BALDOR®
MOTORS AND DRIVES

AC SERVO DRIVE

Series 29M
Servo Control

Installation & Operating Manual

1/98 **MN1230**

Table of Contents

Section 1
Receiving & Inspection

Receiving & Inspection

Baldor Controls are 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. Remove the Control from the shipping container and remove all packing materials. The container and packing materials may be retained for future shipment.
3. Verify that the part number of the control you received is the same as the part number listed on your purchase order.
4. Inspect the control for external physical damage that may have been sustained during shipment and report any damage immediately to the commercial carrier that delivered your control.
5. 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 humidity and temperature specifications. (Refer to Section 7 of this manual).

Section 2
General Information

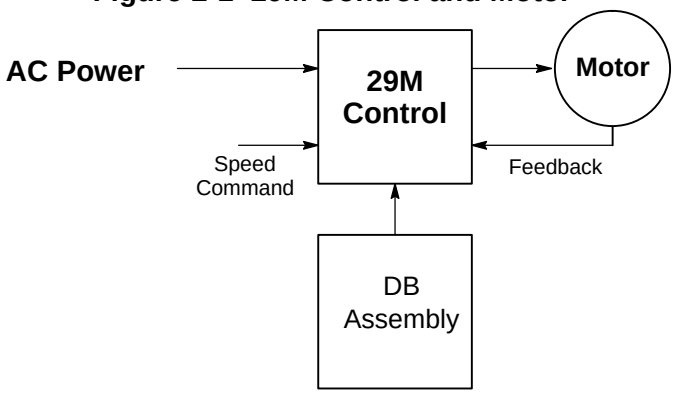
Introduction

Baldor Controls represent the latest technology in microprocessor based motor controls. The Series 29M control adjusts current to produce maximum torque (to zero speed). This provides instantaneous adjustment in response to the speed and position feedback from a shaft mounted resolver.

A keypad interface is used to program the Series 29M parameters to customize your application. The keypad is used to program the control parameters, set the mode of operation, monitor the Local mode operation status, perform diagnostics, and examine fault log.

Baldor has tried to ensure that the information in this manual is correct at the time of printing. The information is subject to change without prior notice.

Figure 2-1 29M Control and Motor



Limited Warranty

For a period of one (1) year from the date of original purchase, BALDOR will repair or replace without charge controls 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 high voltages. 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: Do not attempt to service this equipment while bus voltage is present within the control. Remove input power and wait at least 5 minutes for the residual voltage in the bus capacitors to dissipate.**

⚠ **WARNING: Be sure all wiring complies with the National Electrical Code and all regional and local codes. Improper wiring may result in unsafe conditions.**

⚠ **WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that grounds are connected. 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. 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. Peak torque of several times the rated motor torque can occur during control failure.**

⚠ **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: 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.**

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

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 115 VAC or 230 VAC control rating.**

⚠ **Caution:** **To prevent equipment damage, be certain that the input power has correctly sized protective devices installed as well as a power disconnect.**

⚠ **CAUTION:** **Avoid locating control immediately above or beside heat generating equipment, or directly below water or steam pipes.**

⚠ **CAUTION:** **Avoid locating control in the vicinity of corrosive substances or vapors, metal particles and dust.**

⚠ **Caution:** **Do not connect any shields to the motor frame. At a minimum, resolver signal integrity will be compromised and damage to the control may result.**

Section 3
Installation

Location Considerations

The location of the control 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 can reduce the operating life and degrade performance of the control.

⚠ **CAUTION: Avoid locating control immediately above or beside heat generating equipment, or directly below water or steam pipes.**

⚠ **CAUTION: Avoid locating control in the vicinity of corrosive substances or vapors, metal particles and dust.**

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

1. For effective cooling and maintenance, the control should be mounted on a smooth, non-flammable vertical surface. The amount of heat generated within the control can be calculated based on Table 3-1.
2. At least two inches top and bottom clearance must be provided for air flow.
3. **Altitude derating**. Up to 3300 feet (1000 meters) no derating required. Above 3300 feet, derate the continuous and peak output current by 11% for each 3300 feet (1000 meters) above 3300 feet.
4. **Temperature derating**. From 5°C to 40°C ambient no derating required. Maximum ambient is 40°C.

Table 3-1 Control Efficiency

115 VAC / 230 VAC
>97%

Mechanical Installation

Mount the control to the mounting surface. The control must be securely fastened to the mounting surface. Use the two (2) mounting holes to fasten the control to the mounting surface or enclosure. The location of the mounting holes are shown in Section 7 of this manual.

Remote Keypad Installation The keypad may be remotely mounted using the optional Baldor keypad extension cable. The keypad assembly (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 4 indoor enclosure, it retains the Type 4 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

All external wires for the control should be run in conduit that is separate from power wiring. The use of shielded wire is recommended for all control wiring.

When interconnecting wires from power source, control, motor, host controller and other devices it is important to make proper electrical connections. A connection must ensure that proper electrical connection and mechanical bond of conductors. Use only UL (cUL) listed connectors for the wire gauge and type being connected. Connectors are to be installed using the crimp tool specified by the connector manufacturer. Wire with Class 1 wiring.

Overload Protection

Baldor Controls feature motor overload protection suitable for motors that consume at least 50% of the output rating of the control. Other governing agencies such as NEC (National Electric Code) may require separate over current protection. The installer of this equipment is responsible for complying with NEC guidelines and CE directives (Conformite Europeene) and applicable local codes that govern wiring protection, grounding, disconnects and other current protection.

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.

Protection Devices

The control must have a suitable input power protection device installed. Input and output wire size is based on the use of copper conductor wire rated at 75 °C. Use the recommended circuit breaker or fuse types as follows:

Circuit Breaker: 1 phase, thermal magnetic.
Equal to GE type THQ or TEB for 115 or 230 VAC

Fast Action Fuses: Buss KTN on 115 or 230 VAC.

Time Delay Fuses: Buss
Buss FRN on 115 or 230 VAC.

Table 3-2 describes the wire size to be used for power connections and the ratings of the protection devices.

Table 3-2 Wire Size and Protection Devices

Catalog Number	Maximum Continuous Amps	Input Breaker	Input Fuse		Wire Gauge	
			Fast Acting	Time Delay	AWG	mm^2
SD29M1A02-PR	2.5	18	4	4	#14	2.5
SD29M1A05-PR	5	35	8	8	#14	2.5
SD29M2A02-PR	2.5	18	4	4	#14	2.5
SD29M2A05-PR	5	35	8	8	#14	2.5

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.

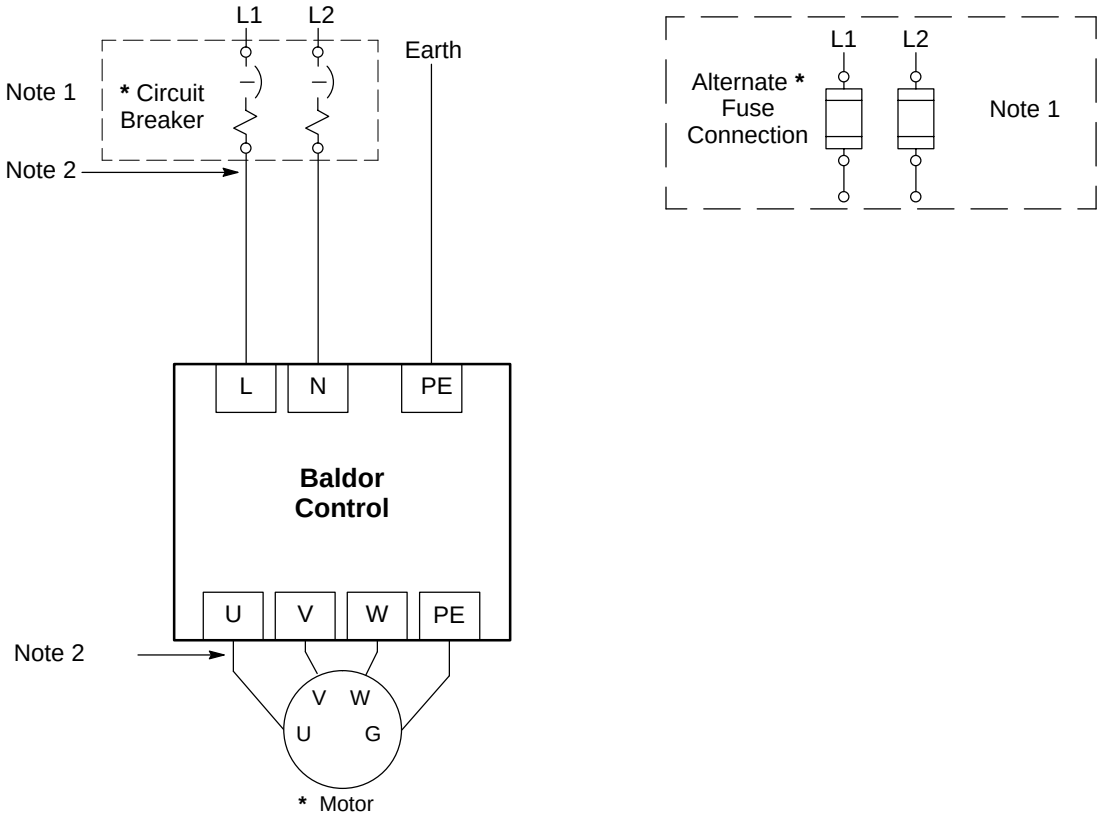
Table 3-3 Short Circuit Current Ratings

115VAC		230VAC	
Catalog Numbers	**Max. Line Short Circuit Current**	**Catalog Numbers**	**Max. Line Short Circuit Current**
SD29M1A02-PR	150	SD29M2A02-PR	150
SD29M1A05-PR	300	SD29M2A05-PR	300

