 / FIF40 Phase Cur	FIF20 / FIF24 Bus Cur	FIF20 / FIF24 Phase Cur
501–E	602	E02	61A	E1A
501–W	602	E02	61A	E1A
502–E	603	E03	61B	EIB
502–W	603	E03	61B	EIB
503–E	604	E04	61C	E1C
503–W	604	E04	61C	E1C
505–E	605	E05	61D	E1D
505–W	605	E05	61D	E1D
507–E	606	E06	61E	E1E
507–W	606	E06	61E	E1E
510–E	607	E07	61F	E1F
510–W	607	E07	61F	E1F
515–E	608	E08	620	E20
515–W	608	E08	620	E20
510L				
515L				
520	611	E11		
520L	60B	EOB		
525	612	E12		
525L	60C	E0C		
530	613	E13		
530L	60D	E0D		
540	614	E14		
540L	60E	E0E		
550	615	E15		
550L	60F	E0F		
560	616	E16		
575	617	E17		
5100	618	E18		
5150		E1A		
5150V	619	E19		
5200		E2A		
5250		E3A		
5300		EA4		
5350		EA5		
5400		EA6		

Note: The Power Base ID number of a control is displayed in a Diagnostic Information screen as a hexadecimal value.

Electrical Noise Considerations

All electronic devices including the Series 18H Control are vulnerable to significant electronic interference signals (commonly called "Electrical Noise"). At the lowest level, noise can cause intermittent operating errors or faults. From a circuit standpoint, 5 or 10 millivolts of noise may cause detrimental operation. For example, analog speed and torque inputs are often scaled at 5 to 10 VDC maximum with a typical resolution of one part in 1,000. Thus noise of only 5 mV represents a substantial error.

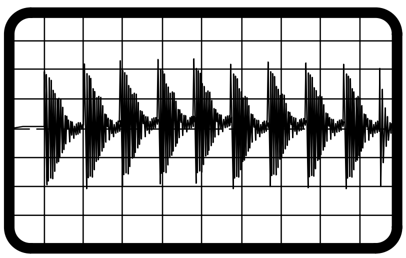
At the extreme level, significant noise can cause damage to the drive. Therefore, it is advisable to prevent noise generation and to follow wiring practices that prevent noise generated by other devices from reaching sensitive circuits. In a control, such circuits include inputs for speed, torque, control logic, and speed and position feedback, plus outputs to some indicators and computers.

Causes and Cures

Unwanted electrical noise can be produced by many sources. Depending upon the source, various methods can be used to reduce the effects of this noise and to reduce the coupling to sensitive circuits. All methods are less costly when designed into a system initially than if added after installation.

Figure 5-1 shows an oscilloscope trace of noise induced (as the coil circuit is opened) in a 1–ft. wire located next to a lead for a Size 2 contactor coil. Scope input impedance is 10KΩ for all scope traces. Maximum peak voltage is over 40V. Unless well filtered this is often enough noise to ruin the output of a productive machine.

Figure 5-1 Electrical Noise Display

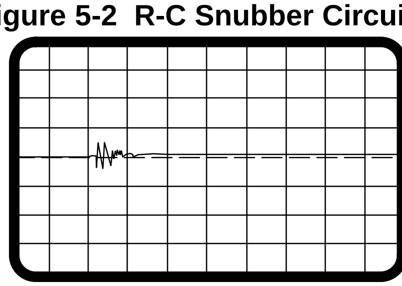


Relay and Contactor Coils

Among the most common sources of noise are the ever–present coils of contactors and relays. When these highly inductive coil circuits are opened, transient conditions often generate spikes of several hundred volts in the control circuit. These spikes can induce several volts of noise in an adjacent wire that runs parallel to a control–circuit wire.

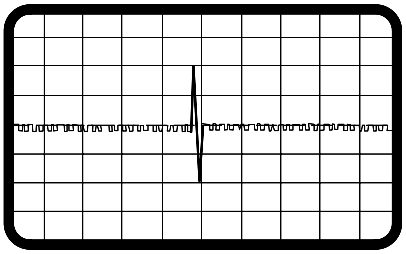
To suppress noise in these AC coils, add an R–C snubber across each relay and contactor coil. A snubber consisting of a 33KΩ resistor in series with a 0.47μF capacitor usually works well. The snubber reduces the rate of rise and peak voltage in the coil when current flow is interrupted. This eliminates arcing and reduces the noise voltage induced in adjacent wires. In our example, the noise was reduced from over 40 Vpeak to about 16 Vpeak as shown in Figure 5-2.

Figure 5-2 R-C Snubber Circuit



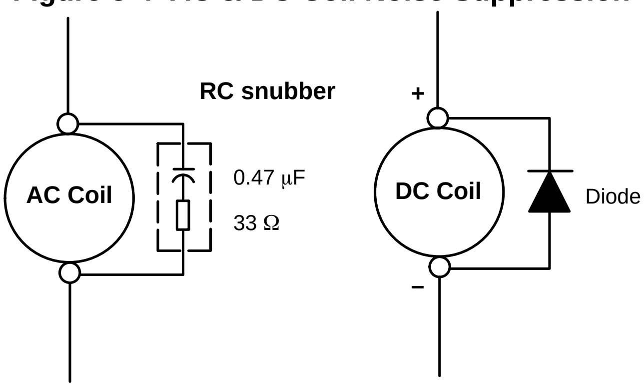
Combining an R-C snubber and twisted-pair shielded cable keeps the voltage in a circuit to less than 2 V for a fraction of a millisecond. The waveform shown in Figure 5-3 in addition to the snubber across the coil, the adjacent wire is grounded in a twisted–pair, shielded cable. Note that the vertical scale is 1 V/div., rather than the 20 V/div. in figures 5-1 and 5-2. This shows that snubbers and twisted-pair shielded wire should be used for sensitive circuits located adjacent to coil wires.

Figure 5-3 R-C Snubber Circuit & twisted-pair



A reverse biased diode across a DC coil achieves the same result as adding an R–C snubber across an AC coil, Figure 5-4.

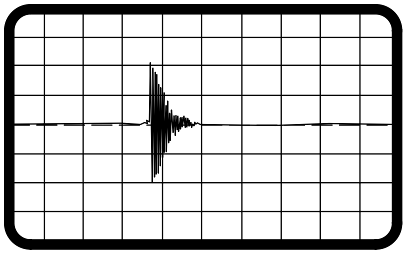
Figure 5-4 AC & DC Coil Noise Suppression



Wires between Controls and Motors

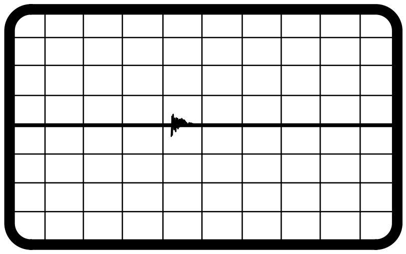
Output leads from a typical 460 VAC drive controller contain rapid voltage rises created by power semiconductors switching 650V in less than a microsecond, 1,000 to 10,000 times a second. These noise signals can couple into sensitive drive circuits as shown in Figure 5-5. For this waveform, a transient induced in 1 ft. of wire adjacent to motor lead of a 10 hp, 460 VAC drive. Scope is set at 5 V/div. and 2 μsec/div.

Figure 5-5 10HP, 460VAC Drive



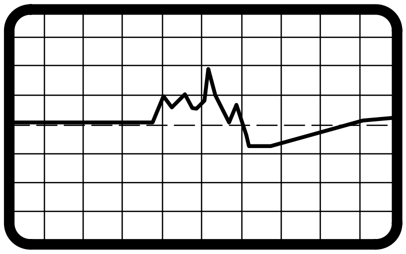
If the shielded pair cable is used, the coupling is reduced by nearly 90%, Figure 5-6.

Figure 5-6 10HP, 460VAC Drive, Shielded



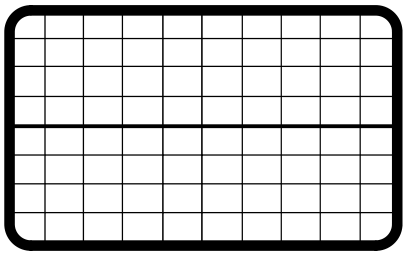
The motor leads of DC motors contain similar voltage transients. The switching rate is about 360 times a second. These noise transients can produce about 2V of noise induced in a wire adjacent to the motor lead. A 30HP, 500VDC Drive, as shown in Figure 5-7. Scope is set at 1 V/div. and 5 μsec/div.

Figure 5-7 30HP, 500VDC Drive



Again, Replacing a single wire with a shielded pair cable reduces the induced noise to less than 0.3 V, Figure 5-8.

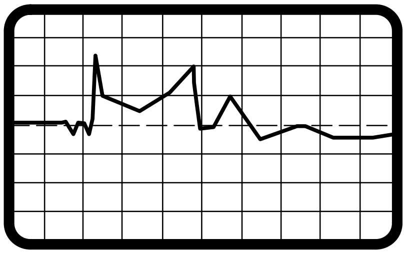
Figure 5-8 30HP, 500VDC Drive, Shielded



Electrical Noise Considerations Continued

Even input AC power lines contain noise and can induce noise in adjacent wires. This is especially severe with SCR controlled DC drives, current–source and six–step inverters. Figure 5-9 shows a transient induced in 1–ft. wire adjacent to AC input power wire to 20 hp, DC drive. Scope is set at 500 mV/div. and 2μsec/div.

Figure 5-9 30HP, 500VDC Drive, Shielded



To prevent induced transient noise in signal wires, all motor leads and AC power lines should be contained in rigid metal conduit, or flexible conduit. Do not place line conductors and load conductors in same conduit. Use separate conduit for 3 phase input wires and motor leads. The conduit should be grounded to form a shield to contain the electrical noise within the conduit path. Signal wires - even ones in shielded cable should never be placed in the conduit with motor power wires.

If flexible conduit is required, the wires should be shielded twisted-pair. Although this practice gives better protection than unshielded wires, it lacks the protection offered by rigid metal conduit.

Special Drive Situations

For severe noise situations, it may be necessary to reduce transient voltages in the wires to the motor by adding load reactors. Load reactors are installed between the control and motor. These are often required where a motor housing lacks the necessary shielding (typically linear motors mounted directly to machine frames) or where the power wires to motors are contained in flexible cables.

Reactors are typically 3% reactance and are designed for the frequencies encountered in PWM drives. For maximum benefit, the reactors should be mounted in the drive enclosure with short leads between the control and the reactors. Baldor offers a complete line of line and load reactors that will reduce ripple current and improve motor life.

Drive Power Lines

The same type of reactor as installed on the load side of the control can also suppress transients on incoming power lines. Connected on the line side of the drive, the reactor protects the adjustable–speed drive from some transients generated by other equipment and suppresses some of the transients produced by the drive itself.

Radio Transmitters

Not a common cause of noise, radio frequency transmitters, such as commercial broadcast stations, fixed short–wave stations, and mobile communications equipment (including walkie talkies) create electrical noise. The probability of this noise affecting an adjustable–speed drive increases with the use of open control enclosures, open wiring, and poor grounding.

Control Enclosures

Motor controls mounted in a grounded enclosure should also be connected to earth ground with a separate conductor to ensure best ground connection. Often grounding the control to the grounded metallic enclosure is not sufficient. Usually painted surfaces and seals prevent solid metallic contact between the control and the panel enclosure. Likewise, conduit should never be used as a ground conductor for motor power wires or signal conductors.

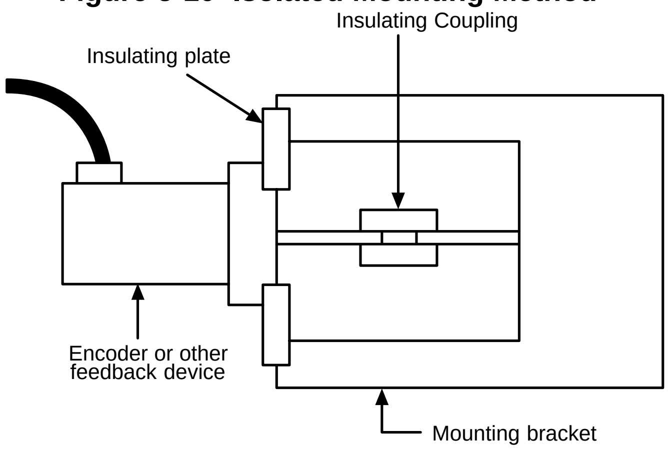
Special Motor Considerations

Motor frames are also on the required grounding list. As with control enclosures, motors should be grounded directly to the control and plant ground with as short a ground wire as possible. Here's why. Capacitive coupling within the motor windings produces transient voltages between the motor frame and ground. The severity of these voltages increases with the length of the ground wire. Installations with the motor and control mounted on a common frame, and with heavy ground wires less than 10 ft. long, rarely have a problem caused by these motor–generated transient voltages.

Another cure may be needed when the motor frame transient voltages are capacitively coupled to feedback devices mounted on the motor shaft. Especially with optical encoders, these transients create noise on the signal leads and disrupt drive operation.

To prevent this problem, add electrical isolation between the motor and the feedback device to stop the current flow and the resulting transients. The most simple isolation method, shown in Figure 5-10, has two parts: 1) A plate of electrical insulating material placed between the motor mounting surface and the feedback device. 2) An insulating coupling between motor shaft and the shaft of the feedback device.

Figure 5-10 Isolated Mounting Method



Wiring Practices

The type of wire used and how it is installed for specific applications makes the difference between obtaining reliable operation and creating additional problems.

Power Wiring Conductors carrying power to anything (motor, heater, brake coil, or lighting units, for example) should be contained in conductive conduit that is grounded at both ends. These power wires must be routed in conduit separately from signal and control wiring.

Control–logic Conductors Typically, operator's controls (push buttons and switches), relay contacts, limit switches, PLC I/O's, operator displays, and relay and contactor coils operate at 115VAC or 24VDC. Although these devices usually operate at low current levels, they contain switching noise caused by contact open/closure and solid–state switch operations. Therefore, these wires should be routed away from sensitive signal wires and contained within conduits or bundled away from open power and signal wires.

DC Tachometer Circuits Among the most sensitive circuits is the DC Tachometer. Reliability of a DC tachometer circuit is often improved by the following noise reduction techniques:

- Connect a 0.1 μF capacitor across the tachometer terminals to suppress AC noise.
- Use twisted-pair shielded wires with the shield grounded at the control end only. You should avoid grounding the shield to the tachometer case or conduit.
- Follow the practices for analog signal wiring.

Analog Signal Wires Analog signals generally originate from speed and torque controls, plus DC tachometers and process controllers. Reliability is often improved by the following noise reduction techniques:

- Use twisted-pair shielded wires with the shield grounded at the drive end only.
- Route analog signal wires away from power or control wires (all other wiring types).
- Cross power and control wires at right angles (90°) to minimize inductive noise coupling.

Encoder Circuits Adjustable speed drives are especially sensitive to high frequency noise on encoder signal lines. Because these input signals cannot be heavily filtered special care must be taken to avoid transient noise from entering these signal lines. Drive reliability can be greatly improved by using the following noise reduction techniques:

- Use line driver output encoders to reduce the encoder output impedance.
- Select line driver inputs on the adjustable speed drive.
- Install twisted-pair shielded wire for power to the encoder and having each output with its own return. (Avoid common conductors with multiple outputs or with an output and the power source.)
- Never connect the encoder ground to the power ground terminal of the control.
- Run all encoder wires independently from all other power wires.

Serial Communication Conductors Standard serial communication cables are usually made with a shield that is connected to the connector shell at both ends. This usually grounds the data source to the grounded drive chassis. If the data source is floating, such a connection offers good data transmission. However, if the data source is grounded, adding a heavy ground wire (#14 or larger) in parallel with the communication cable between the source and the drive chassis usually reduces noise problems.

Optical Isolation

Isolating electrical circuits with some form of light transmission reduces the electrical noise that is transmitted from one part of a circuit to another. That is, an electrical signal is converted to a light signal that is transmitted to a light receiver. This converts the light back to an electrical signal that has less noise than the input. Two methods are commonly used; optical couplers and fiber optics.

Optical Couplers

Optical couplers, often referred to as opto couplers use a light transmitter and light receiver in the same unit to transmit data while electrically isolating two circuits. This isolation rejects some noise. The magnitude of noise rejection is usually specified by the "common mode rejection, dv/dt rating". Typically, low cost opto couplers have a common mode rejection of 100 to 500 V/μ sec, which is adequate for most control logic signals. High performance opto couplers with common mode ratings up to 5,000 V/μ sec are installed for the most severe noise environments.

Fiber Optics

Special plastic fiber strands transmit light over long as well as short distances. Because the fibers are immune to electromagnetic energy, the use of fiber optic bundles eliminate the problem of coupling noise into such circuits. These noise–free fiber optic cables can be run with power or motor conductors because noise cannot be inductively or capacitively coupled into the fiber optic stands.

Plant Ground

Connecting electrical equipment to a good ground is essential for safety and reliable operation. In many cases, what is perceived as a ground isn't.
Result: equipment malfunctions or electrical shock hazard exists.

It may be necessary to retain the services of an electrical consultant, who is also a licensed professional engineer experienced in grounding practices to make the necessary measurements to establish if the plant ground is really grounded.

Manually Tuning the Control

In some applications the drive cannot be accurately auto-tuned in an application. In these cases it is necessary to calculate the values needed to tune the drive and manually enter these calculated parameter values.

Motor Mag Amps Parameter

This parameter is located in the Level 2, Motor Data Block. This parameter is normally entered using the nameplate data (motor no load amps) or auto–tuned. If no other data is available, set Motor Mag Amps parameter to about 40% of the motor rated current stated on the nameplate.

The following procedure should be used for setting the Motor Mag Amps parameter with the motor coupled to the load:

1. Adjust the Motor Mag Amps Parameter to 40% of the motor nameplate full load current rating.
2. Give the controller a speed command input of 80% of the Base Speed on motor nameplate.
3. Select motor voltage on keypad display by pressing the DISP key until the motor voltage value is displayed.
4. Observe the motor voltage. Ideally, it should read 80% of motor nameplate voltage. By raising the Motor Mag Amps parameter value, the motor voltage will raise proportionally. Continuing to raise the Motor Mag Amps parameter value will eventually saturate the motor voltage. By lowering the Motor Mag Amps parameter value, the motor voltage will lower proportionally.
5. While the motor is running adjust the Motor Mag Amps parameter until the display indicates the proper voltage (80% of motor rated).

Slip Frequency Parameter

This parameter is located in the Level 1, Vector Control Block. The slip frequency may be calculated from nameplate data or auto tuned.

$$F_{slip} = \text{Rated Freq} - \left[\frac{\text{(Rated RPM x Number of Motor Poles)}}{120}\right] \quad \text{OR}$$

$$F_{slip} = \text{Rated Freq} - \left(\frac{\text{Base Speed}}{\text{Sync Speed}}\right)\text{(Rated Freq)}$$

Current Prop Gain Parameter

This parameter is located in the Level 1, Vector Control Block. The Current Prop Gain parameter is normally auto–tuned when motor inductance is not known. Where auto–tuning can't be used, the proper manual setting for the proportional gain can be calculated by:

$$\text{Current PROP Gain} = \frac{[740 \text{ x } L \text{ x } (A/V)]}{VAC}$$

Where:

L = Line to neutral leakage inductance of the motor in mH
VAC = Nominal line volts
A/V = The Amps/Volt scaling of the current feedback

Motor line to neutral leakage inductance can be obtained either from the motor manufacturer or by measuring the line–to–line inductance and dividing by two.

The A/V scaling for the controller can be found in the diagnostic information located in the DISPLAY MODE.

For most applications setting the Current Prop Gain parameter to a value of 20 will yield adequate performance.

Current Int Gain Parameter

The Current Int Gain parameter located in the Level 1 Vector Control Block is factory preset at 150 Hz. This setting is suitable for essentially all systems. DO NOT CHANGE WITHOUT FACTORY APPROVAL.

Speed Prop Gain Parameter

The Speed Prop Gain parameter located in the Level 1 Vector Control Block is factory set to 10. This gain may be increased or decreased to suit the application. Increasing the Speed Prop Gain parameter will result in faster response, excessive proportional gain will cause overshoot and ringing. Decreasing the Speed Prop Gain parameter will cause slower response and decrease overshoot and ringing caused by excessive proportional gain.

Speed Int Gain Parameter

The Speed Int Gain parameter located in the Level 1 Vector Control Block is set to 1 Hz and may be set at any value from zero to 9.99 Hz. See also, PI Controller later in this section.

Setting the Speed Int Gain parameter to 0Hz removes integral compensation that results in a proportional rate loop. This selection is ideal for systems where overshoot must be avoided and substantial stiffness (ability of the controller to maintain commanded speed despite varying torque loads) isn’t required.

Increasing values of the Speed Int Gain parameter increases the low frequency gain and stiffness of the controller, an excessive integral gain setting will cause overshoot for transient speed commands and may lead to oscillation. Typical setting is 4 Hz. If the Speed Prop Gain parameter and the Speed Int Gain parameter are set too high, an overshoot condition can also occur.

To manually tune the control, the following procedure is used:

1. Set the speed Int Gain parameter = 0 (remove integral gain).
2. Increase the Speed Prop Gain parameter setting until adequate response to step speed commands is attained.
3. Increase the Speed Int Gain parameter setting to increase the stiffness of the drive, or ability to maintain speed with dynamic load changes.

Note: It is convenient to monitor speed step response with a strip chart recorder or storage oscilloscope connected to J1–6 or –7 with Level 1, Output Block Analog Out #1 or #2 set to ABS SPEED, 0 VDC = zero speed. See Section 3 for a discussion of analog outputs.

PI Controller

Both the current and rate control loops are of the Proportional plus Integral type. If "E" is defined to be the error signal,

E = Command – Feedback

then the PI controller operated on "E" as

$\text{Output} = (K_p * E) + (K_i \int E\, dt)$

where K_p is the proportional gain of the system and K_i is the integral gain of the system.

The transfer function (output /E) of the controller using 1/s (Laplace Operator) to denote the integral,

$\text{Output}/E = K_p + K_I / s = K_p (s + K_i/K_p) /s.$

The second equation shows that the ratio of K_i/K_p is a frequency in radians/sec. In the Baldor Series 18H AC Vector Control, the integral gain has been redefined to be,

$K_I = (K_i / K_p) / (2\pi)$ Hz,

and the transfer function is,

$\text{Output}/E = K_p (s + 2\pi K_I) / s.$

This sets the integral gain as a frequency in Hz. As a rule of thumb, set this frequency about 1/10 of the bandwidth of the control loop.

The proportional gain sets the open loop gain of the system, the bandwidth (speed of response) of the system. If the system is excessively noisy, it is most likely due to the proportional gain being set too high.

Section 7
Specifications, Ratings & Dimensions

Specifications:

Horsepower	1-50 HP @ 230VAC 1-500 HP @ 460VAC 1-150 HP @ 575VAC	
Input Frequency	50/60 HZ ± 5%	
Output Voltage	0 to Maximum Input VAC	
Output Current	See Ratings Table	
Service Factor	1.0	
Duty	Continuous	
Overload Capacity	Constant Torque Mode:	170-200% for 3 secs 150% for 60 secs
	Variable Torque Mode:	115% for 60 secs

Operating Conditions:

Voltage Range:	230 VAC Models	180-264 VAC 3∅ 60 Hz / 180-230 VAC 3∅ 50 Hz
	460 VAC Models	340-528 VAC 3∅ 60 Hz / 340-460 VAC 3∅ 50 Hz
	575 VAC Models	495-660 VAC 3∅ 60 Hz
Input Line Impedance:		3% Minimum Required
Ambient Operating Temperature:		0 to +40 °C Derate Output 2% per °C over 40 °C to 55 °C Max
Rated Storage Temperature:		– 30 °C to +65 °C
Enclosure:		NEMA 1: E and EO (suffix) Models NEMA 4X indoor: W (suffix) Models
Humidity:		NEMA 1: 10 to 90% RH Non-Condensing NEMA 4X indoor: To 100% RH Condensing
Altitude:		Sea level to 3300 Feet (1000 Meters) Derate 2% per 1000 Feet (303 Meters) above 3300 Feet

Keypad Display:

Display	Backlit LCD Alphanumeric 2 Lines x 16 Characters
Keys	12 key membrane with tactile response
Functions	Output status monitoring Digital speed control Parameter setting and display Diagnostic and Fault log display Motor run and jog Local/Remote toggle
LED Indicators	Forward run command Reverse run command Stop command Jog active
Remote Mount	100 feet (30.3m) max from control

Control Specifications:

Control Method	PWM
Velocity Loop Bandwidth	Adjustable to 180 Hz
Current Loop Bandwidth	Adjustable to 1200 Hz
Maximum Output Frequency	1000 Hz
Quiet Frequency Version	Full rating 1-8 KHz PWM frequency, Adjustable to 16 KHz with linear derating (between 8 - 16KHz) by 30% at 16 KHz
Standard Frequency Version	Full rating 1-2.5 KHz PWM frequency, Adjustable to 5 KHz with linear derating (between 2.5 - 5KHz) by 10% at 5 KHz
Selectable Operating Modes	Keypad Standard 3 Wire Control Two Wire Control with 15 Preset Speeds Fan Pump 2 Wire Control Fan Pump 3 Wire Control Bipolar Speed/Torque Control Serial Process

Differential Analog Input:

Common Mode Rejection	40 db
Full Scale Range	±5VDC, ±10VDC, 4-20 mA
Resolution	9 bits + sign
Update rate	500 μs

Other Analog Input:

Full Scale Range	0 - 10 VDC
Resolution	9 bits + sign
Update Rate	500 μs

Analog Outputs:

Analog Outputs	2 Assignable
Full Scale Range	0 - 5 VDC
Source Current	1 mA maximum
Resolution	8 bits
Update Rate	2.0 msec

Digital Inputs:

Opto-isolated Logic Inputs	9 Assignable
Rated Voltage	10 - 30 VDC (closed contacts std)
Input Impedance	6.8 K Ohms
Leakage Current	10 μA maximum
Update Rate	16 msec

Digital Outputs:

Opto-isolated Logic Outputs	4 Assignable
ON Current Sink	50 mA Max
ON Voltage Drop	2 VDC Max
Update Rate	33 msec
Maximum Voltage	30 VDC

Diagnostic Indications:

Current Sense Fault	Regeneration (db) Overload	Following Error
Ground Fault	Soft Start Fault	Encoder Loss
Instantaneous Over Current	Under Voltage	Logic Power Fault
Overload	Ready	
Line Power Loss	Parameter Loss	
Microprocessor Failure	Overload	
Over temperature (Motor or Control)	Overvoltage	
Over speed	Torque Proving	

Note: All specifications are subject to change without notice.

Ratings Series 18H Stock Products

CATALOG NO.	INPUT VOLT	SIZE	STANDARD 2.5 kHz PWM								QUIET 8.0 kHz PWM							
			CONSTANT TORQUE				VARIABLE TORQUE				CONSTANT TORQUE				VARIABLE TORQUE			
			HP	KW	IC	IP	HP	KW	IC	IP	HP	KW	IC	IP	HP	KW	IC	IP
ZD18H201–E, –W	230	A	1	0.75	4.0	8.0	2	1.5	6.8	7.8	0.75	0.56	3.0	6.0	1	0.75	3.6	4.2
ZD18H202–E, –W	230	A	2	1.5	7.0	14	3	2.2	9.6	11	1	0.75	4.0	8.0	2	1.5	6.8	7.8
ZD18H203–E, –W	230	A	3	2.2	10	20	5	3.7	16	19	2	1.5	7.0	14	3	2.2	9.6	11
ZD18H205–E	230	A	5	3.7	16	32	7.5	5.5	22	25	3	2.2	10	20	5	3.7	16	19
ZD18H205–W	230	B	5	3.7	16	32	7.5	5.5	22	25	3	2.2	10	20	5	3.7	16	19
ZD18H207–E, –W	230	B	7.5	5.5	22	44	10	7.4	28	32	5	3.7	16	32	7.5	5.5	22	25
ZD18H210–E	230	B	10	7.4	28	56	15	11.1	42	48	7.5	5.5	22	44	10	7.4	28	32
ZD18H210–W	230	B	10	7.4	28	56	15	11.1	42	48	7.5	5.5	22	44	10	7.4	28	32
ZD18H215–E	230	B	15	11.1	42	84	15	11.1	42	48	10	7.4	28	56	15	11.1	42	48
ZD18H215–W	230	B	15	11.1	42	84	15	11.1	42	48	10	7.4	28	56	15	11.1	42	48
ZD18H215–EO	230	C	15	11.1	42	72	20	14.9	54	62	10	7.4	30	61	15	11.1	42	48
ZD18H220–EO	230	C	20	14.9	55	100	25	18.6	68	78	15	11.1	42	92	20	14.9	54	62
ZD18H225–EO	230	C	25	18.6	68	116	30	22.3	80	92	20	14.9	54	92	25	18.6	68	78
ZD18H230–EO	230	C	30	22.3	80	140	40	29.8	104	120	25	18.6	70	122	30	22.3	80	92
ZD18H230V–EO	230	C	30	22.3	80	200	40	29.8	104	120	30	22.3	80	183	40	29.8	104	120
ZD18H240–MO	230	D	40	29.8	105	200	50	37.2	130	150	30	22.3	80	160	40	29.8	104	120
ZD18H250–MO	230	D	50	37.2	130	225	50	37.2	130	150	40	29.8	105	183	50	37.2	130	150
ZD18H250V–MO	230	D	50	37.2	130	260	50	37.2	130	150	50	37.2	130	244	50	37.2	130	150
ZD18H401–E, –W	460	A	1	0.75	2.0	4.0	2	1.5	4.0	5.0	0.75	0.56	1.5	3.0	1	0.75	2.0	3.0
ZD18H402–E, –W	460	A	2	1.5	4.0	8.0	3	2.2	5.0	6.0	1	0.75	2.0	4.0	2	1.5	4.0	5.0
ZD18H403–E, –W	460	A	3	2.2	5.0	10	5	3.7	8.0	10	2	1.5	4.0	8.0	3	2.2	5.0	6.0
ZD18H405–E, –W	460	A	5	3.7	8.0	16	7.5	5.5	11	13	3	2.2	5.0	10	5	3.7	8.0	10
ZD18H407–E	460	A	7.5	5.5	11	22	10	7.4	14	17	5	3.7	8.0	16	7.5	5.5	11	13
ZD18H407–W	460	B	7.5	5.5	11	22	10	7.4	14	17	5	3.7	8.0	16	7.5	5.5	11	13
ZD18H410–E, –W	460	B	10	7.4	14	28	15	11.1	21	25	7.5	5.5	11	22	10	7.4	14	17
ZD18H415–E	460	B	15	11.1	21	42	20	14.9	27	31	10	7.4	15	30	15	11.1	21	25
ZD18H415–W	460	B	15	11.1	21	42	20	14.9	27	31	10	7.4	15	30	15	11.1	21	25
ZD18H415–EO	460	C	15	11.1	21	36	20	14.9	27	31	10	7.4	15	30	15	11.1	21	24
ZD18H420–EO	460	C	20	14.9	27	54	25	18.6	34	39	15	11.1	21	46	20	14.9	27	31
ZD18H425–EO	460	C	25	18.6	34	58	30	22.3	40	46	20	14.9	27	46	25	18.6	34	39
ZD18H430–EO	460	C	30	22.3	40	70	40	29.8	52	60	25	18.6	35	61	30	22.3	40	46
ZD18H430V–EO	460	C	30	22.3	40	100	40	29.8	52	60	30	22.3	40	92	30	22.3	40	46
ZD18H440–EO	460	D	40	29.8	55	100	50	37.2	65	75	30	22.3	40	80	40	29.8	52	60
ZD18H450–EO	460	D	50	37.2	65	115	60	44.8	80	92	40	29.8	55	92	50	37.2	65	75
ZD18H460–EO	460	D	60	44.7	80	140	75	56	100	115	50	37.2	65	122	60	44.7	80	92
ZD18H460V–EO	460	D	60	44.7	80	200	75	56	100	115	60	44.7	80	183	60	44.7	80	92
ZD18H475–EO	460	E	75	56	100	200	100	75	125	144	60	44.7	80	160	75	56	100	115
ZD18H4100–EO	460	E	100	75	125	220	125	93	160	184	75	56	100	183	100	75	125	144
ZD18H4150V–EO	460	E	150	112	180	300	150	112	180	207	100	75	125	240	125	93	160	184
ZD18H4150–EO	460	F	150	112	190	380	200	149	240	276	125	93	150	260	150	112	170	200
ZD18H4200–EO	460	F	200	149	250	500	250	186.5	310	360	150	112	190	380	175	131	210	240
ZD18H4250–EO	460	F	250	187	310	620	300	224	370	430	200	149	250	500	250	187	310	360
ZD18H4300–EO	460	G	300	224	370	630	350	261	420	490								
ZD18H4350–EO	460	G	350	261	420	720	400	298	480	560								
ZD18H4400–EO	460	G	400	298	480	820	450	336	540	620								
ZD18H4450–EO	460	G	450	336	540	920	500	373	590	680								
ZD18H501–E	575	A	1	0.75	1.5	3.0	2.0	1.5	3.0	4.0	0.75	0.56	1.1	2.2	1	0.75	1.5	1.7
ZD18H502–E	575	A	2	1.5	3.0	6.0	3	2.2	4.0	5.0	1	0.75	1.5	3.0	2	1.5	3.0	4.0
ZD18H503–E	575	A	3	2.2	4.0	8.0	5	3.7	7.0	8.0	2	1.5	3.0	6.0	3	2.2	4.0	5.0
ZD18H505–E	575	A	5	3.7	7.0	14	7.5	5.5	9.0	11	3	2.2	4.0	8.0	5	3.7	7.0	8.0
ZD18H507–E	575	A	7.5	5.5	9.0	18	10	7.4	11	13	5	3.7	7.0	14	7.5	5.5	9	11
ZD18H510–E	575	B	10	7.4	11	22	15	11.1	17	20	7.5	5.5	9	18	10	7.4	11	13
ZD18H515–EO	575	B	15	11.1	17	34	20	14.9	22	26	10	7.4	11	22	15	11.1	17	20
ZD18H520–EO	575	C	20	14.9	22	44	25	18.6	27	31	15	11.1	17	34	20	14.9	22	25
ZD18H525–EO	575	C	25	18.6	27	46	30	22.3	32	37	20	14.9	22	38	25	18.6	27	31
ZD18H530–EO	575	C	30	22.3	32	56	40	29.8	41	47	25	18.6	27	47	30	22.3	32	37
ZD18H540–EO	575	D	40	29.8	41	75	50	37.2	52	60	30	22.3	32	58	40	29.8	41	47
ZD18H550–EO	575	D	50	37.2	52	92	60	44.7	62	71	40	29.8	41	73	50	37.2	52	60
ZD18H560–EO	575	D	60	44.7	62	109	60	44.7	62	71	50	37.2	52	91	60	44.7	62	71
ZD18H575–EO	575	E	75	56	77	155	100	75	100	115								
ZD18H5100–EO	575	E	100	75	100	200	125	93	125	145								
ZD18H5150V–EO	575	E	150	112	145	260	150	112	145	166								