Table 3-4 Input Current Requirements

230VAC		460VAC	
Catalog Numbers	**Input Amps**	**Catalog Numbers**	**Input Amps**
SD29M1A02-PR	2.6	SD29M2A02-PR	2.6
SD29M1A05-PR	5.2	SD29M2A05-PR	5.2

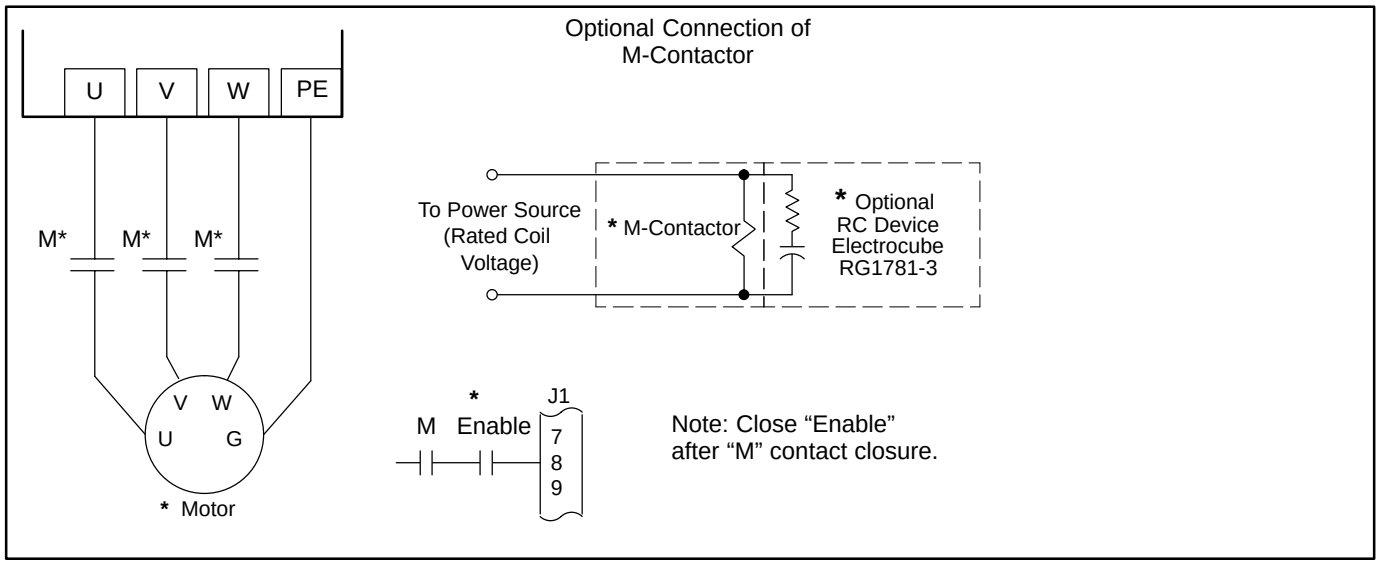
Figure 3-1 Single Phase AC Power and Motor Connections



Notes:

1. See Protective Device description in this section of the manual.
2. Shield wires inside a metal conduit.

***** Optional components not provided with Control.



See Recommended Tightening Torques in Section 7.

AC and DC Power Connections Refer to Figures 3-1 and 3-3.

⚠ **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.**

1. Connect the single phase incoming power wires from the protection devices to the control terminal X1 pins L and N. Torque as specified.
2. Connect earth ground (plant ground) to control terminal X1 pin PE. Torque as specified.

Motor Connections

A motor circuit contactor (M-Contactor shown in Figure 3-1) is recommended and should be installed to provide a positive disconnect of the motor from the control. This ensures that the motor shaft will not rotate and cause damage or injury. The M-contactor should open the Enable line (J1B pin 8) 20 msec before the main M-Contacts open. This will prevent contact arcing and allows use of IEC rated contacts.

1. Connect the “U” terminal of the 29M to the U motor lead.
2. Connect the “V” terminal of the 29M to the V motor lead.
3. Connect the “W” terminal of the 29M to the W motor lead.
4. Connect the “PE” terminal of the 29M to motor ground (G).

Dynamic Brake Resistor

An external DB (Dynamic Brake) resistor must be installed to dissipate excess power from the DC bus during motor deceleration operations.

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

1. Mount the DB resistor near the top of the enclosure.
2. Connect one wire from the DB resistor to terminal DB+ of the control.
3. Connect the other wire from the DB resistor to terminal DB– of the control.

Note: For selection of the DB resistor, refer to the Specifications located in Section 7 of this manual.

Figure 3-2 DB Resistor Installation Considerations

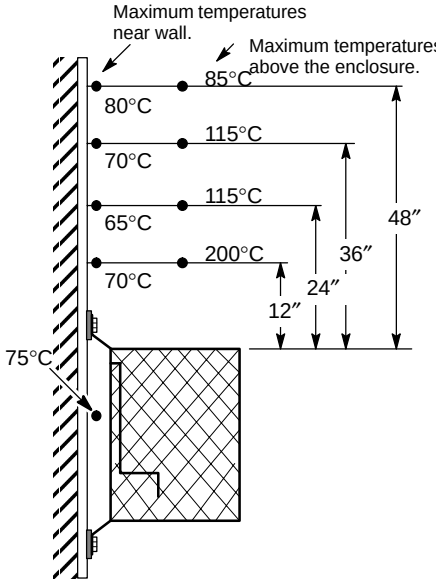
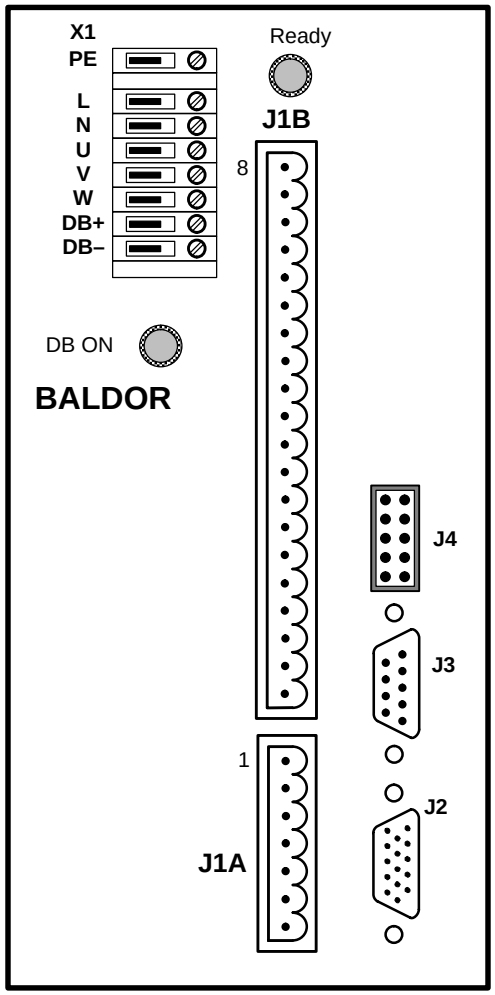


Figure 3-3 29M AC Servo Connector Locations

X1 - Power Connector

PE	Earth	Input Power
L	AC Line	
N	Neutral	
U	Motor lead “U”	Motor
V	Motor lead “V”	
W	Motor lead “W”	
DB+	Dynamic Brake	Dynamic Brake or Regen Resistor
DB–	Dynamic Brake	



J1B - Digital I/O

8	Enable	18	N.C.
9	FWD CMD	19	CREF (OPTO IN)
10	REV CMD	20	OUT1–
11	IN1	21	OUT1+
12	IN2	22	OUT2–
13	IN3	23	OUT2+
14	IN4	24	OUT3–
15	IN5	25	OUT3+
16	External Trip	26	OUT4–
17	N.C.	27	OUT4+

J1A - Analog I/O

1	AGND	5	ANA IN 2–
2	ANA IN 1	6	ANA OUT1
3	Reference	7	ANA OUT2
4	ANA IN 2+		

See Terminal Tightening Torques in Section 7 of this manual.

J4 - Keypad

1	Shield	6	RCV–
2	N.C.	7	N.C.
3	XMIT+	8	N.C.
4	XMIT–	9	+8VDC
5	RCV+	10	DGND

J3 - Simulated Encoder Output

1	CHA+	6	CHA–
2	CHB+	7	CHB–
3	CHC+	8	CHC–
4	N.C.	9	N.C.
5	DGND		

J2 - Resolver Input

1	SIN+	9	N.C.
2	COS+	10	N.C.
3	REF+	11	EXT Z
4	N.C.	12	N.C.
5	N.C.	13	AGND
6	SIN–	14	N.C.
7	COS–	15	N.C.
8	REF–		

Resolver Feedback

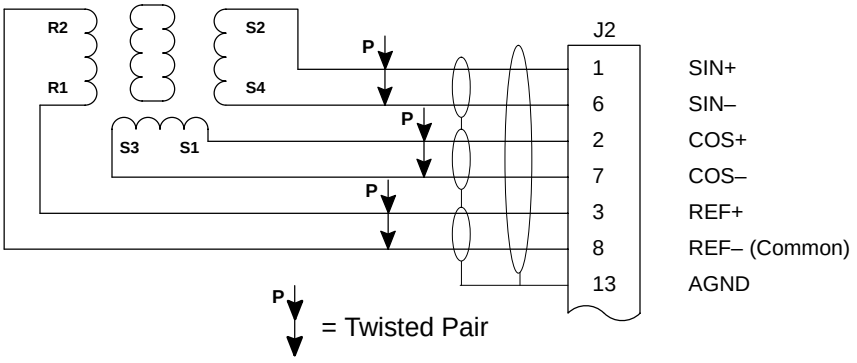
The resolver connections are made at the J2 connector as shown in Figure 3-4. The resolver cable must be shielded twisted pair #22 AWG (0.34mm^2) wire minimum. The cable must also have an overall shield and not exceed 150 feet (45m) in length. Maximum wire-to-wire or wire-to-shield capacitance is 50pf per foot (maximum of 7500pf for 150 ft). See electrical noise considerations in Section 5 of this manual.

Resolver wiring must be separated from power wiring. Separate parallel runs of resolver and power cables by at least 3″. Cross power wires at right angles only. Insulate or tape ungrounded end of shields to prevent contact with other conductors or ground.

⚠ **Caution: Do not connect any shields to the motor frame. At a minimum, resolver signal integrity will be compromised and damage to the control may result.**

1. Connect the SIN+ to J2-1 and SIN– to J2-6.
2. Connect the COS+ to J2-2 and COS– to J2-7.
3. Connect the REF+ to J2-3 and REF– to J2-8.
4. Connect the analog ground wire to J2-13.

Figure 3-4 Resolver Cable Connections

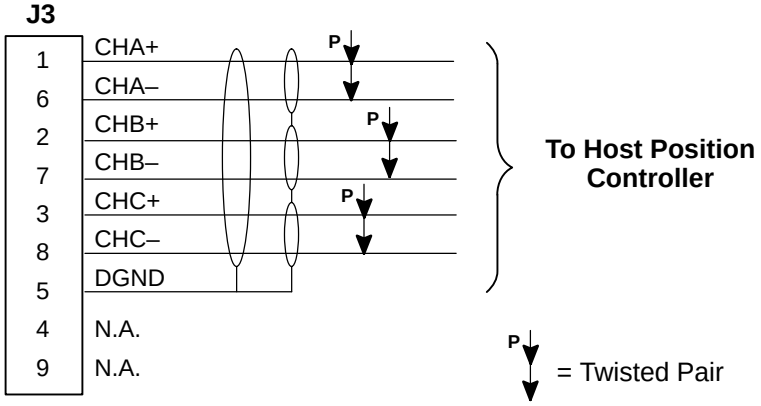


Simulated Encoder Output

The control provides a simulated encoder output at connector J3 as shown in Figure 3-5. This output provides position information to the host controller. Use twisted pair wire with an overall shield.

This output simulates a 1024 ppr encoder with quadrature outputs. Counting in quadrature will provide 4096 ppr with one index marker (CHC) per revolution. It is recommended that this output only drive one output circuit load. Driving multiple loads is not recommended.

Figure 3-5 Simulated Encoder Output



1. Connect J3-1 and J3-6 outputs to Host Position Controller CHA inputs.
2. Connect J3-2 and J3-7 outputs to Host Position Controller CHB inputs.
3. Connect J3-3 and J3-8 outputs to Host Position Controller CHC inputs.
4. Connect the cable shields to J3-5.

Control Circuit Connections Eight operating modes are available. 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 Level 1 Input block Operating Mode parameter. Available operating modes are:

- Keypad Mode
- Standard Run 3 Wire Mode (e.g. Potentiometer)
- 15 Speed 2 Wire Mode (e.g. Preset Speeds)
- 2 Wire Multi INP (e.g. 2 wire control mode)
- 3 Wire Multi INP (e.g. 3 wire control mode)
- Serial
- Bipolar Speed or Torque Mode (e.g. ±10VDC, ±5VDC or 4-20mA)
- Process Mode

External devices are connected at the AC Servo Control connectors shown in Figure 3-3.

1. Connect the Keypad to J4 on the control panel.
2. Determine the operating mode for your application. Connect the remaining control connections as shown in the diagram for that operating mode. (Refer to Figures 3-7, 3-8, 3-9 and 3-12.)

Note: Input connections at J1B can be wired as active High or active Low as shown in Figure 3-6. J1B pin 19 is the Control Reference point (CREF) for the Opto Isolated Input signals. Input signals are on J1B pins 8, 9, 10, 11, 12, 13, 14, 15, 16.

Active High/Low Description

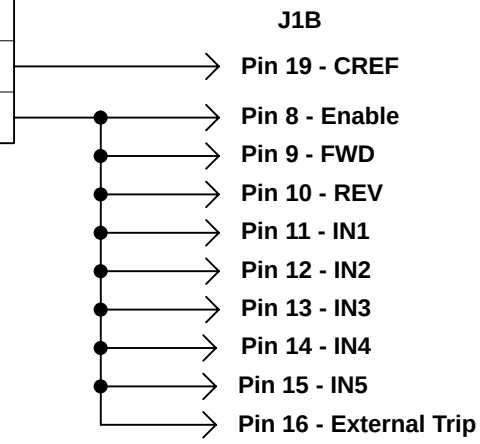
A customer supplied power source is required for operation of the Opto Inputs. The V_{ext} and GND_{ext} inputs are optional and are not provided with this control.

Active High - If pin 19 is grounded, an input is active when it is at +24VDC (+10VDC to +30VDC).

Active Low - If pin 19 is at +24VDC (+10VDC to +30VDC), an input is active when it is grounded.

Figure 3-6 Active HIGH/LOW Relationship

Active Low	Active High
GND_{ext} (Sink)	V_{ext} (Source)
+24VDC	GND
GND	+24VDC



Note: These pins are shown wired together. Although this can be done, each input is usually connected to a switch for individual control of each input condition.

Keypad Mode

In the Keypad Operating mode:

To operate in the Keypad mode, set the Level 1 Input block, OPERATING MODE parameter to KEYPAD. In this mode, only two Opto inputs can be active. Both analog outputs (at J1A) remain active.

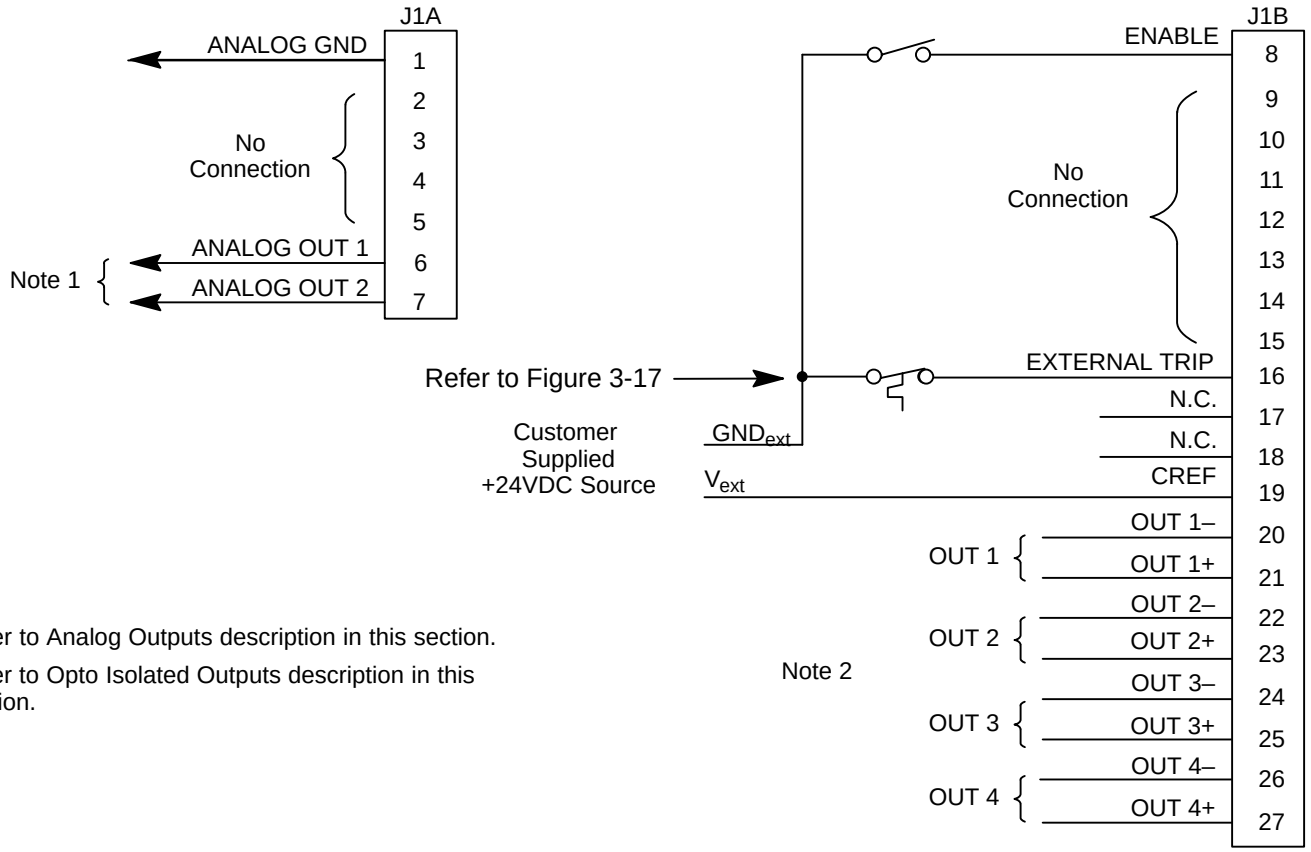
If the Level 2 PROTECTION block, EXTERNAL TRIP and LOCAL ENABLE INPUT parameters remain OFF (factory setting), no terminal strip wiring is required.