Note: –E, –EO= NEMA 1 Enclosure
–W= NEMA 4X Indoor Enclosure
–MO= Protected Chassis (not NEMA1)

Ratings Series 18H Custom High Peak Current Control

CATALOG NO.	INPUT VOLT	SIZE	STANDARD 2.5 kHz PWM								QUIET 8.0 kHz PWM							
			CONSTANT TORQUE				VARIABLE TORQUE				CONSTANT TORQUE				VARIABLE TORQUE			
			HP	KW	IC	IP	HP	KW	IC	IP	HP	KW	IC	IP	HP	KW	IC	IP
ZD18H210L–ER	230	C	10	7.4	32	72	15	11.1	42	48	7.5	5.5	24	61	15	11.1	42	48
ZD18H215L–ER	230	C	15	11.1	46	108	20	14.9	54	62	10	7.4	32	92	20	14.9	54	62
ZD18H220L–ER	230	C	20	14.9	60	140	20	14.9	54	62	15	11.1	48	122	20	14.9	54	62
ZD18H225L–ER	230	C	25	18.6	75	190	25	18.6	68	78	20	14.9	60	170	20	14.9	54	62
ZD18H230L–ER	230	C	30	22.3	90	210	40	29.8	104	120	25	18.6	75	190	30	22.3	80	92
ZD18H240L–MR	230	D	40	29.8	115	270	40	29.8	115	133	30	22.3	90	240	40	29.8	104	120
ZD18H410L–ER	460	C	10	7.4	16	36	15	11.1	21	24	7.5	5.5	12	30	15	11.1	21	24
ZD18H415L–ER	460	C	15	11.1	24	54	20	14.9	27	31	10	7.4	16	46	20	14.9	27	31
ZD18H420L–ER	460	C	20	14.9	30	70	20	14.9	27	31	15	11.1	24	61	20	14.9	27	31
ZD18H425L–ER	460	C	25	18.6	38	90	25	18.6	34	38	20	14.9	30	90	20	14.9	27	31
ZD18H430L–ER	460	C	30	22.3	45	108	40	29.8	52	60	25	18.6	37	95	30	22.3	40	46
ZD18H440L–ER	460	C	40	29.8	60	140	40	29.8	60	69	30	22.3	45	122	30	22.3	40	46
ZD18H450L–ER	460	D	50	37.2	75	190	60	44.7	80	92	40	29.8	60	170	50	37.2	65	75
ZD18H460L–ER	460	D	60	44.7	90	215	75	56	100	115	50	37.2	75	190	60	44.7	80	92
ZD18H475L–EO	460	E	75	56	110	270	100	74.6	125	144	60	44.7	90	240	75	56	100	115

Ratings Series 18H Custom Vector Control w/Internal DB Transistor

CATALOG NO.	INPUT VOLT	SIZE	STANDARD 2.5 kHz PWM								QUIET 8.0 kHz PWM							
			CONSTANT TORQUE				VARIABLE TORQUE				CONSTANT TORQUE				VARIABLE TORQUE			
			HP	KW	IC	IP	HP	KW	IC	IP	HP	KW	IC	IP	HP	KW	IC	IP
ZD18H215–E	230	B	15	11.1	42	84	15	11.1	42	48	10	7.4	30	61	15	11.1	42	48
ZD18H215–ER	230	C	15	11.1	42	72	20	14.9	54	62	10	7.4	30	61	15	11.1	42	48
ZD18H220–ER	230	C	20	14.9	55	100	25	18.7	68	78	15	11.1	42	92	20	14.9	54	62
ZD18H225–ER	230	C	25	18.6	68	116	30	22.3	80	92	20	14.9	54	92	25	18.6	68	78
ZD18H230–ER	230	C	30	22.3	80	140	40	29.8	104	120	25	18.6	70	122	30	22.3	80	92
ZD18H230V–ER	230	C	30	22.3	80	200	40	29.8	104	120	30	22.3	80	183	40	29.8	104	120
ZD18H240–MR	230	D	40	29.8	105	200	50	37.2	130	150	40	29.8	105	183	50	37.2	130	150
ZD18H250V–MR	230	D	50	37.2	130	260	50	37.2	130	150	50	37.2	130	244	50	37.2	130	150
ZD18H250–MR	230	D	50	37.2	130	225	50	37.2	130	150	40	29.8	105	183	50	37.2	130	150
ZD18H415–ER	460	C	15	11.1	21	36	20	14.9	27	31	10	7.4	15	30	15	11.1	21	24
ZD18H420–ER	460	C	20	14.9	27	54	25	18.7	34	39	15	11.1	21	46	20	14.9	27	31
ZD18H425–ER	460	C	25	18.6	34	58	30	22.3	40	46	20	14.9	27	46	25	18.6	34	39
ZD18H430–ER	460	C	30	22.3	40	70	40	29.8	52	60	25	18.6	35	61	30	22.3	40	46
ZD18H430V–ER	460	C	30	22.3	40	100	40	29.8	52	60	30	22.3	40	92	30	22.3	40	46
ZD18H440–ER	460	D	40	29.8	55	100	50	37.2	65	75	30	22.3	40	80	40	29.8	52	60
ZD18H450–ER	460	D	50	37.2	65	115	60	44.8	80	92	40	29.8	55	92	50	37.2	65	75
ZD18H460–ER	460	D	60	44.7	80	140	75	56	100	115	50	37.2	65	122	60	44.7	80	92
ZD18H460V–ER	460	D	60	44.7	80	200	75	56	100	115	60	44.7	80	183	60	44.7	80	92
ZD18H515–ER	575	B	15	11.1	17	29	20	14.9	22	26	10	7.5	11	19	15	11.1	17	20
ZD18H520–ER	575	C	20	14.9	22	44	25	18.7	27	31	15	11.1	17	34	20	14.9	22	25
ZD18H525–ER	575	C	25	18.7	27	46	30	22.3	32	37	20	14.9	22	38	25	18.6	27	31
ZD18H530–ER	575	C	30	22.3	32	56	40	29.8	41	47	25	18.6	27	47	30	22.3	32	37
ZD18H540–ER	575	D	40	29.8	41	75	50	37.2	52	60	30	22.3	32	58	40	29.8	41	47
ZD18H550–ER	575	D	50	37.2	52	92	60	44.7	62	71	40	29.8	41	73	50	37.2	52	60
ZD18H560–ER	575	D	60	44.7	62	109	60	44.7	62	71	50	37.2	52	91	60	44.7	62	71

Terminal Tightening Torque Specifications

Table 7-4 Tightening Torque Specifications

230 VAC Catalog No.	Tightening Torque									
	Power TB1		Ground		Control J1		B+/R1; B+; B–; or R2		D1/D2	
	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm
ZD18H201–E or W	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H202–E or W	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H203–E or W	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H205–E	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H205–W	20	2.5	15	1.7	7	0.8	20	2.5	–	–
ZD18H207–E or W	20	2.5	15	1.7	7	0.8	20	2.5	–	–
ZD18H210–E	20	2.5	15	1.7	7	0.8	20	2.5	–	–
ZD18H210–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H210L–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H215–E	20	2.5	15	1.7	7	0.8	20	2.5	–	–
ZD18H215V–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H215V–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H215–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H215–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H215L–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H220–EO	35	4	22–26	2.5–3	7	0.8	35	4	3.5	0.4
ZD18H220–ER	35	4	22–26	2.5–3	7	0.8	35	4	–	–
ZD18H220L–ER	35	4	22–26	2.5–3	7	0.8	35	4	–	–
ZD18H225V–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H225V–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H225–EO	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	3.5	0.4
ZD18H225–ER	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	–	–
ZD18H225L–ER	35	4	22–26	2.5–3	7	0.8	35	4	–	–
ZD18H230–EO	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	3.5	0.4
ZD18H230V–EO	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	3.5	0.4
ZD18H230V–ER	35	4	22–26	2.5–3	7	0.8	35	4	–	–
ZD18H230L–ER	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	–	–
ZD18H240–MO	140	15.8	50	5.6	7	0.8	140	15.8	3.5	0.4
ZD18H240–MR	140	15.8	50	5.6	7	0.8	140	15.8	–	–
ZD18H240L–MR	140	15.8	50	5.6	7	0.8	140	15.8	–	–
ZD18H250V–MO	140	15.8	50	5.6	7	0.8	140	15.8	3.5	0.4
ZD18H250V–MR	140	15.8	50	5.6	7	0.8	140	15.8	–	–
ZD18H250–MO	140	15.8	22–26	2.5–3	7	0.8	140	15.8	3.5	0.4
ZD18H250–MR	140	15.8	22–26	2.5–3	7	0.8	140	15.8	–	–

Table 7-4 Tightening Torque Specifications Continued

460 VAC Catalog No.	Tightening Torque									
	Power TB1		Ground		Control J1		B+/R1; B+; B–; or R2		D1/D2	
	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm
ZD18H401–E or W	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H402–E or W	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H403 –E or W	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H405–E	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H405–W	20	2.5	20	2.5	7	0.8	20	2.5	–	–
ZD18H407–E or W	20	2.5	20	2.5	7	0.8	20	2.5	–	–
ZD18H410–E	20	2.5	20	2.5	7	0.8	20	2.5	–	–
ZD18H410–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H415–E	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H415V–EO	35	4	20	2.5	7	0.8	35	4	3.5	0.4
ZD18H415–EO	35	4	20	2.5	7	0.8	35	4	3.5	0.4
ZD18H415–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H415L–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H420–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H420–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H420L–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H425V–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H425V–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H425–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H425–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H425L–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H430V–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H430V–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H430–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H430L–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H440–EO	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	3.5	0.4
ZD18H440–ER	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	–	–
ZD18H440L–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H450–EO	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	3.5	0.4
ZD18H450–ER	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	–	–
ZD18H450L–ER	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	–	–
ZD18H460V–EO	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	3.5	0.4
ZD18H460V–ER	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	–	–
ZD18H460–EO	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	3.5	0.4
ZD18H460–ER	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	–	–
ZD18H460L–ER	22–26	2.5–3	22–26	2.5–3	7	0.8	22–26	2.5–3	–	–
ZD18H475–EO	140	15.8	50	5.6	7	0.8	140	15.8	3.5	0.4
ZD18H475L–EO	75	8.5	50	5.6	7	0.8	75	8.5	3.5	0.4

Table 7-4 Tightening Torque Specifications Continued

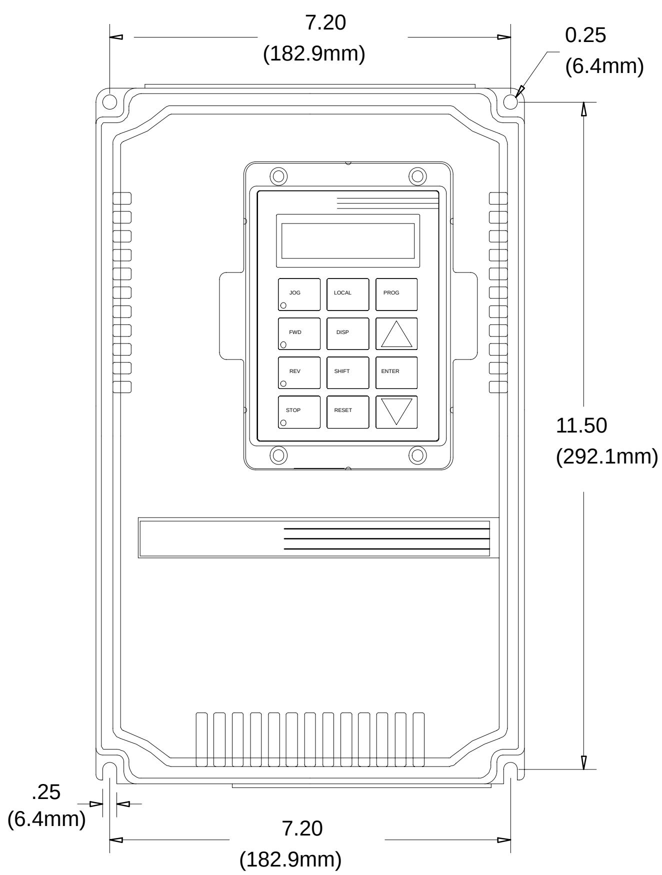
460 VAC Catalog No. Continued	Tightening Torque									
	Power TB1		Ground		Control J1		B+/R1; B+; B–; or R2		D1/D2	
	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm
ZD18H4100–EO	75	8.5	50	5.6	7	0.8	75	8.5	3.5	0.4
ZD18H4150V–EO	75	8.5	50	5.6	7	0.8	75	8.5	3.5	0.4
ZD18H4150–EO	275	31	50	5.6	7	0.8	275	31	3.5	0.4
ZD18H4200–EO	275	31	50	5.6	7	0.8	275	31	3.5	0.4
ZD18H4250–EO	375	42	375	42	7	0.8	375	42	3.5	0.4
ZD18H4300–EO	375	42	375	42	7	0.8	375	42	3.5	0.4
ZD18H4350–EO	375	42	375	42	7	0.8	375	42	3.5	0.4
ZD18H4400–EO	375	42	375	42	7	0.8	375	42	3.5	0.4
ZD18H4400–EO	375	42	375	42	7	0.8	375	42	3.5	0.4
ZD18H4450–EO	375	42	375	42	7	0.8	375	42	3.5	0.4