1. The External Trip Opto Input at J1B-16 is active if the Level 2 PROTECTION block, EXTERNAL TRIP parameter is set to ON. If the Level 2 PROTECTION block, EXTERNAL TRIP parameter is programmed “ON”, make connections as shown in Figure 3-7.
2. The Local Enable Opto Input at J1B-8 is active if the Level 2 PROTECTION block, LOCAL INP ENABLE parameter is set to ON. If the Level 2 PROTECTION block, LOCAL INP ENABLE parameter is programmed “ON”, make connections as shown in Figure 3-7.

The STOP key can operate in two ways:

- Press STOP key one time to brake or coast to stop.
- Press STOP key two times to disable control.

Figure 3-7 Keypad Mode Connection Diagram



Notes:

1. Refer to Analog Outputs description in this section.
2. Refer to Opto Isolated Outputs description in this section.

J1B-8	CLOSED allows current to flow in the motor. OPEN disables the control and motor coasts to a stop (if Level 2 Protection block, LOCAL ENABLE INP is set to ON). This input is optional.
J1B-16	OPEN causes an external trip to be received by control. The control will disable and display External Trip when programmed “ON”. If J1B-16 is connected, you must set Level 2 Protection block, External Trip to “ON” to recognize the J1B-16 input.

Standard Run 3 Wire Mode

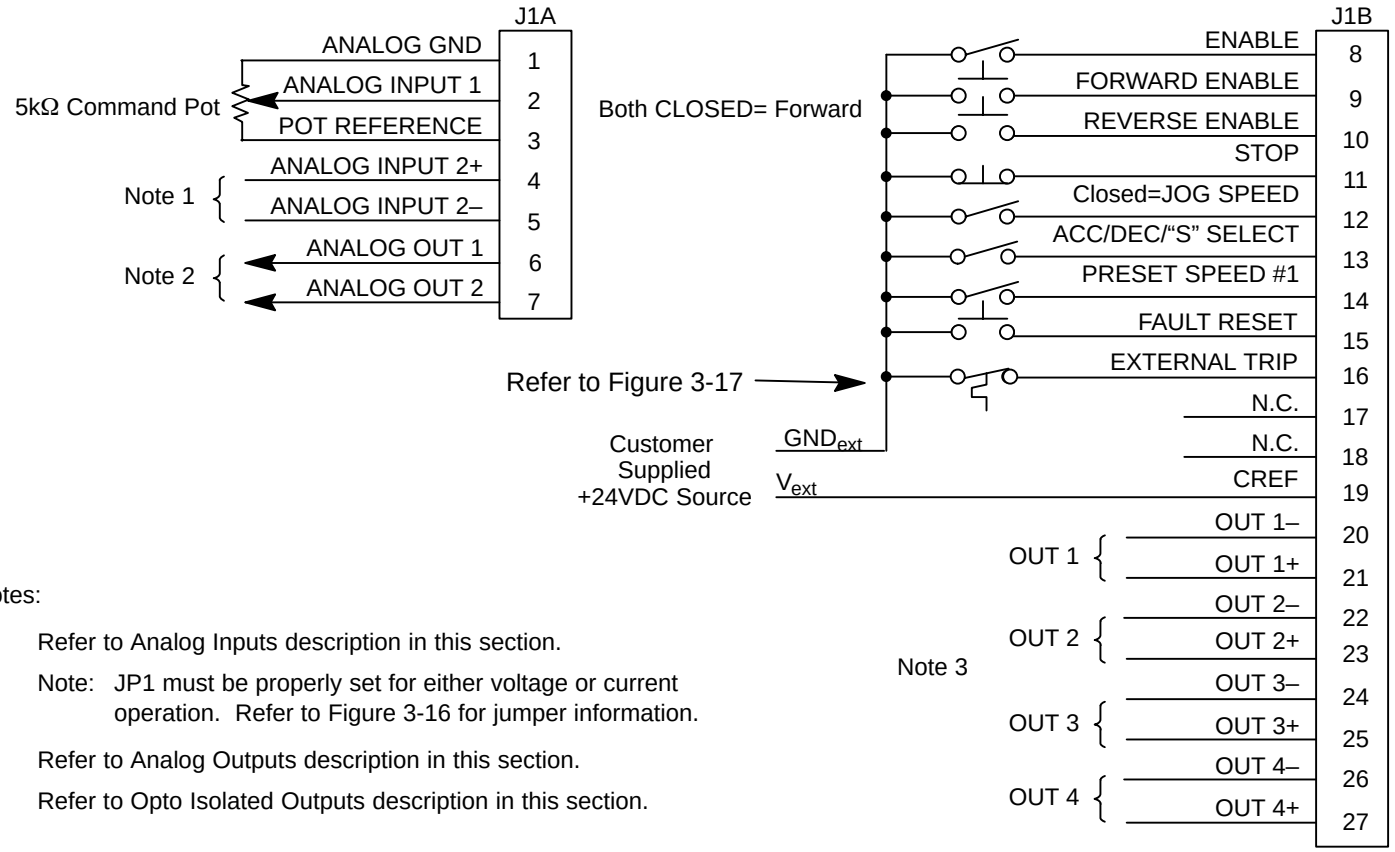
In standard run mode, the control is operated by the Opto Isolated inputs at J1B-8 through J1B-16 and the analog command input J1A pins 1, 2 and 3 (5KΩ pot, 0-5VDC or 0-10VDC). J1A-4 and J1A-5 can be used as the input (0-5VDC, 0-10VDC or 4-20mA). The Opto inputs can be switches as shown in Figure 3-8 or logic signals from another device. The External Trip Opto Input at J1B-16 is active if connected as shown and the Level 2 PROTECTION block, EXTERNAL TRIP parameter is set to ON.

The motor speed command may be one of the following:

- Preset Speed (J1B–14)
- Command Input (Potentiometer, 0-5VDC or 0-10VDC)
- Differential analog input (±5VDC, ±10VDC or 4-20mA)

Make control connections as shown in Figure 3-8.

Figure 3-8 Standard Run 3-Wire Mode Connection Diagram



Notes:

1. Refer to Analog Inputs description in this section.

   Note: JP1 must be properly set for either voltage or current operation. Refer to Figure 3-16 for jumper information.

2. Refer to Analog Outputs description in this section.
3. Refer to Opto Isolated Outputs description in this section.

J1B-8	CLOSED allows current to flow in the motor and produce torque. OPEN disables the control and motor coasts to a stop.
J1B-9	Momentary CLOSED starts motor operation in the Forward direction. In JOG mode (J1-12 CLOSED), continuous CLOSED jogs motor in the Forward direction.
J1B-10	Momentary CLOSED starts motor operation in the Reverse direction. In JOG mode (J1-12 CLOSED), CONTINUOUS closed JOGS motor in the Reverse direction.
J1B-11	When OPEN control removes power from motor and disables. Coasts or brakes to stop depending on Keypad Stop Mode parameter setting.
J1B-12	CLOSED places control in JOG mode, Forward and Reverse run are used to jog the motor.
J1B-13	CLOSED selects group 2. OPEN selects ACC / DEC / S-CURVE group 1.
J1B-14	CLOSED selects preset speed #1. OPEN allows speed command from Analog input #1 or #2.
J1B-15	CLOSED to reset fault condition. OPEN to run,
J1B-16	OPEN causes an external trip to be received by control. The control will disable and display External Trip when programmed "ON". If J1B-16 is connected, you must set Level 2 Protection block, External Trip to "ON" to recognize the J1B-16 input.

15 Speed 2-Wire Mode

In this mode, 15 preset motor speeds are stored during setup and selected during operation. Switch Truth Table is defined in Table 3-5.

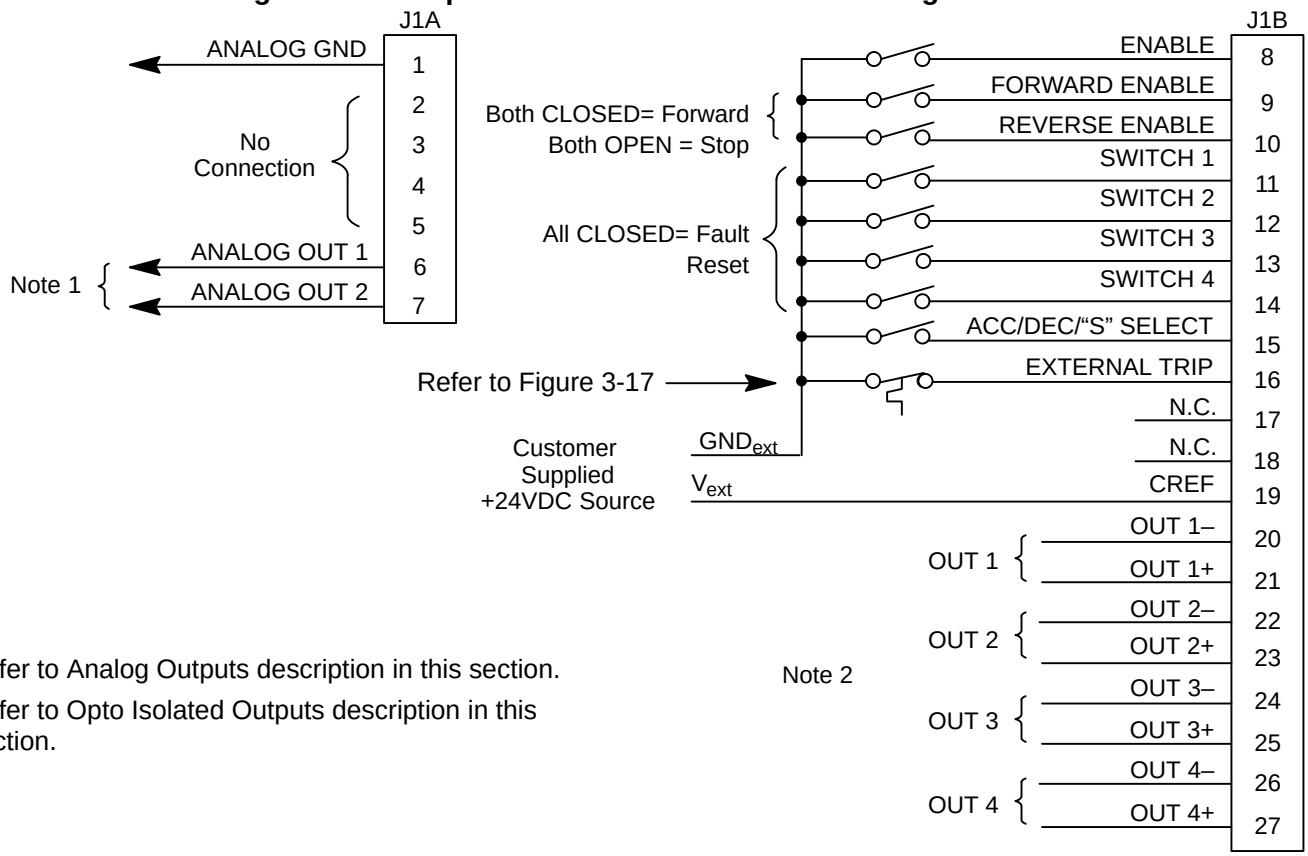
Operation in the 15 Speed 2-Wire mode is controlled by the Opto Isolated inputs at J1B-11 through J1B-15. The Opto inputs can be switches as shown in Figure 3-9 or logic signals from another device. The External Trip Opto Input at J1B-16 is active if connected as shown and the Level 2 PROTECTION block, EXTERNAL TRIP parameter is set to ON.

Switched inputs at J1B-11 through J1B-14 allow selection of 15 preset speeds and provide Fault Reset as defined in Table 3-5.

Table 3-5 Switch Truth Table for 15 Speed, 2 Wire Control Mode

Function	J1B-11	J1B-12	J1B-13	J1B-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 3-9 15 Speed 2-Wire Mode Connection Diagram



Notes:

1. Refer to Analog Outputs description in this section.
2. Refer to Opto Isolated Outputs description in this section.

J1B-8	CLOSED allows current to flow in the motor and produce torque. OPEN disables the control & motor coasts to a stop.
J1B-9	CLOSED operates the motor in the Forward direction. OPEN coasts brakes to stop depending on Keypad Stop mode parameter setting.
J1B-10	CLOSED operates motor in the Reverse direction. OPEN coasts or brakes to stop depending on Keypad Stop mode parameter setting.
J1B-11 to 14	Selects programmed preset speeds as defined in Table 3-5.
J1B-15	Selects ACC/DEC group. CLOSED selects group 2. OPEN selects group 1.
J1B-16	OPEN causes an external trip to be received by control. The control will disable and display External Trip when programmed "ON". If J1B-16 is connected, you must set Level 2 Protection block, External Trip to "ON" to recognize the J1B-16 input.

2 Wire Multi INP Control Mode

The Opto inputs can be switches as shown in Figure 3-10 or logic signals from another device. The External Trip Opto Input at J1B-16 is active if connected as shown and the Level 2 PROTECTION block, EXTERNAL TRIP parameter is set to ON.

J1B-8 CLOSED allows current to flow in the motor and produce torque.
OPEN disables the control & motor coasts to a stop.

J1B-9 CLOSED to start motor operation in the Forward direction.
OPEN to initiate a stop command.

J1B-10 CLOSED to start motor operation in the Reverse direction.
OPEN to initiate a stop command.

J1B-11 CLOSED selects Analog Input #1.
OPEN selects the value of the Level 1 Input block, Command Select parameter.

Note: If Level 1 Input block, Command Select parameter is set to “Potentiometer”, then Analog Input #1 is always selected.

J1B-12 CLOSED selects Start/Stop and Reset commands from the terminal strip.
OPEN selects Start/Stop and Reset commands from keypad.

J1B-13 CLOSED selects terminal strip speed source (Level 1 Input block, Command Select).
OPEN selects speed command from Keypad.

Note: When changing from keypad to terminal strip (J1B-12 or 13) the motor speed and direction will remain the same after the change.

J1B-14 OPEN selects Preset Speed #1 regardless of the Speed Command input (J1B-13). (FIRESTAT).

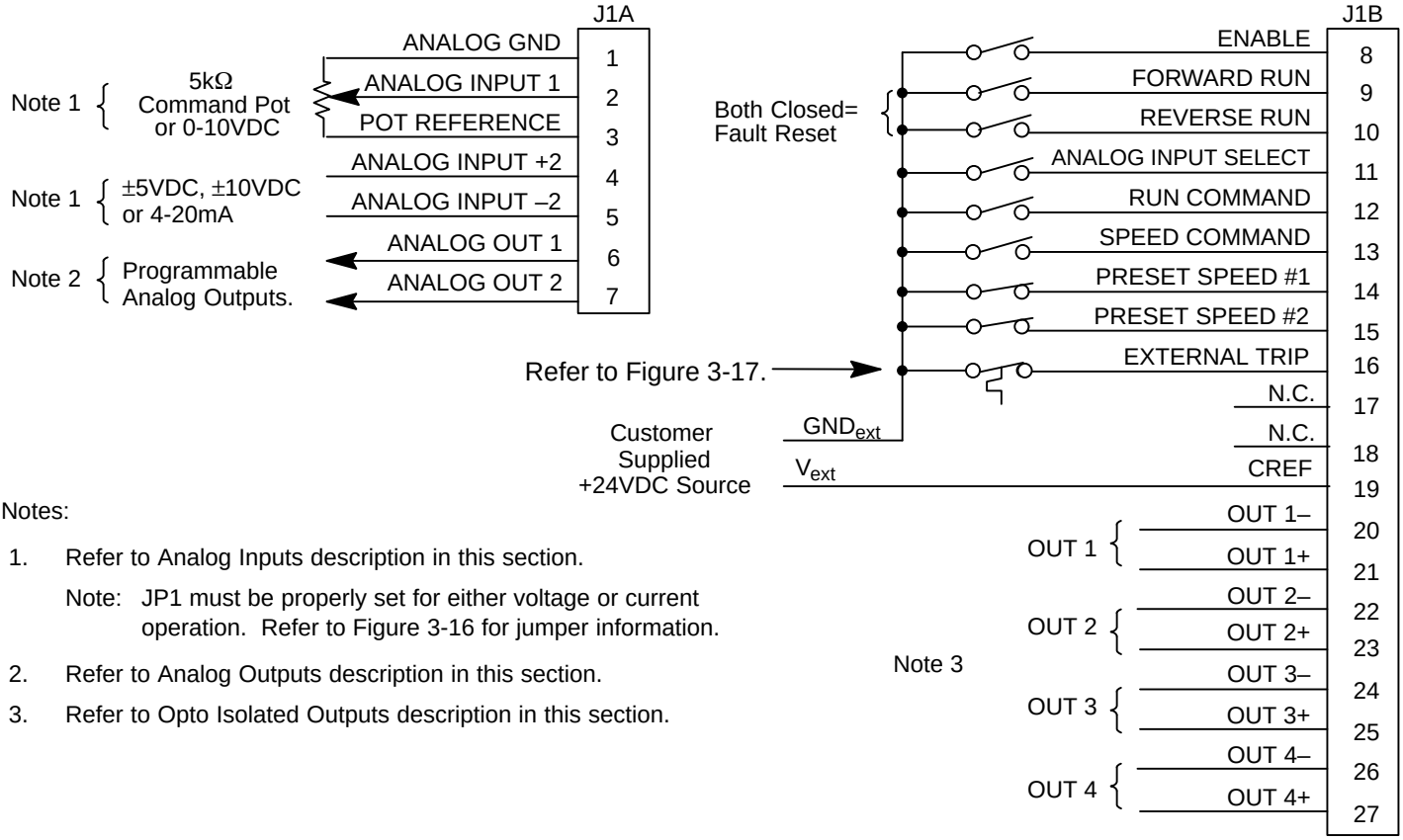
J1B-15 OPEN selects Preset Speed #2 regardless of the Speed Command input (J1B-13). (FREEZESTAT).

Note: If J1B-14 and 15 are both OPEN, Preset Speed #1 is selected.

J1B-16 OPEN causes an External Trip to be received by the control (when programmed to “ON”). When this occurs, the control disables and an external trip error is displayed on the keypad display (also logged into the error log).
If J1B-16 is connected, you must set Level 2 Protection block, External Trip to “ON” to recognize the J1B-16 input.

J1B-19 Jumper to J1B-18 (+24VDC) for “Active Low” operation of input signals at J1B-8 to 16. J1B-17 is then used as switch common.

Figure 3-10 2 Wire Multi INP Mode Connection Diagram



Notes:

1. Refer to Analog Inputs description in this section.

   Note: JP1 must be properly set for either voltage or current operation. Refer to Figure 3-16 for jumper information.

2. Refer to Analog Outputs description in this section.
3. Refer to Opto Isolated Outputs description in this section.

3 Wire Multi INP Control Mode

The Opto inputs can be switches as shown in Figure 3-11 or logic signals from another device. The External Trip Opto Input at J1B-16 is active if connected as shown and the Level 2 PROTECTION block, EXTERNAL TRIP parameter is set to ON.

J1B-8 CLOSED allows current to flow in the motor and produce torque.
OPEN disables the control & motor coasts to a stop.

J1B-9 Momentary CLOSED to start motor operation in the Forward direction.
OPEN to initiate a stop command.