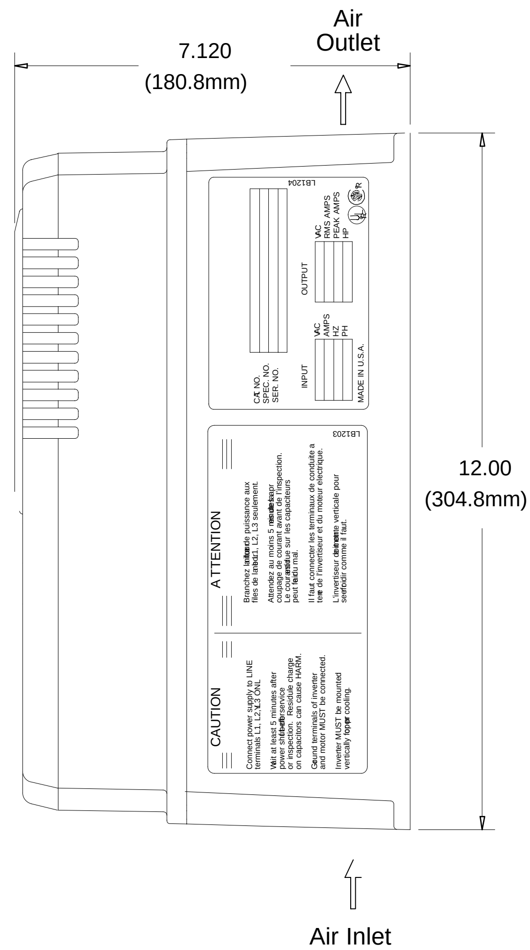
Table 7-4 Tightening Torque Specifications Continued

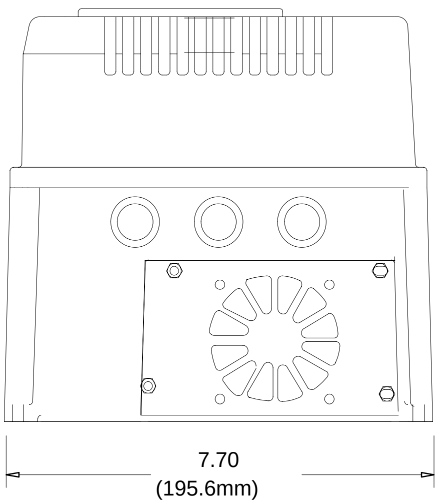
575 VAC Catalog No.	Tightening Torque									
	Power TB1		Ground		Control J1		B+/R1; B+; B–; or R2		D1/D2	
	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm	Lb-in	Nm
ZD18H501–E	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H502–E	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H503–E	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H505–E	8	0.9	15	1.7	7	0.8	8	0.9	–	–
ZD18H507–E	20	2.5	20	2.5	7	0.8	20	2.5	–	–
ZD18H510–E	20	2.5	20	2.5	7	0.8	20	2.5	–	–
ZD18H515–E	20	2.5	20	2.5	7	0.8	20	2.5	–	–
ZD18H515–EO	35	4	20	2.5	7	0.8	35	4	3.5	0.4
ZD18H515–ER	35	4	20	2.5	7	0.8	35	4	–	–
ZD18H520–EO	35	4	20	2.5	7	0.8	35	4	3.5	0.4
ZD18H520–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H525–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H525–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H530–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H530–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H540–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H540–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H550–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H550–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H560–EO	35	4	50	5.6	7	0.8	35	4	3.5	0.4
ZD18H560–ER	35	4	50	5.6	7	0.8	35	4	–	–
ZD18H575–EO	20 - 30	2.5 - 3.5	50	5.6	7	0.8	20 - 30	2.5 - 3.5	3.5	0.4
ZD18H5100–EO	20 - 30	2.5 - 3.5	50	5.6	7	0.8	20 - 30	2.5 - 3.5	3.5	0.4
ZD18H5150V–EO	35 - 50	4 - 5.7	50	5.6	7	0.8	35 - 50	4 - 5.7	3.5	0.4

Dimensions

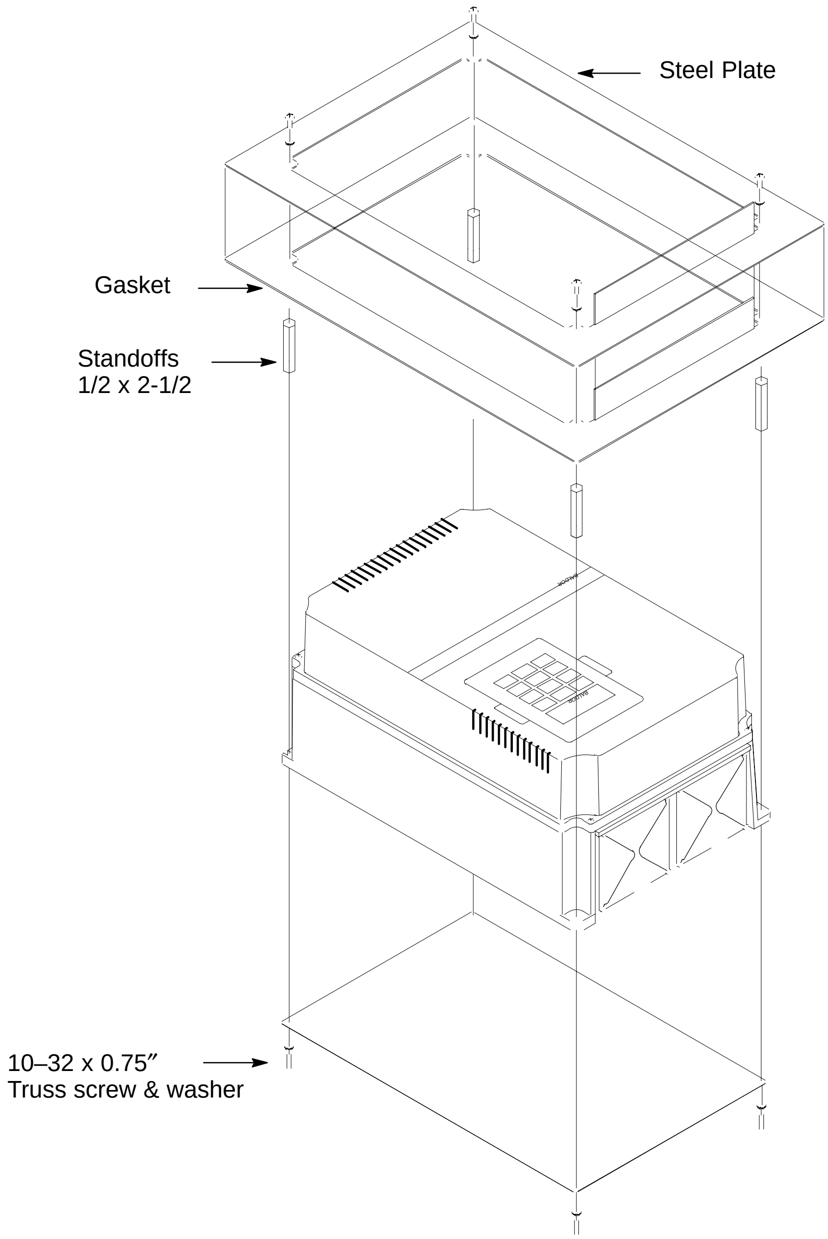
Size A Control





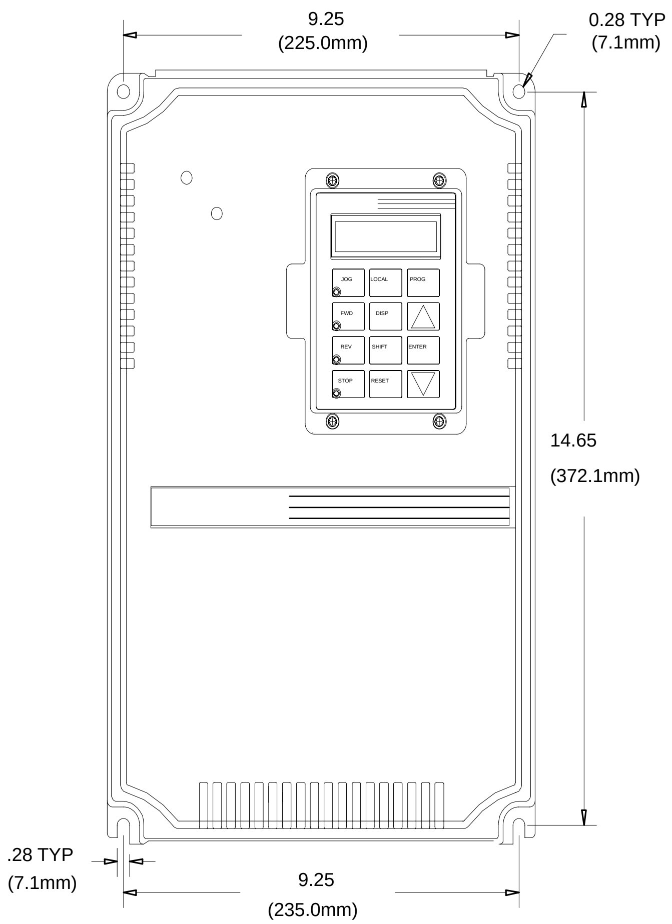


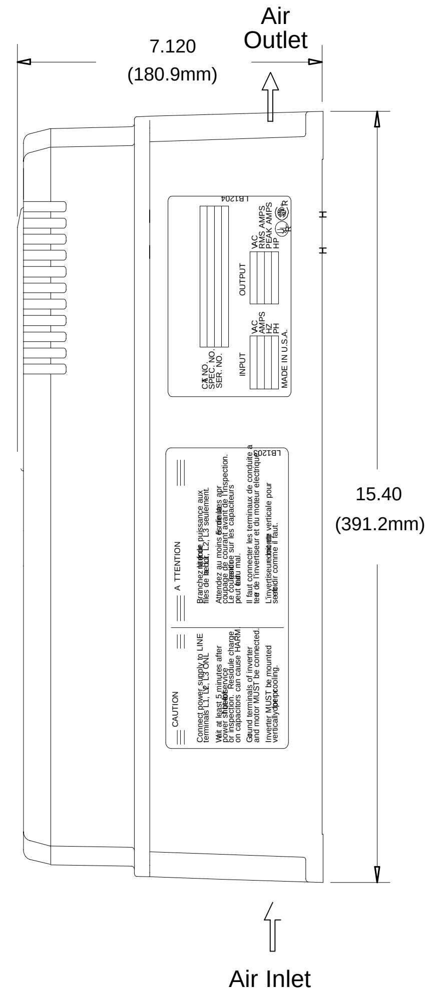
Size A Control – Through–Wall Mounting

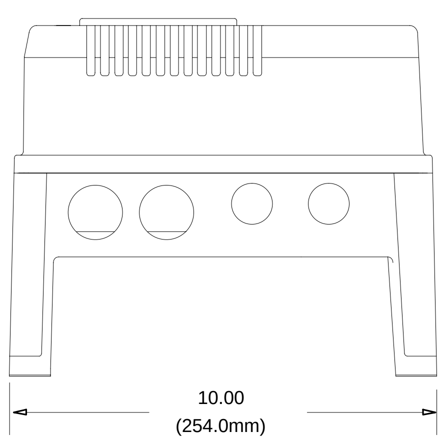


Dimensions Continued

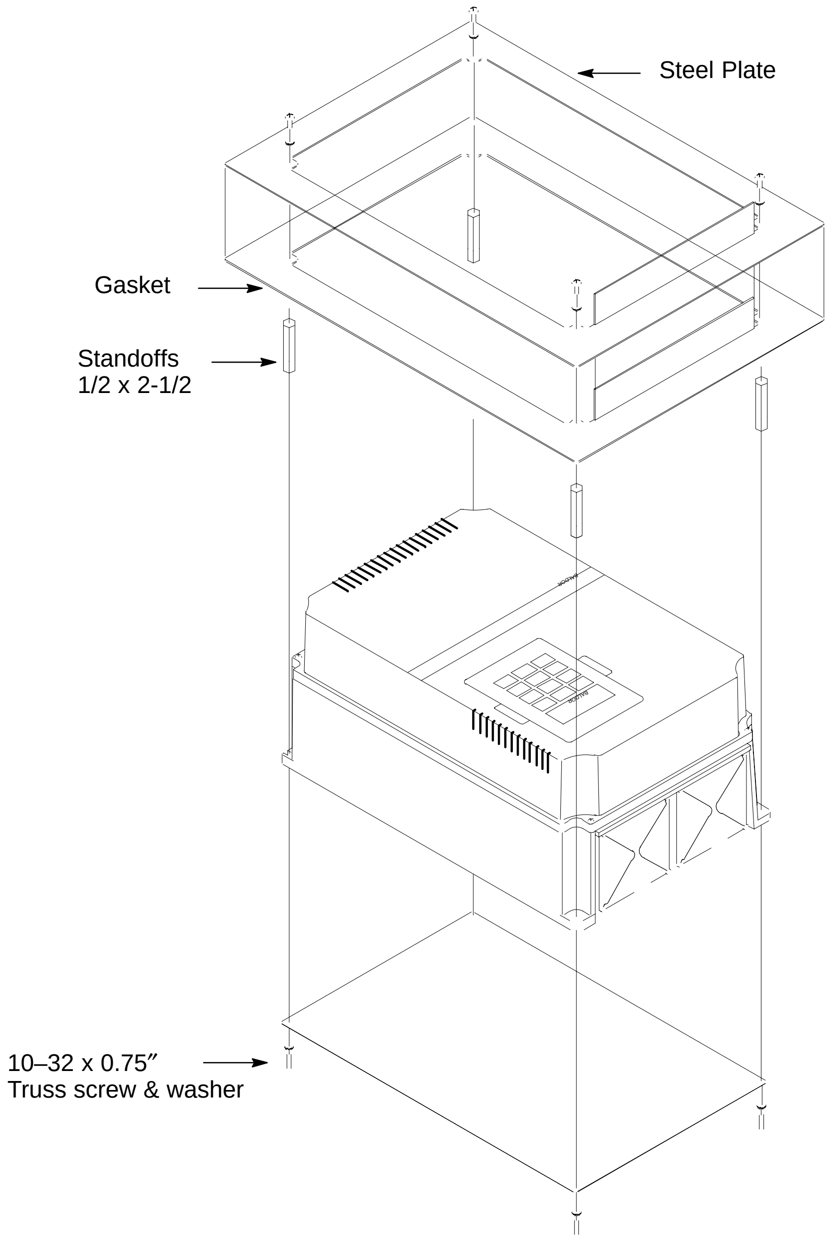
Size B Control





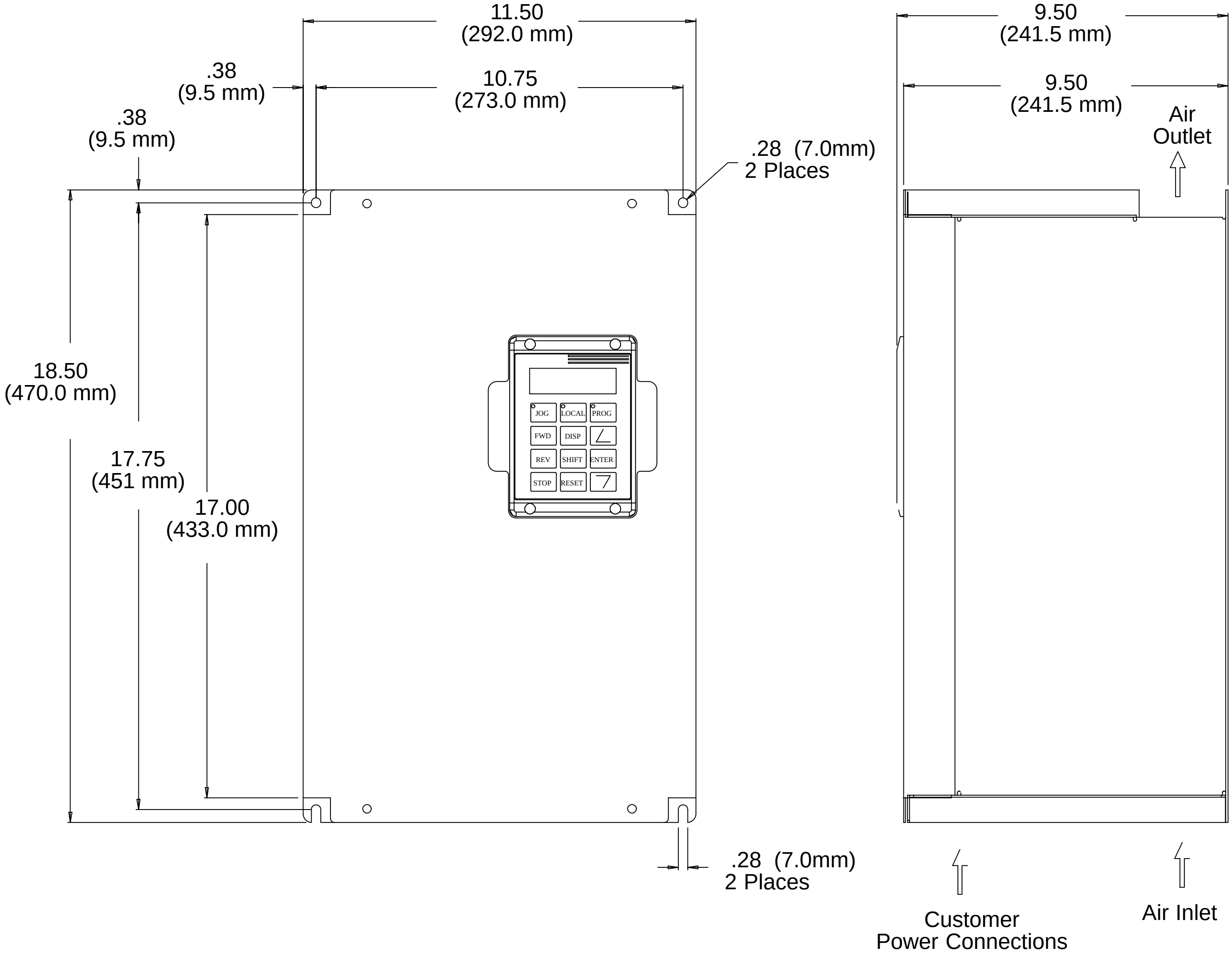


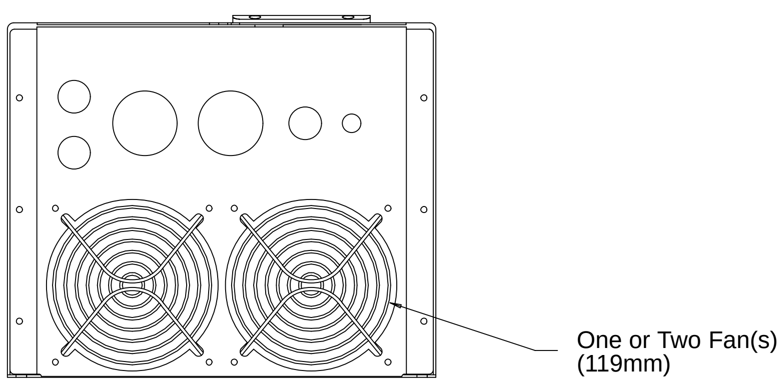
Size B Control – Through–Wall Mounting



Dimensions Continued

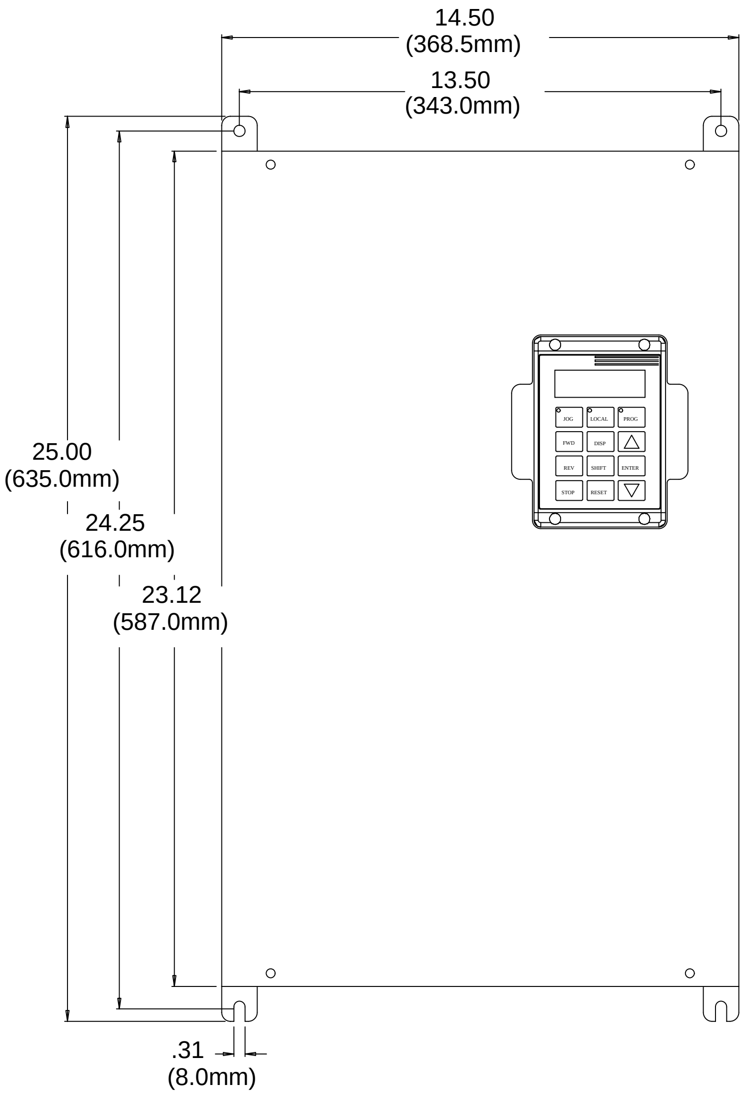
Size C Control

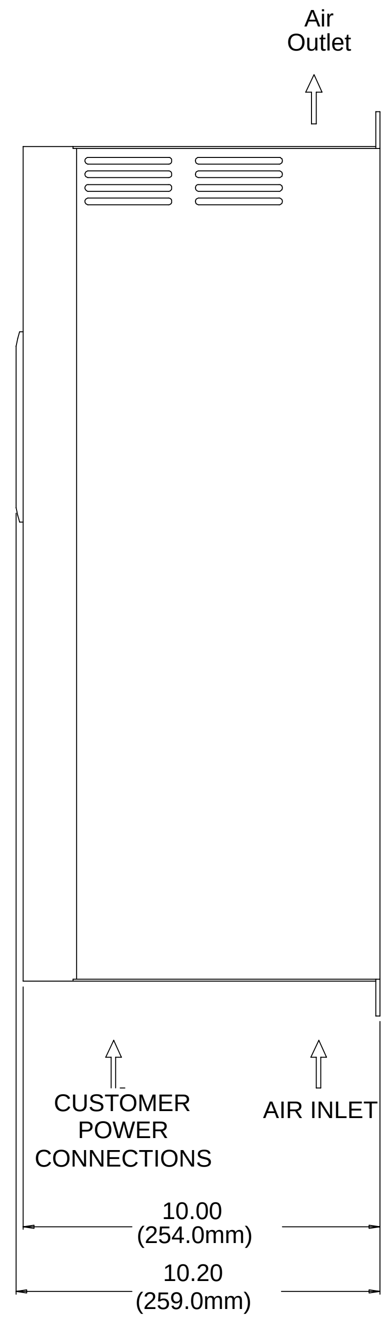


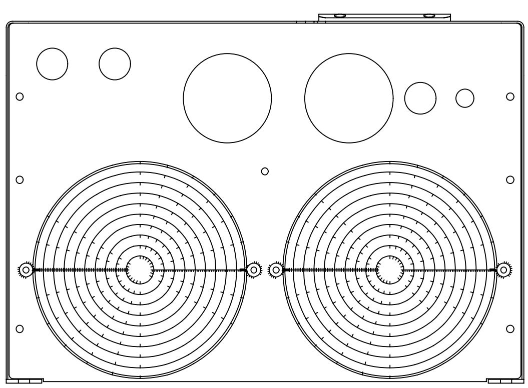


Dimensions Continued

Size D Control

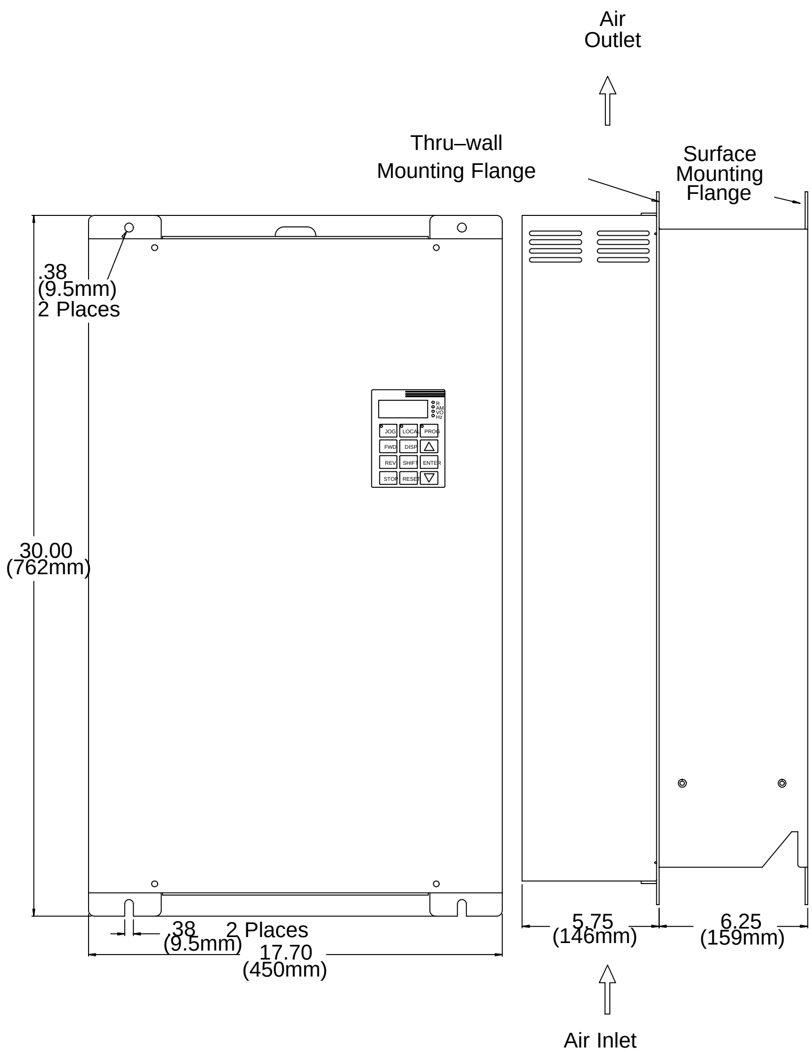