J1B-10 Momentary CLOSED to start motor operation in the Reverse direction.
OPEN to initiate a stop command.

J1B-11 OPEN causes motor to decel to stop.

J1B-12 CLOSED selects Start/Stop and Reset commands from the terminal strip.
OPEN selects Start/Stop and Reset commands from keypad.

J1B-13 CLOSED selects terminal strip speed source (Level 1 Input block, Command Select).
OPEN selects speed command from Keypad.

Note: When changing from keypad to terminal strip (J1B-12 or 13) the motor speed and direction will remain the same after the change.

J1B-14 OPEN selects Preset Speed #1 regardless of the Speed Command input (J1B-13). (FIRESTAT).

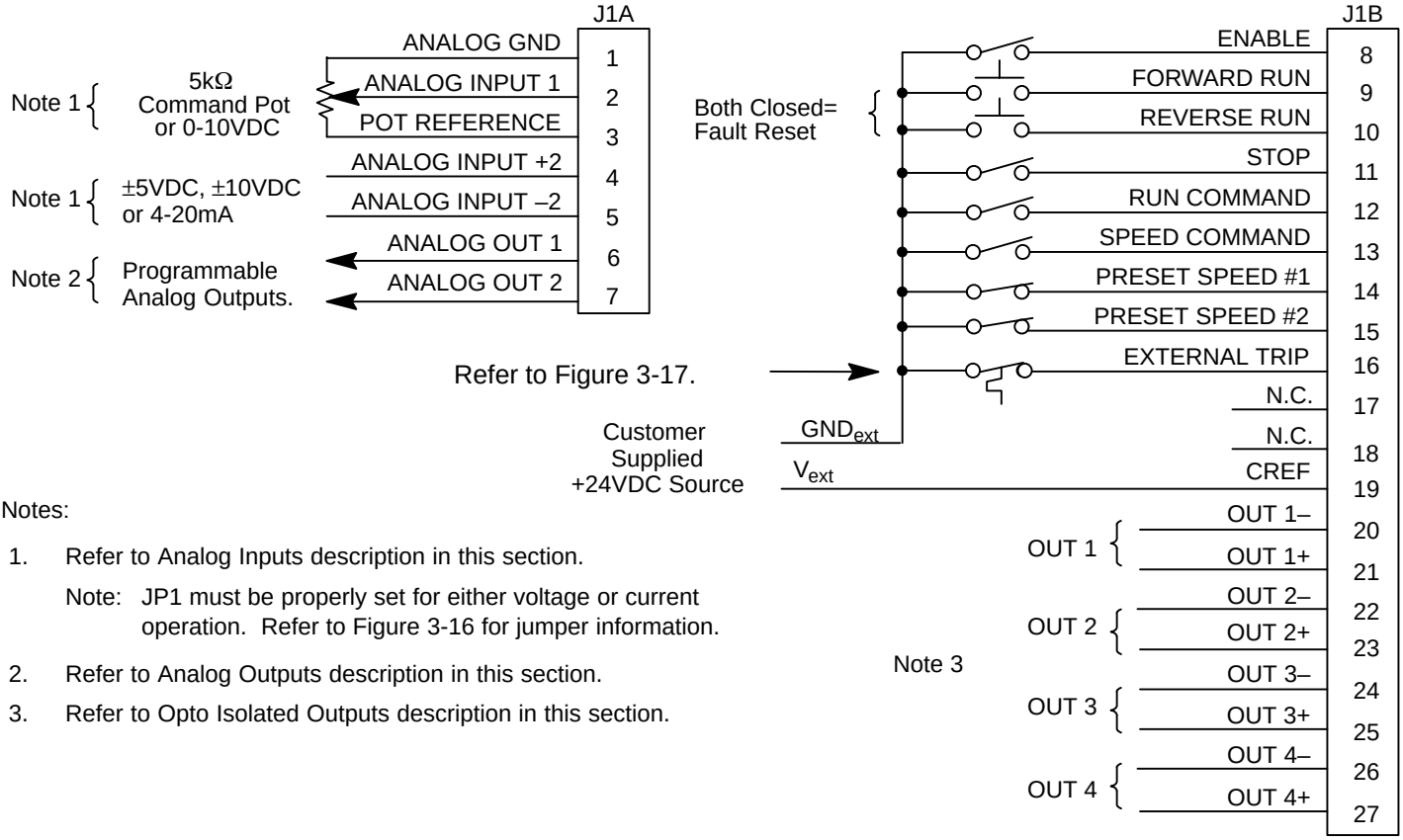
J1B-15 OPEN selects Preset Speed #2 regardless of the Speed Command input (J1B-13). (FREEZESTAT).

Note: If J1B-14 and 15 are both OPEN, Preset Speed #1 is selected.

J1B-16 OPEN causes an External Trip to be received by the control (when programmed to “ON”). When this occurs, the control disables and an external trip error is displayed on the keypad display (also logged into the error log).
If J1B-16 is connected, you must set Level 2 Protection block, External Trip to “ON” to recognize the J1B-16 input.

J1B-19 Jumper to J1B-18 (+24VDC) for “Active Low” operation of input signals at J1B-8 to 16. J1B-17 is then used as switch common.

Figure 3-11 3 Wire Multi INP Mode Connection Diagram



Notes:

1. Refer to Analog Inputs description in this section.

   Note: JP1 must be properly set for either voltage or current operation. Refer to Figure 3-16 for jumper information.

2. Refer to Analog Outputs description in this section.
3. Refer to Opto Isolated Outputs description in this section.

Bipolar Speed or Torque Control Mode with Multiple Parameter Sets

The normal bipolar speed or torque control for servo motors is provided by this mode. This mode also 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, different jog speeds or to store tuning parameter values for different motors.

To use multiple parameter sets: (refer to Figure 3-12 and Table 3-6.)

1. Set switches J1B-13 open and J1B-14 open (Parameter Table #0). Be sure switches J1B-9 and J1B-10 are OPEN, J1B-8 is CLOSED. Use the keypad and enter all parameter values, and autotune as instructed later in this section. This creates and saves the first parameter set which is numbered Table#0.

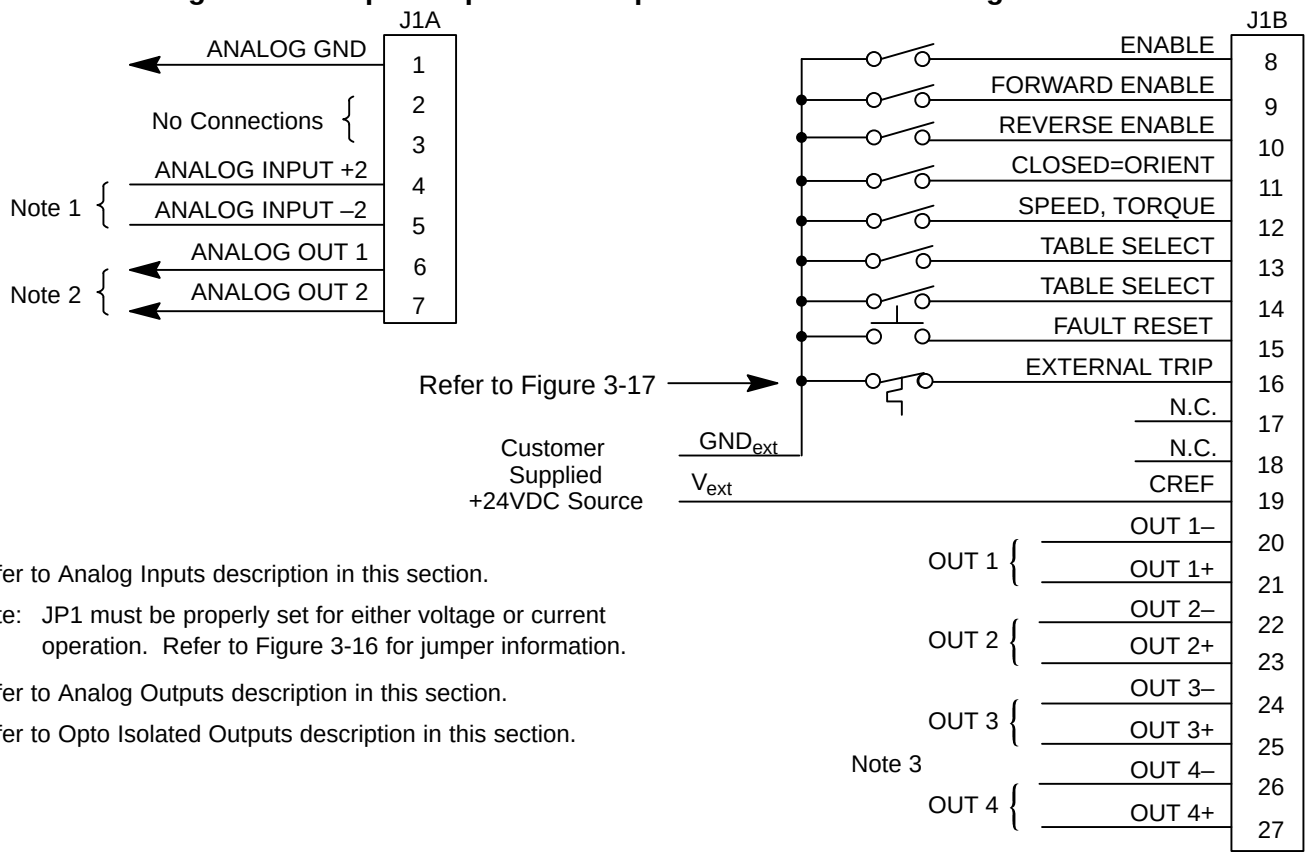
Note: When programming each parameter set, use the ENTER key to accept and automatically save parameter values.