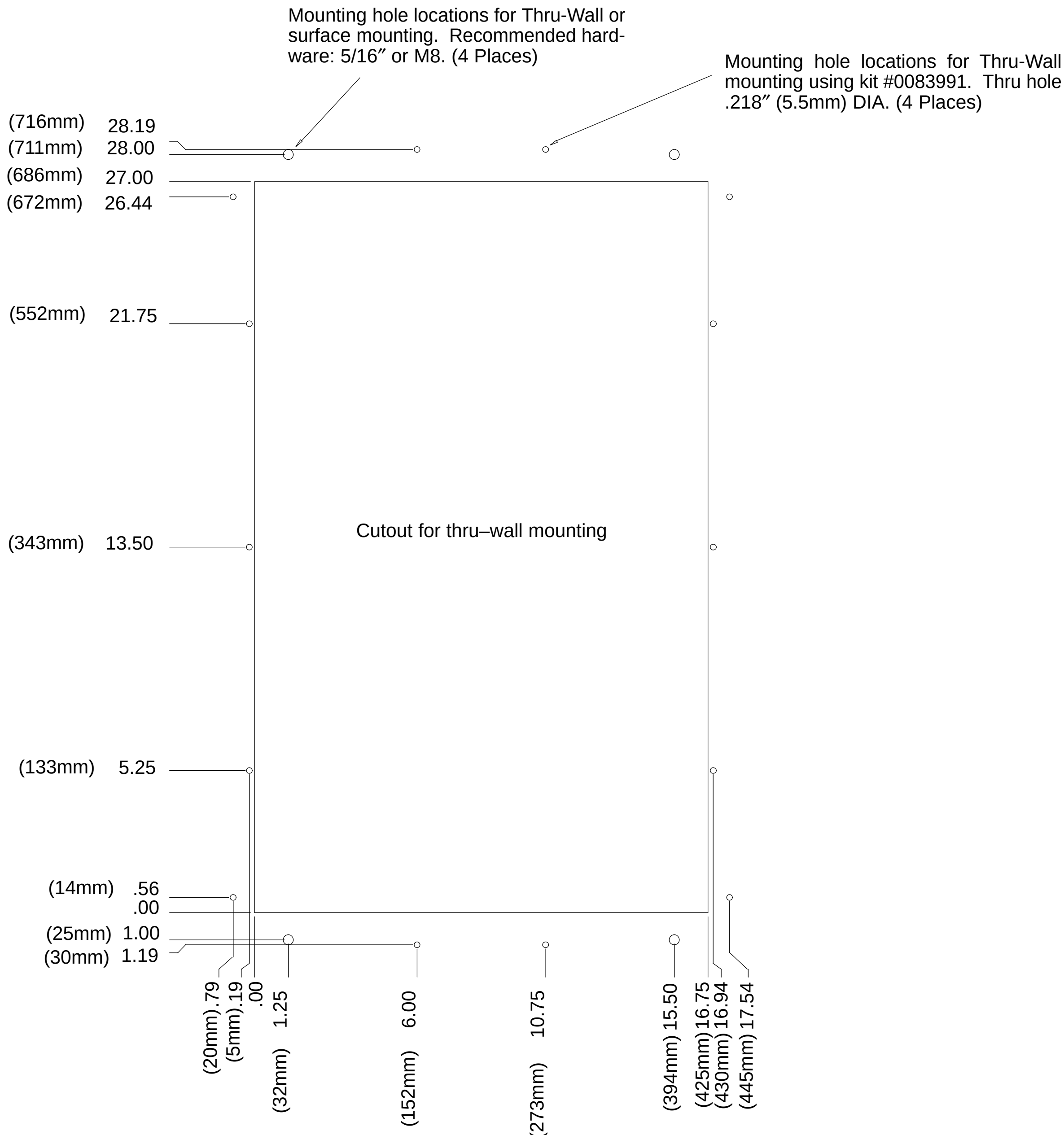


Dimensions Continued

Size E Control

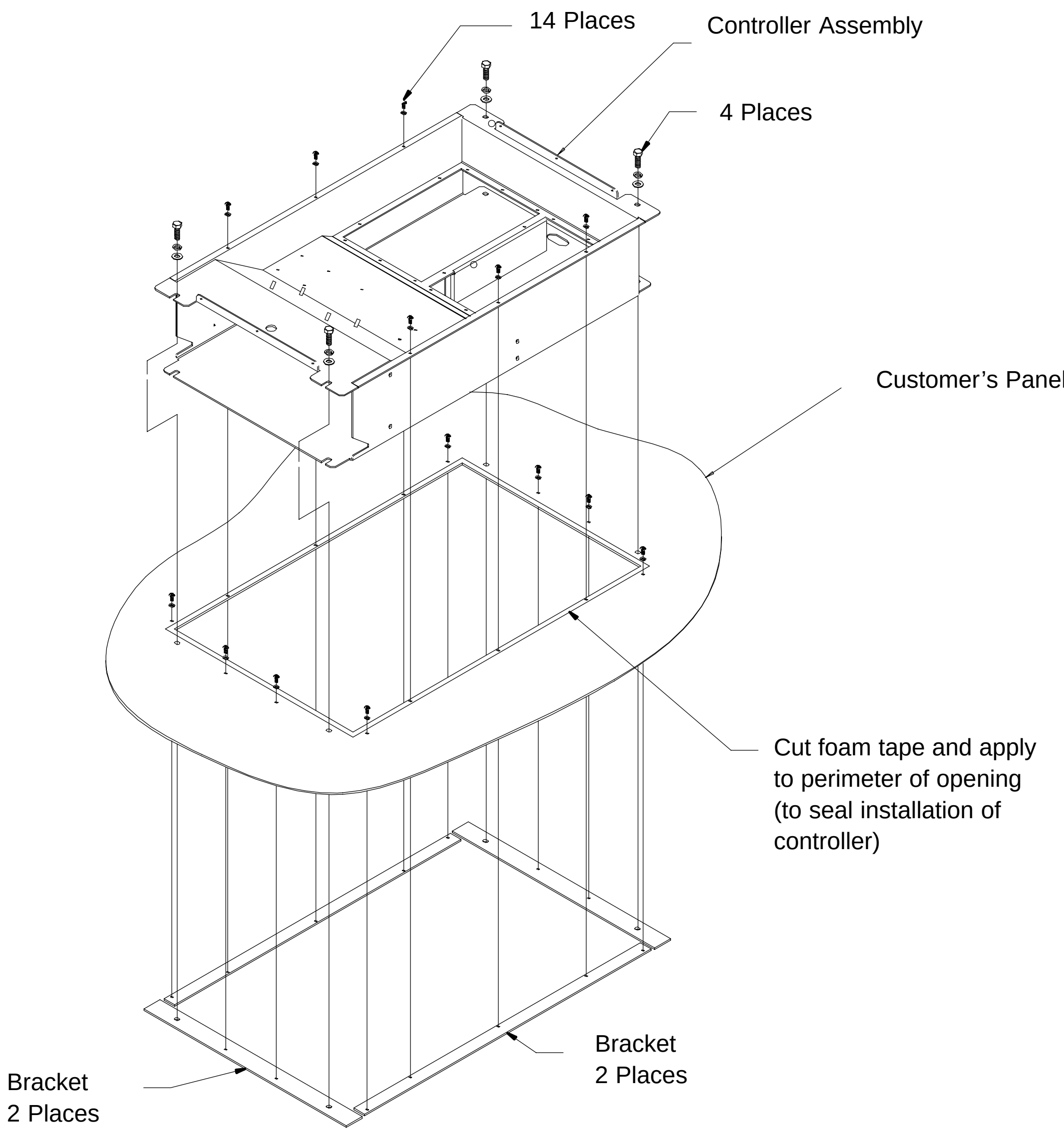


Size E Control – Through–Wall Mounting



Dimensions Continued

Size E Control – Through–Wall Mounting Continued

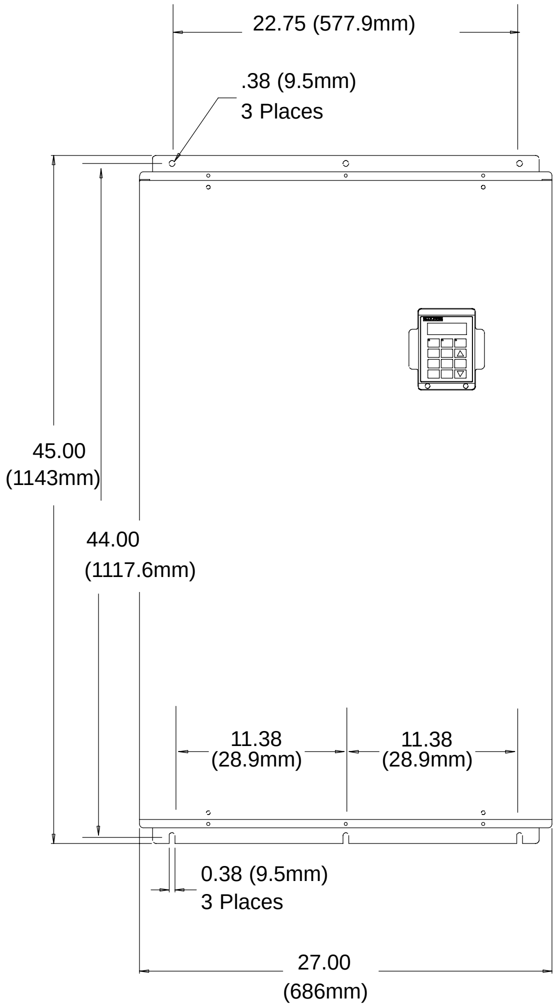


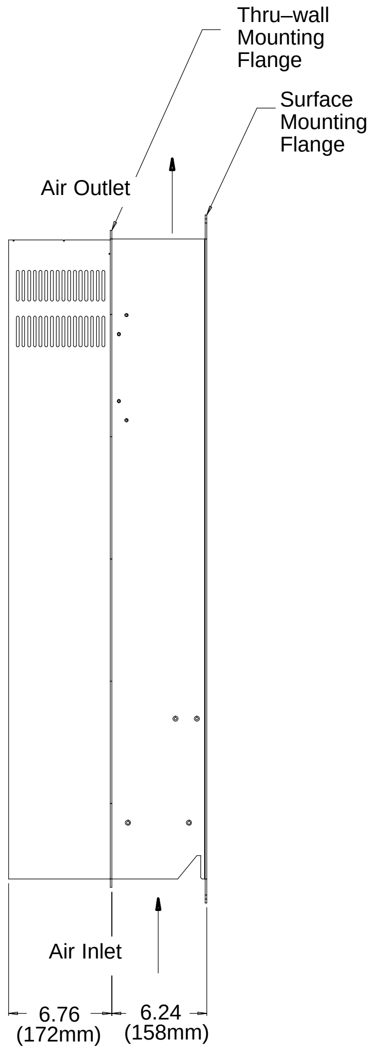
Thru–Wall Mounting Kit No. V0083991
Parts List

QTY	Part No.	Description
2	V1083991	Bracket, small (left & right)
2	V1083992	Bracket, Large (top & bottom)
14	V6300710	Screw, 10-32 x 5/8
14	V6420010	Lock Washer No. 10
4	V6390205	Hex Bolt 5/16-18 x 5/8
4	V6420032	Lock Washer 5/16
4	V6410132	Flat Washer 5/16
1	C6990204	Tape, Single coated vinyl – 3.0 Yards (2.74m)