2. Set switches J1B-13 closed and J1B-14 open (Parameter Table #1). Be sure switches J1B-9 and J1B-10 are OPEN, J1B-8 is CLOSED. Use the keypad and enter all parameter values, and autotune as instructed later in this section. This creates and saves the second parameter set which is numbered Table#1.
3. Set switches J1B-13 open and J1B-14 closed (Parameter Table #2). Be sure switches J1B-9 and J1B-10 are OPEN, J1B-8 is CLOSED. Use the keypad and enter all parameter values, and autotune as instructed later in this section. This creates and saves the third parameter set which is numbered Table#2.
4. Set switches J1B-13 closed and J1B-14 closed (Parameter Table #3). Be sure switches J1B-9 and J1B-10 are OPEN, J1B-8 is CLOSED. Use the keypad and enter all parameter values, and autotune as instructed later in this section. This creates and saves the final parameter set which is numbered Table#3.

Table 3-6 Bipolar Mode Table Select Truth Table

Function	J1B-13	J1B-14
Parameter Table #0	Open	Open
Parameter Table #1	Closed	Open
Parameter Table #2	Open	Closed
Parameter Table #3	Closed	Closed

Figure 3-12 Bipolar Speed or Torque Mode Connection Diagram



Notes:

1. Refer to Analog Inputs description in this section.

   Note: JP1 must be properly set for either voltage or current operation. Refer to Figure 3-16 for jumper information.

2. Refer to Analog Outputs description in this section.
3. Refer to Opto Isolated Outputs description in this section.

J1B-8	CLOSED allows current to flow in the motor and produce torque. OPEN disables the control & motor coasts to a stop.
J1B-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).
J1B-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).
J1B-11	Causes the motor shaft to orient to a marker or external switch.
J1B-12	CLOSED puts the control in torque mode. OPEN puts the control in velocity mode.
J1B-13 & J1B-14	Select from four parameter tables as defined in Table 3-6.
J1B-15	Momentary CLOSED to reset fault condition. OPEN to run.
J1B-16	OPEN causes an external trip to be received by control. The control will disable and display External Trip when programmed “ON”. If J1B-16 is connected, you must set Level 2 Protection block, External Trip to “ON” to recognize the J1B-16 input.

Process Mode Connections The process control mode provides an auxiliary closed loop general purpose PID set point control that is shown in Figure 3-13. 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.

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 J1A terminal strip or expansion board. Selections are shown in Figure 3-13. A signal compatibility matrix is shown in Table 3-7.
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 3-13. A signal compatibility matrix is shown in Table 3-7.
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 J1A terminal strip or expansion board. Selections are shown in Figure 3-13. A signal compatibility matrix is shown in Table 3-7.
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 3-13. A signal compatibility matrix is shown in Table 3-7.

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 3-13.

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

Figure 3-13 Simplified Process Control Block Diagram

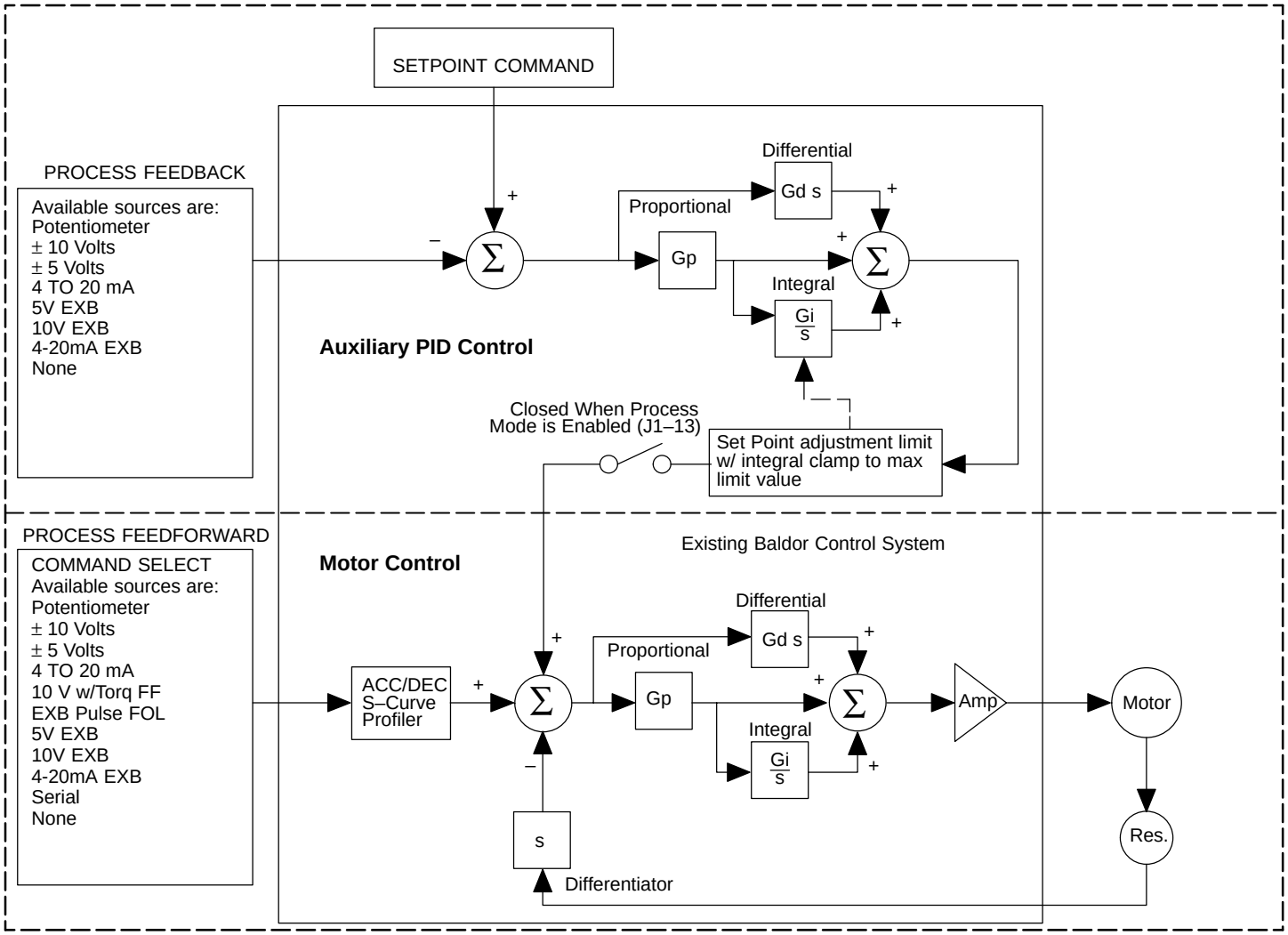


Table 3-7 Process Mode Input Signal Compatibility

Setpoint or Feedforward	Feedback					
	J1-1 & 2	J1-4 & 5	5V EXB [1]	10V EXB [1]	4-20mA EXB [1]	3-15 PSI EXB [4]
J1-1 & 2	■					
J1-4 & 5		■				
5V EXB [1]			■	■	■	
10V EXB [1]			■	■	■	
4-20mA EXB [1]			■	■	■	
3-15 PSI EXB [4]						■
Serial [3]						

[1] Requires expansion board EB0110A01 (Serial + High Resolution Analog I/O for M Series controls).

[2] Requires expansion board EB0110A02 (Serial + Pulse Follower for M Series controls).

[3] Requires expansion board EB0110A00 (Serial Communications for M Series controls).

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

Note: Only one expansion board may be installed.

Specific Process Mode Outputs

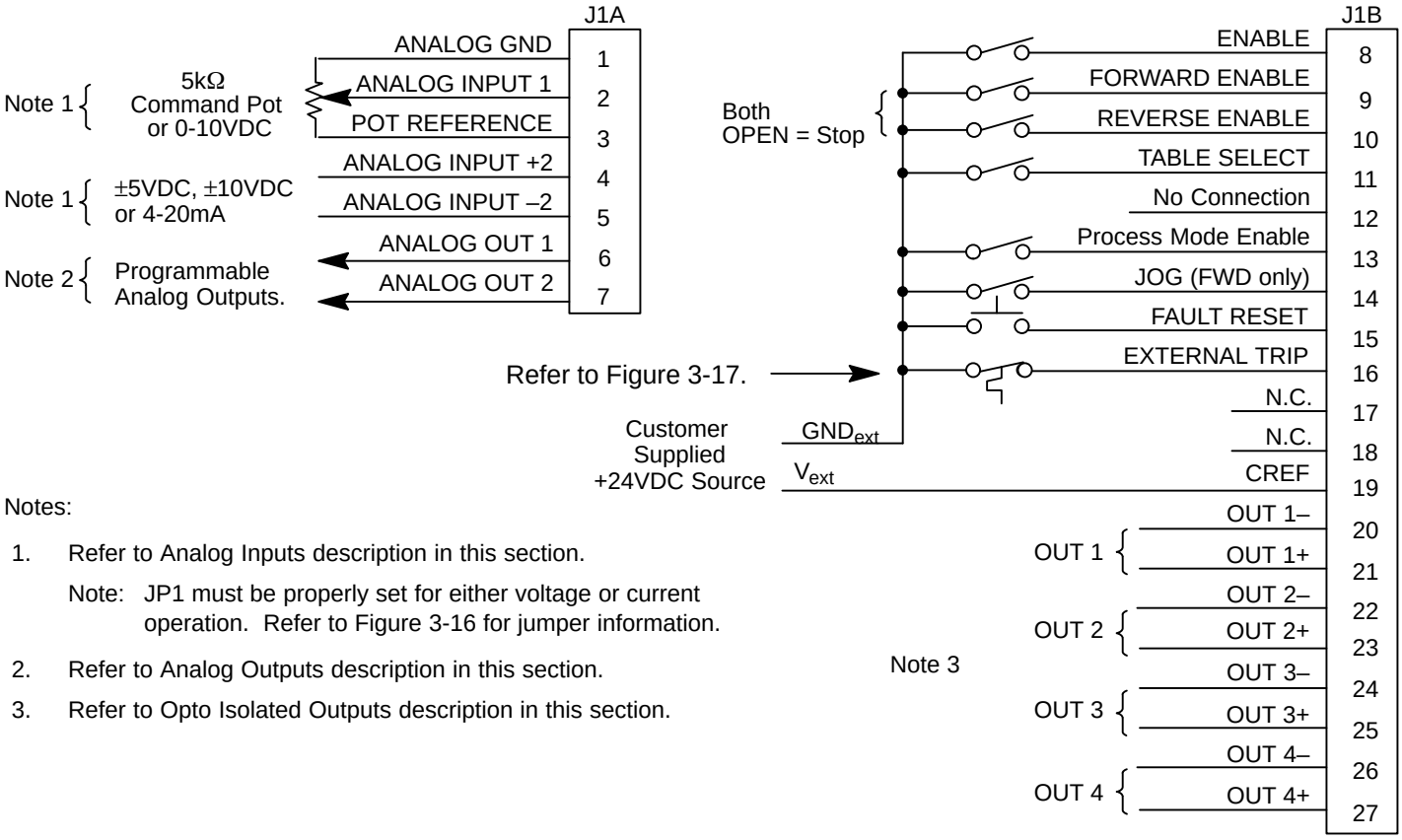
Process Mode Only, Analog Monitoring Outputs