Dimensions Continued

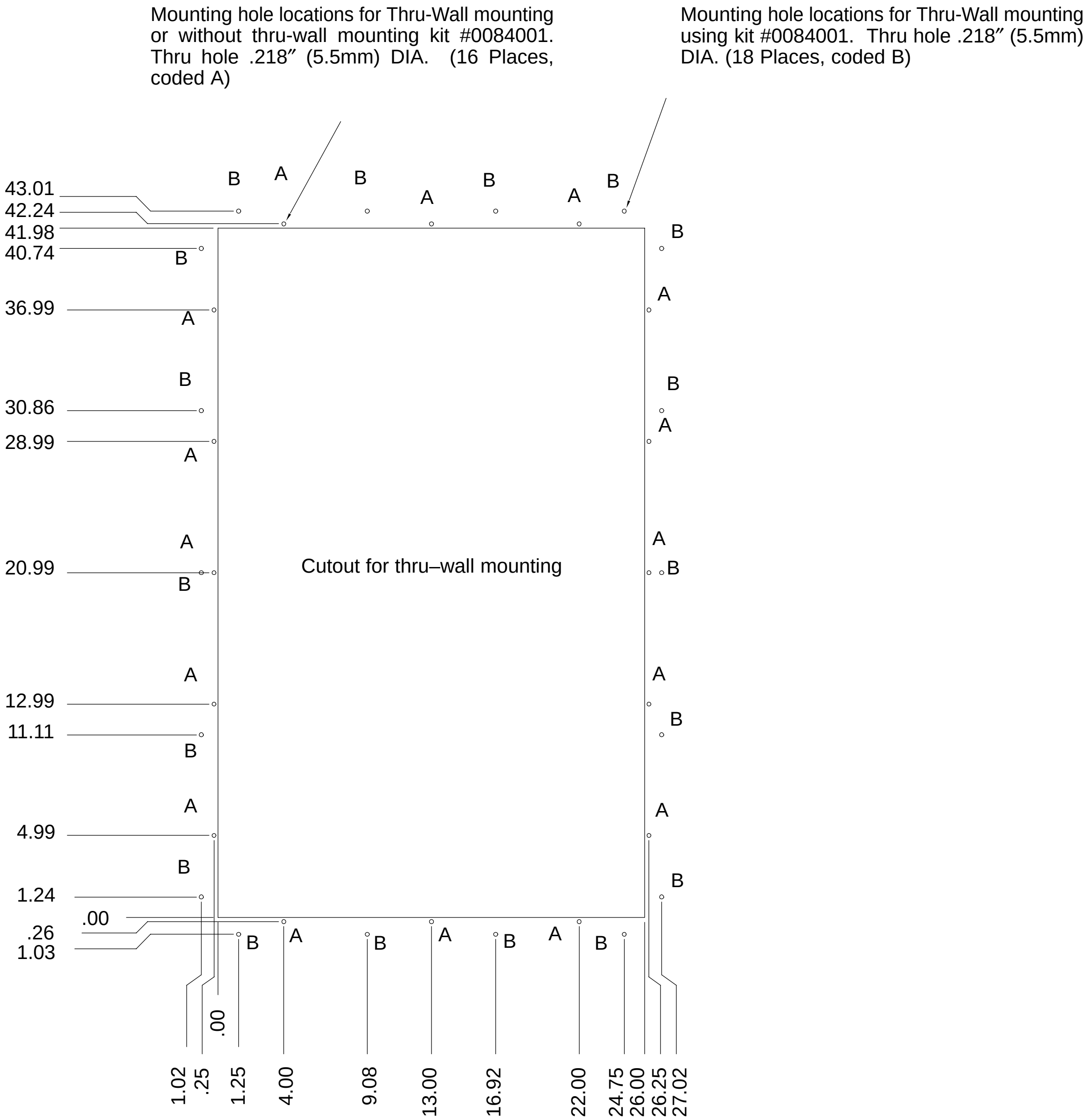
Size F Control





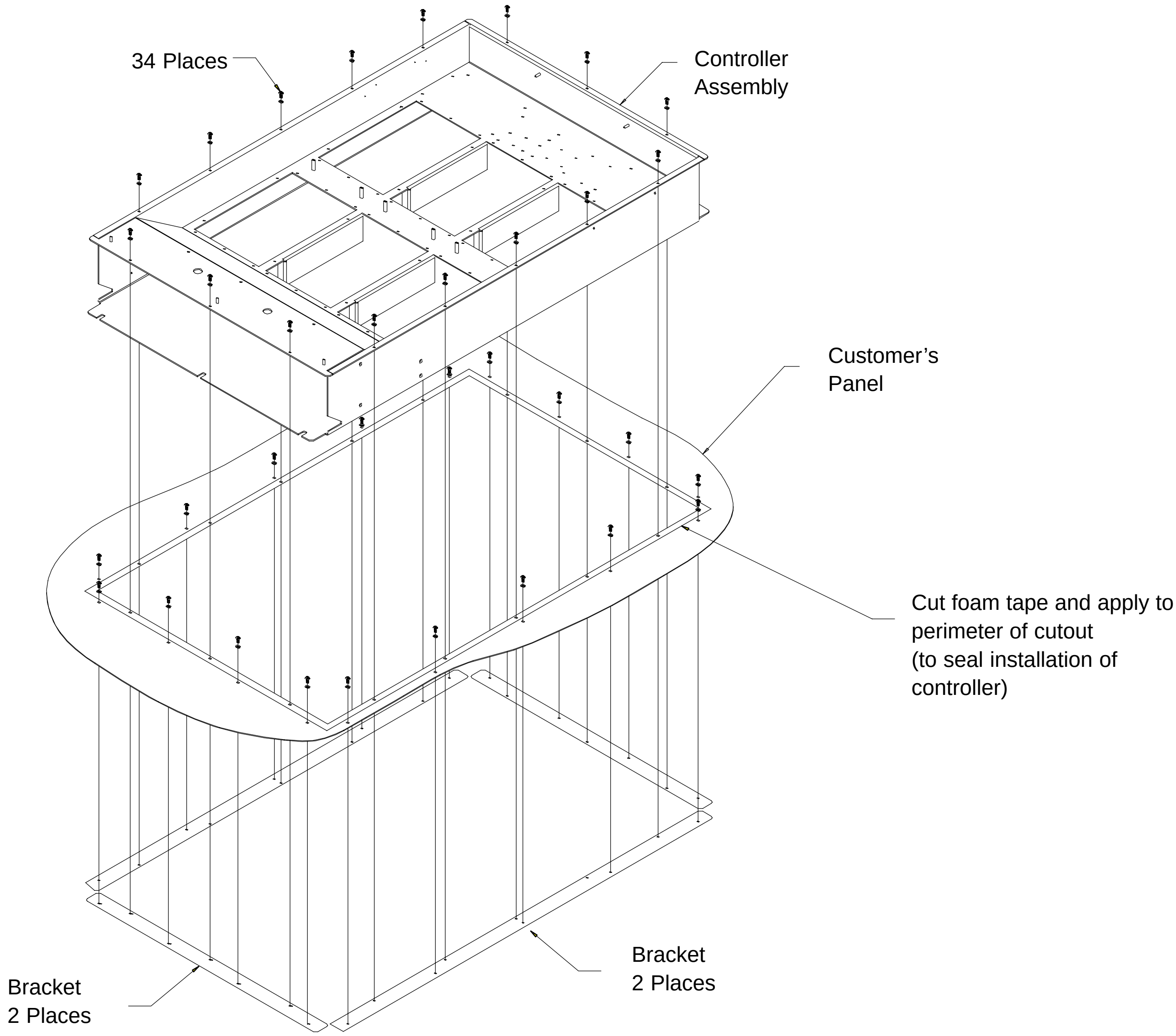
Dimensions Continued

Size F Control – Through–Wall Mounting



Dimensions Continued

Size F Control – Through–Wall Mounting Continued

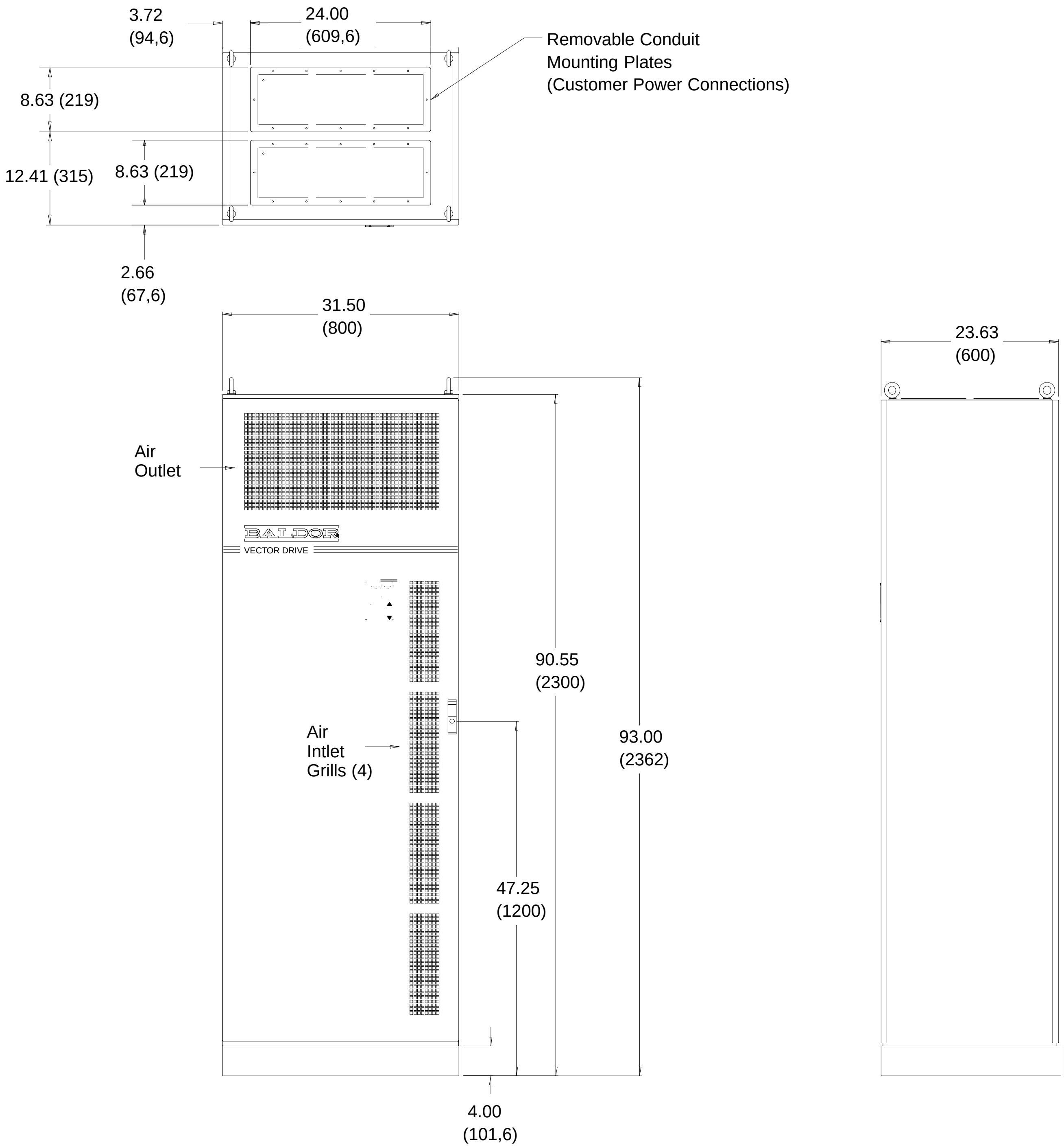


Thru–Wall Mounting Kit No. V0084001
Parts List

QTY	Part No.	Description
2	V1084002	Bracket, small (left & right)
2	V1084001	Bracket, Large (top & bottom)
34	V6300710	Screw, 10-32 x 5/8
34	V6420010	Lock Washer No. 10
1	C6990204	Tape, Single coated vinyl – 4.0 Yards (3.65m)

Dimensions Continued

Size G Control



Dynamic Braking (DB) Hardware Whenever a motor is abruptly stopped or forced to slow down quicker than if allowed to coast to a stop, the motor becomes a generator. This energy appears on the DC Bus of the control and must be dissipated using dynamic braking hardware. Dynamic braking (DB) hardware can be a resistor or transistor load. Table A-1 provides a matrix of DB turn ON and turn OFF voltages.

Table A-1

Parameter Description	Control Input Voltage		
Nominal Voltage	230VAC	460VAC	575VAC
AC Input Voltage Range	180-264VAC	340-528VAC	495-660VAC
Overvoltage Fault (Voltage exceeded)	400VDC	800VDC	992VDC
DB ON Voltage	381VDC	762VDC	952VDC
DB UTP *	388VDC	776VDC	970VDC
DB OFF Voltage	375VDC	750VDC	940VDC

* DBUTP (DB Upper Tolerance Peak) $= 1.02 \times \sqrt{2} \times V_{L-L}$

Braking torque and time should not exceed the available drive braking torque and time rating. The drive braking torque is limited to the available peak current and peak current time rating of the control. If the peak current or peak current time limit is exceeded during braking, the control may trip on an over voltage or a regen power fault. Selecting an oversized control or a line regenerative control should be considered in these cases.

Selection Procedure

1. Calculate the Watts to be dissipated using the following formulas for the appropriate load type.
2. Identify the control model number and determine which braking hardware is required based on the model number suffix: E, EO, ER, MO or MR.
3. Select appropriate braking hardware from Baldor 501 Catalog or Tables A-2, A-3 and A-4.

Hoisting Load Calculations

1. Calculate braking duty cycle:

$$\text{Duty Cycle} = \frac{\text{Lowering Time}}{\text{Total Cycle Time}}$$

2. Calculate braking Watts to be dissipated in dynamic braking resistors:

$$\text{Watts} = \frac{\text{duty cycle} \times \text{lbs} \times \text{FPM} \times \text{efficiency}}{44}$$

where: lbs = weight of load
FPM = Feet Per Minute
efficiency = mechanical efficiency
i.e., 95% = 0.95

Continued on next page

Dynamic Braking (DB) Hardware Continued

General Machinery Load Calculations:

1. Calculate braking duty cycle:

$$\text{Duty Cycle} = \frac{\text{Braking Time}}{\text{Total Cycle Time}}$$

2. Calculate deceleration torque:

$$T_{Decel} = \frac{\text{RPM change} \times Wk^2}{308 \times \text{time}} - \text{Friction}_{(Lb.Ft.)}$$

where: T_{Decel} = Deceleration torque in lb.-ft.
Wk^2 = Inertia in lb.ft.^{2}
time = In seconds

3. Calculate Watts to be dissipated in dynamic braking resistor:

$$\text{Watts} = T_{Decel} \times (S_{max} + S_{min}) \times \text{Duty Cycle} \times (0.0712)$$

where: S_{max} = Speed to start braking
S_{min} = Speed after braking

4. Multiply Watts calculated in step 3 by 1.25 to allow for unanticipated loads (safety factor).

Dynamic Braking (DB) Hardware Continued

18H Catalog Numbers with an "E" Suffix

These controls are equipped with a factory installed dynamic brake transistor and brake resistor(s). Size A controls have 400 Watts and size B controls have 800 Watts of dissipation. These can provide 100% braking torque for 6 seconds of a 20% braking duty cycle. Should additional braking capacity be required an optional externally mounted RGA brake resistor can be used in lieu of the internal resistors. See RGA assemblies.

18H Catalog Numbers with an "ER" or "MR" Suffix

These controls include a factory installed dynamic braking transistor. If dynamic braking is required, use an optional external RGA brake resistor. See RGA assemblies.

18H Catalog Numbers with an "EO" or "MO" Suffix

No dynamic braking hardware is installed in these controls. If dynamic braking is required, an optional RBA assembly or a combination of RTA and RGA assemblies should be added. The RBA assembly provide up to 4,000 Watts dynamic braking capacity. Should more capacity be required, a combination of an RTA (DB transistor) and RGA (DB resistor) should be used. Refer to RBA, RTA and RGA Assemblies description.

RGA Assemblies

RGA Assemblies include braking resistors completely assembled and mounted in a NEMA 1 enclosure. A listing of available RGA assemblies is provided in Table A-2. The minimum resistance "Minimum Ohms" shown in the table is the minimum resistor value that can be connected to the control without causing damage to the internal dynamic brake transistor for E, ER and MR controls.

RGA assemblies can also be used with EO and MO controls in combination with an RTA assembly when more than 4000 Watts of brake capacity is needed. In this case, the minimum resistance of the RGA assembly must be equal to or greater than the minimum resistance specified for the RTA assembly. Refer to Section 3 "Optional Dynamic Brake Hardware" for wiring diagram.

Table A-2 Dynamic Braking Resistor Assemblies (RGA)

Input Volts	HP	Minimum Ohms	Continuous Rated Watts						
			600	1200	2400	4800	6400	9600	14200
230	1 - 2	30	RGA630	RGA1230	RGA2430				
	3 - 5	20	RGA620	RGA1220	RGA2420	RGA4820			
	7.5 - 10	10		RGA1210	RGA2410	RGA4810			
	15 - 20	6		RGA1206	RGA2406	RGA4806			
	25 - 40	4		RGA1204	RGA2404	RGA4804			
	50	2			RGA2402	RGA4802	RGA6402	RGA9602	RGA14202
460	1 - 3	120	RGA6120	RGA12120	RGA24120				
	5 - 7.5	60	RGA660	RGA1260	RGA2460	RGA4860			
	10	30	RGA630	RGA1230	RGA2430	RGA4830			
	15 - 25	20	RGA620	RGA1220	RGA2420	RGA4820			
	30 - 60	10		RGA1210	RGA2410	RGA4810			
	75 - 250	4		RGA1204	RGA2404	RGA4804	RGA6404	RGA9604	RGA14204
	300 - 450	2			RGA2402	RGA4802	RGA6402	RGA9602	RGA14202
575	1 - 2	200	RGA6200	RGA12200	RGA24200				
	3 - 5	120	RGA6120	RGA12120	RGA24120				
	7.5 - 10	60	RGA660	RGA1260	RGA2460	RGA4860			
	15	30	RGA630	RGA1230	RGA2430	RGA4830			
	20 - 30	24		RGA1224	RGA2424	RGA4824			
	40 - 150	14			RGA2414	RGA4814	RGA6414	RGA9614	RGA14214

Dynamic Braking (DB) Hardware Continued

RBA Assemblies

An RBA Assembly includes a dynamic brake transistor and resistors completely assembled and mounted in a NEMA 1 enclosure. The are designed for EO and MO controls. Select the RBA based on the voltage rating of the control and the dynamic brake watt capacity required. Use Table A-3 to select the RBA assembly. If more than 4,000 Watts of brake capacity is required, use a combination of RTA (DB transistor) and RGA (DB resistor) assemblies. Refer to Section 3 “Optional Dynamic Brake Hardware” for wiring diagram.

Table A-3 Dynamic Braking Assemblies (RBA)

MAXIMUM BRAKING TORQUE IN % OF MOTOR RATING														Cont. Watts	Catalog No.
INPUT VOLTAGE	HP	20	25	30	40	50	60	75	100	150V	150	200	250		
	200 to 240	90%	75%	60%	45%	36%								600	RBA2-610
		150%	125%	100%	75%	62%								1800	RBA2-1806
		150%	150%	150%	115%	92%								4000	RBA2-4004
	380 to 480	150%	150%	120%	90%	72%	60%	48%	36%	28%				600	RBA4-620
		150%	150%	120%	90%	72%	60%	48%	36%	28%				1800	RBA4-1820
		150%	150%	150%	150%	150%	120%	96%	72%	56%	48%	36%	29%	4000	RBA4-4010
	550 to 600	150%	150%	120%	90%	72%	60%	48%	36%	28%				600	RBA5-624
		150%	150%	120%	90%	72%	60%	48%	36%	28%				1800	RBA5-1824
		150%	150%	150%	150%	150%	120%	96%	72%	56%				4000	RBA5-4014

Dynamic Braking (DB) Hardware Continued

RTA Assemblies

RTA assemblies include a dynamic brake transistor and gate driver circuit board completely assembled and mounted in a NEMA 1 enclosure. Brake resistors are not included in the RTA assembly. Each RTA assembly is designed to be used with an RGA dynamic brake resistor assembly. The minimum resistance of the RGA assembly must be equal to or greater than the minimum resistance specified for the RTA assembly. Select the RTA based on the voltage rating of the control and HP which provides the dynamic brake watt capacity required. Use Table A-4 to select the RTA assembly. Refer to Section 3 "Optional Dynamic Brake Hardware" for wiring diagram.

Table A-4 Dynamic Braking Transistor Assemblies (RTA)

HP	MAXIMUM BRAKING TORQUE IN % OF MOTOR RATING									
	208 - 230 VAC			380 - 480 VAC				550 - 600 VAC		
20	150%	150%	150%	150%	150%	150%	150%	150%	150%	150%
25	125%	150%	150%	150%	150%	150%	150%	150%	150%	150%
30	100%	150%	150%	120%	150%	150%	150%	150%	150%	150%
40	75%	115%	150%	90%	150%	150%	150%	127%	150%	150%
50	62%	92%	150%	72%	150%	150%	150%	100%	150%	150%
60				60%	150%	150%	150%	85%	145%	150%
75				48%	96%	150%	150%	68%	116%	150%
100				36%	72%	150%	150%	50%	87%	150%
150V				28%	56%	150%	150%	40%	70%	150%
150					48%	126%	150%	34%	58%	150%
200					36%	95%	150%	25%	44%	150%
250					29%	76%	150%		35%	122%
300						62%	125%		29%	100%
350						54%	108%			87%
400						47%	94%			76%
450						41%	84%			68%
CAT. NO.	**RTA2-6**	**RTA2-4**	**RTA2-2**	**RTA4-20**	**RTA4-10**	**RTA4-4**	**RTA4-2**	**RTA5-24**	**RTA5-14**	**RTA5-4**
Minimum Ohms	6	4	2	20	10	4	2	24	14	4

Parameter Values

Table B-1 Parameter Block Values Level 1

Level 1 Blocks					
Block Title	**Parameter**	P#	**Adjustable Range**	**Factory Setting**	**User Setting**
PRESET SPEEDS	PRESET SPEED #1	1001	0-MAX Speed	0 RPM	
	PRESET SPEED #2	1002	0-MAX Speed	0 RPM	
	PRESET SPEED #3	1003	0-MAX Speed	0 RPM	
	PRESET SPEED #4	1004	0-MAX Speed	0 RPM	
	PRESET SPEED #5	1005	0-MAX Speed	0 RPM	
	PRESET SPEED #6	1006	0-MAX Speed	0 RPM	
	PRESET SPEED #7	1007	0-MAX Speed	0 RPM	
	PRESET SPEED #8	1008	0-MAX Speed	0 RPM	
	PRESET SPEED #9	1009	0-MAX Speed	0 RPM	
	PRESET SPEED #10	1010	0-MAX Speed	0 RPM	
	PRESET SPEED #11	1011	0-MAX Speed	0 RPM	
	PRESET SPEED #12	1012	0-MAX Speed	0 RPM	
	PRESET SPEED #13	1013	0-MAX Speed	0 RPM	
	PRESET SPEED #14	1014	0-MAX Speed	0 RPM	
	PRESET SPEED #15	1015	0-MAX Speed	0 RPM	
ACCEL/DECEL RATE	ACCEL TIME #1	1101	0 to 3600 Seconds	3.0 SEC	
	DECEL TIME #1	1102	0 to 3600 Seconds	3.0 SEC	
	S-CURVE #1	1103	0-100%	0 %	
	ACCEL TIME #2	1104	0 to 3600 Seconds	3.0 SEC	
	DECEL TIME #2	1105	0 to 3600 Seconds	3.0 SEC	
	S-CURVE #2	1106	0-100%	0 %	
JOG SETTINGS	JOG SPEED	1201	0-MAX Speed	200 RPM	
	JOG ACCEL TIME	1202	0 to 3600 Seconds	3.0 SEC	
	JOG DECEL TIME	1203	0 to 3600 Seconds	3.0 SEC	
	JOG S-CURVE TIME	1204	0-100%	0 %	
KEYPAD SETUP	KEYPAD STOP KEY	1301	REMOTE OFF (Stop key inactive during remote operation). REMOTE ON (Stop key active during remote operation).	REMOTE ON	
	KEYPAD STOP MODE	1302	COAST, REGEN	REGEN	
	KEYPAD RUN FWD	1303	OFF, ON	ON	
	KEYPAD RUN REV	1304	OFF, ON	ON	
	KEYPAD JOG FWD	1305	OFF, ON	ON	
	KEYPAD JOG REV	1306	OFF, ON	ON	

Table B-1 Parameter Block Values Level 1 Continued

Level 1 Blocks - Continued					
Block Title	**Parameter**	**P#**	**Adjustable Range**	**Factory**	**User Setting**
INPUT	OPERATING MODE	1401	KEYPAD STANDARD RUN 15SPD FAN PUMP 2 WIRE FAN PUMP 3 WIRE SERIAL BIPOLAR PROCESS MODE	KEYPAD	
	COMMAND SELECT	1402	POTENTIOMETER +/-10 VOLTS +/-5 VOLTS 4 TO 20 mA 10V W/ TORQ FF EXB PULSE FOL 5V EXB 10 V EXB 4-20mA EXB 3-15 PSI EXB TACHOMETER EXB SERIAL NONE	+/-10 VOLTS	
	ANA CMD INVERSE	1403	OFF, ON	OFF	
	ANA CMD OFFSET	1404	-20.0 TO +20.0% (where ±0.5V=±20%)	0.0 %	
	ANA 2 DEADBAND	1405	0-10.00 V	0.00 V	
	ANA 1 CUR LIMIT	1406	OFF, ON	OFF	
OUTPUT	OPTO OUTPUT #1	1501	READY ZERO SPEED AT SPEED AT SET SPEED OVERLOAD KEYPAD CONTROL FAULT FOLLOWING ERR MOTR DIRECTION DRIVE ON CMD DIRECTION AT POSITION OVER TEMP WARN PROCESS ERROR DRIVE RUN	READY	
	OPTO OUTPUT #2	1502		ZERO SPEED	
	OPTO OUTPUT #3	1503		AT SPEED	
	OPTO OUTPUT #4	1504		FAULT	
	ZERO SPD SET PT	1505	0-MAX Speed	200 RPM	
	AT SPEED BAND	1506	0-1000 RPM	100 RPM	
	SET SPEED	1507	0-MAX Speed	Rated Motor Speed	

Table B-1 Parameter Block Values Level 1   Continued

Level 1 Blocks - Continued					
Block Title	**Parameter**	P#	**Adjustable Range**	**Factory**	**User Setting**
OUTPUT (Continued)	ANALOG OUT #1	1508	ABS SPEED ABS TORQUE SPEED COMMAND PWM VOLTAGE FLUX CURRENT CMD FLUX CUR LOAD CURRENT CMD LOAD CUR MOTOR CURRENT LOAD COMPONENT QUAD VOLTAGE DIRECT VOLTAGE AC VOLTAGE BUS VOLTAGE TORQUE POWER VELOCITY OVERLOAD PH2 CURRENT PH1 CURRENT PROCESS FDBK SETPOINT CMD POSITION	ABS SPEED	
	ANALOG OUT #2	1509		MOTOR CURRENT	
	ANALOG #1 SCALE	1510	10 - 100%	100%	
	ANALOG #2 SCALE	1511	10 - 100%	100%	
	POSITION BAND	1512	0-32767 CNTS	CALC	
VECTOR CONTROL	CTRL BASE SPEED	1601	0-MAX Speed	CALC	
	FEEDBACK FILTER	1602	0-7	CALC	
	FEEDBACK ALIGN	1603	FORWARD, REVERSE	FORWARD	
	CURRENT PROP GAIN	1604	0-1000	CALC	
	CURRENT INT GAIN	1605	0-400 Hz	150 Hz	
	SPEED PROP GAIN	1606	0-1000	10	
	SPEED INT GAIN	1607	0-9.99 Hz	1.00 HZ	
	SPEED DIFF GAIN	1608	0-100	0	
	POSITION GAIN	1609	0-9999	31	
	SLIP FREQUENCY	1610	0-20.00 Hz	CALC	
	STATOR R1	1611	0-65.535	CALC	
	STATOR X1	1612	0-65.535	CALC	
LEVEL 2 BLOCK	ENTERS LEVEL 2 MENU - See Table B-2.				
PRESS ENTER FOR PROGRAMMING EXIT	Exit programming mode and return to display mode.				

Table B-2 Parameter Block Values Level 2

Level 2 Blocks					
Block Title	**Parameter**	**P#**	**Adjustable Range**	**Factory**	**User Setting**
OUTPUT LIMITS	OPERATING ZONE	2001	STD CONST TQ STD VAR TQ QUIET CONST TQ QUIET VAR TQ	STD CONST TQ	
	MIN OUTPUT SPEED	2002	0-MAX Speed	0 RPM	
	MAX OUTPUT SPEED	2003	0-32767 RPM	Rated Motor Speed	
	PK CURRENT LIMIT	2004	0-PEAK RATED CURRENT	PK Control Rating	
	PWM FREQUENCY	2005	1.0-5.0 KHZ (Standard) 1.0-16.0 KHZ (Quiet)	2.5 KHZ	
	CUR RATE LIMIT	2006	0-10.00 SEC	0.000 SEC	
CUSTOM UNITS	DECIMAL PLACES	2101	0-5	5	
	VALUE AT SPEED	2102	0-65535 / 0-65535	00000/ 01000 RPM	
	UNITS OF MEASURE	2103	Selection of 9 Character Sets	-	
PROTECTION	OVERLOAD	2201	FAULT, FOLDBACK	FOLDBACK	
	EXTERNAL TRIP	2202	OFF, ON	OFF	
	LOCAL ENABLE INP	2203	OFF, ON	OFF	
	FOLLOWING ERROR	2204	OFF, ON	OFF	
	TORQUE PROVING	2205	OFF, ON	OFF	
MISCELLANEOUS	RESTART AUTO/MAN	2301	AUTOMATIC, MANUAL	MANUAL	
	RESTART FAULT/HR	2302	0-10	0	
	RESTART DELAY	2303	0-120 SECONDS	0 SEC	
	FACTORY SETTINGS	2304	YES, NO	NO	
	HOMING SPEED	2305	0-MAX Speed	100 RPM	
	HOMING OFFSET	2306	0-65535 CNTS	Encoder Counts	
SECURITY CONTROL	SECURITY STATE	2401	OFF LOCAL SECURITY SERIAL SECURITY TOTAL SECURITY	OFF	
	ACCESS TIMEOUT	2402	0-600 SEC	0 SEC	
	ACCESS CODE	2403	0-9999	9999	
MOTOR DATA	MOTOR VOLTAGE	2501	0-999 VOLTS	Factory Set	
	MOTOR RATED AMPS	2502	0-999.9	Factory Set	
	MOTOR RATED SPD	2503	0-32767 RPM	1750 RPM	
	MOTOR RATED FREQ	2504	0-1000 Hz	60.0 Hz	
	MOTOR MAG AMPS	2505	0-85% Rated Current	CALC	
	ENCODER COUNTS	2506	50-65535 CNTS	1024 PPR	
	RESOLVER SPEEDS	2507	0 to 10	0 SPEED	
	CALC PRESETS	2508	YES, NO	NO	

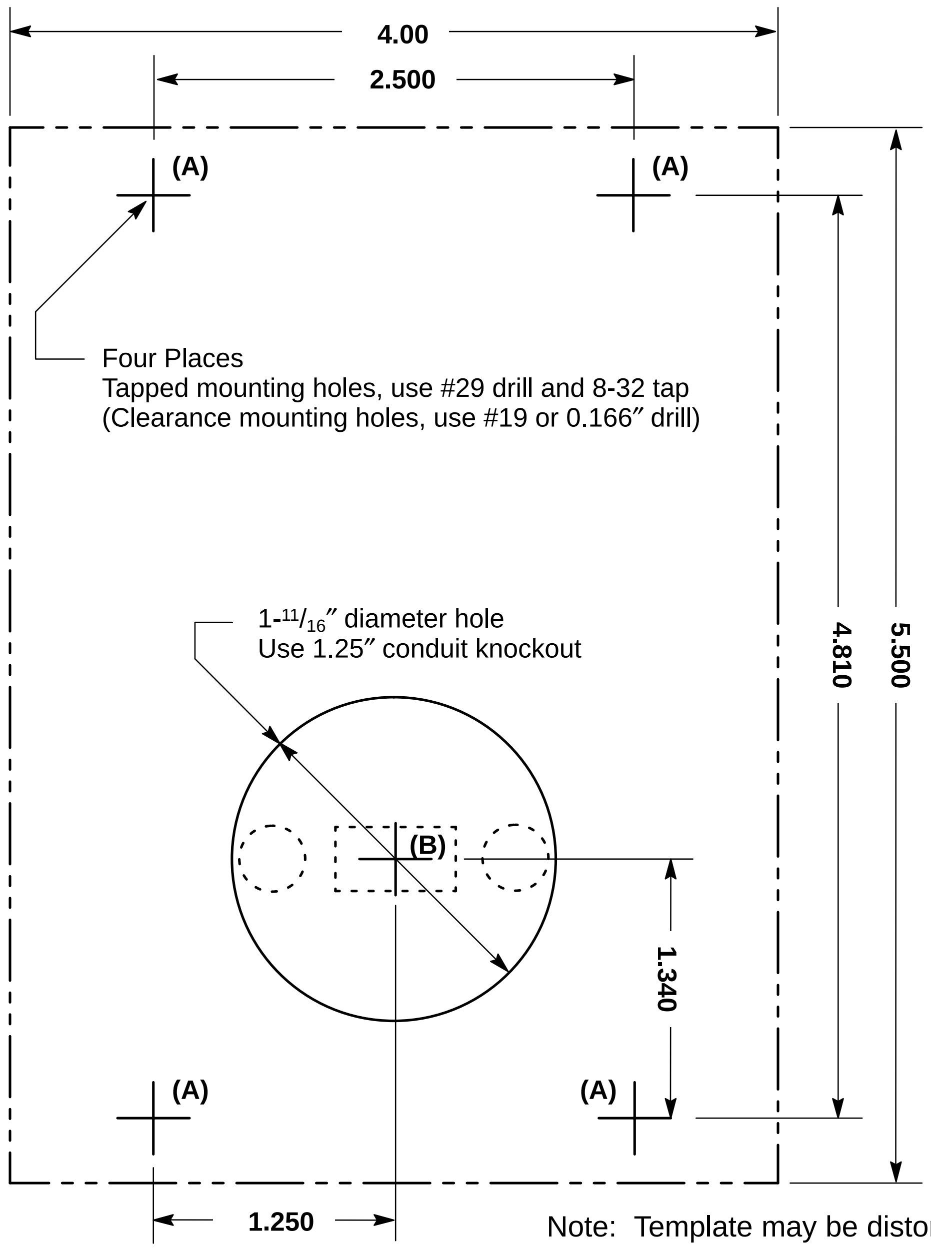
Table B-2 Parameter Block Values Level 2 Continued

Level 2 Blocks - Continued					
Block Title	**Parameter**	**P#**	**Adjustable Range**	**Factory**	**User Setting**
BRAKE ADJUST	RESISTOR OHMS	2601	0-255 Ohms	Factory Set	
	RESISTOR WATTS	2602	0-32767 Watts	Factory Set	
	DC BRAKE CURRENT	2603	0-100%	0%	
PROCESS CONTROL	PROCESS FEEDBACK	2701	POTENTIOMETER +/-10VOLTS +/-5 VOLTS 4-20mA 5V EXB 10V EXB 4-20mA EXB 3-15 PSI EXB TACHOMETER EXB NONE	NONE	
	PROCESS INVERSE	2702	OFF, ON	OFF	
	SETPOINT SOURCE	2703	SETPOINT CMD POTENTIOMETER +/-10VOLTS +/-5 VOLTS 4-20mA 5V EXB 10V EXB 4-20mA EXB 3-15 PSI EXB TACHOMETER EXB NONE	SETPOINT CMD	
	SETPOINT COMMAND	2704	–100% to +100%	0.0 %	
	SET PT ADJ LIMIT	2705	0-100%	10.0 %	
	PROCESS ERR TOL	2706	1-100%	10 %	
	PROCESS PROP GAIN	2707	0-2000	0	
	PROCESS INT GAIN	2708	0-9.99 HZ	0.00 HZ	
	PROCESS DIFF GAIN	2709	0-1000	0	
	FOLLOW I:O RATIO	2710	(1-65535) : (1-20)	1:1	
	FOLLOW I:O OUT	2711	1-65535 : 1-65535	1:1	
	MASTER ENCODER	2712	50-65535	1024 PPR	

Table B-2 Parameter Block Values Level 2 Continued

Level 2 Blocks - Continued					
Block Title	**Parameter**	**P#**	**Adjustable Range**	**Factory**	**User Setting**
COMMUNICATIONS	PROTOCOL	2801	RS–232 ASCII, RS-485 ASCII	RS–232 ASCII	
	BAUD RATE	2802	9600, 19.2KB, 38.4KB, 57.6KB, 115.2KB, 230.4KB	9600	
	DRIVE ADDRESS	2803	0 - 31	0	
AUTO-TUNING	**CALC PRESETS**	2508	YES, NO	NO	
	CMD OFFSET TRM Measures and trims out offset voltage at Analog Input #2 (J1-4 & J1-5).	AU1	-	-	
	CUR LOOP COMP Measures current response while running motor at one half the rated motor current.	AU2	-	-	
	STATOR R1 Measures stator resistance	AU3	-	-	
	FLUX CUR SETTING Sets the Motor Mag Amps.	AU4	-	-	
	FEEDBACK TESTS Checks the Master Encoder and Feedback Align values.	AU5	-	-	
	SLIP FREQ TEST Measures motor Slip Frequency during motor acceleration/deceleration at repeated intervals.	AU6	-	-	
	SPD CNTRLR CALC Measures the motor current to acceleration ratio during motor rotation. This procedure adjusts the Speed INT Gain and Speed PROP Gain parameters.	AU7		-	
LEVEL 1 BLOCK	Enters Level 1 Menu - See Table B-1.				
PRESS ENTER FOR PROGRAMMING EXIT	Exit programming mode and return to display mode.				

Remote Keypad Mounting Template



Note: Template may be distorted due to reproduction.

BALDOR ELECTRIC COMPANY
P.O. Box 2400
Ft. Smith, AR 72902–2400
(501) 646–4711
Fax (501) 648–5792

MN718
Printed in USA
9/97 C&J 2500