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 3-14 Process Mode Connection Diagram



Notes:

1. Refer to Analog Inputs description in this section.

   Note: JP1 must be properly set for either voltage or current operation. Refer to Figure 3-16 for jumper information.

2. Refer to Analog Outputs description in this section.
3. Refer to Opto Isolated Outputs description in this section.

J1B-8 CLOSED allows current to flow in the motor and produce torque.
OPEN disables the control & motor coasts to a stop.

J1B-9 CLOSED to enable operation in the Forward direction.
OPEN TO DISABLE Forward operation.

J1B-10 CLOSED to enable operation in the Reverse direction.
OPEN to disable Reverse operation.

J1B-11 OPEN=Table 0, CLOSED=Table 1.

J1B-13 CLOSED to enable the Process Mode.

J1B-14 CLOSED puts the control in JOG Mode. Control will only JOG in the forward direction.
OPEN allows PID & Feedforward Speed or Torque control.

J1B-15 Momentary CLOSED to reset fault condition.
OPEN to run.

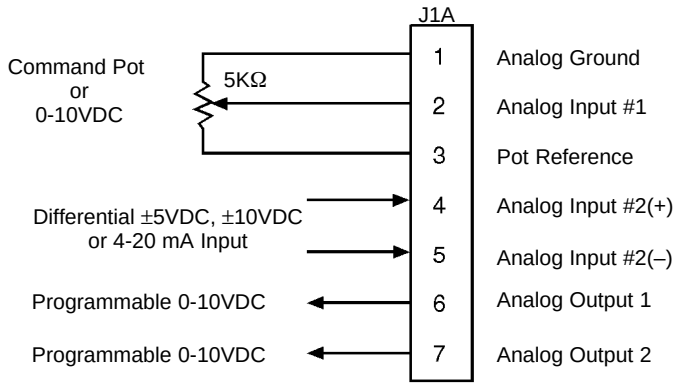
J1B-16 OPEN causes an External Trip to be received by the control (when programmed to "ON"). When this occurs, the control disables and an external trip error is displayed on the keypad display (also logged into the error log).
If J1B-16 is connected, you must set Level 2 Protection block, External Trip to "ON" to recognize the J1B-16 input.

Analog Inputs and Outputs

Analog Inputs

Two analog inputs are available: analog input #1 (J1A-1 and J1A-2) and analog input #2 (J1A-4 and J1A-5) as shown in Figure 3-15. 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. Only one analog input can be used but either may be selected.

Figure 3-15 Analog Inputs and Outputs



Analog Input #1

The single ended analog input #1 is used when the control is set to Standard 3 Wire Mode. When using a potentiometer as the command input, 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 3-15. One end of the pot is connected to J1A-1 (analog ground) and the other end is connected to J1A-3 (Pot Reference).
2. Connect the wiper of the pot to J1A-2. The voltage across terminals J1A-1 and J1A-2 is the speed command input.
3. A 0-10VDC speed command signal may be connected across J1A-1 and J1A-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 COMMAND SELECT parameter.

Note: Analog Input #2 is used with Standard Run 3-Wire or Bipolar Control modes and not used for the 15 Speed 2 Wire mode.

1. Connect the Analog Input 2(+) wire to J1A-4 and the 2(–) wire to J1A-5.
2. JP1 must be properly set for either voltage or current operation. Refer to Figure 3-16 for jumper 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 3-16 Jumper Locations

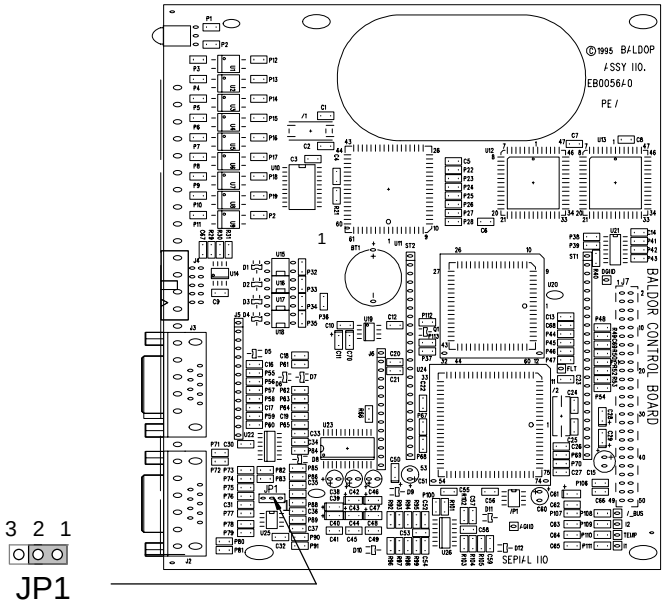


Table 3-8 Jumper Positions

Jumper	Jumper Position	Description of Jumper Position Setting
JP1	1–2	Voltage Command Signal. (Factory Setting)
	2–3	4–20mA Command Signal.

Note: Early production boards had JP2 jumper. If present, leave JP2 on pins 1 & 2.

Analog Outputs

Two programmable analog outputs are provided on J1A-6 and J1A-7. These outputs are scaled ±10 VDC (1mA maximum output current) and can be used to provide real-time status of various control conditions. The output conditions are defined in Section 4 of this manual.

The return for these outputs is J1A-1 analog ground. Each output is programmed in the Level 1 Output block.

1. Connect the Output #1 wires to J1A-6 and J1A-1.
2. Connect the Output #2 wires to J1A-7 and J1A-1.

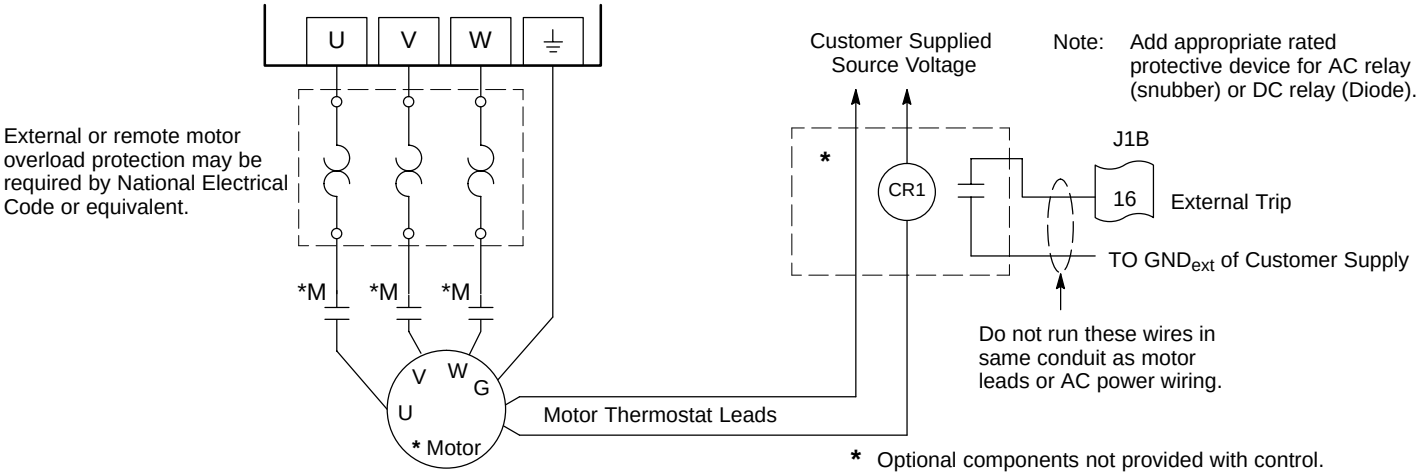
External Trip Input

Terminal J1B-16 is available for connection to a normally closed thermostat or overload relay contact in all operating modes as shown in Figure 3-17. 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 (opens the J1B-16 connection) the control will automatically shut down and give an External Trip fault.

Connect the External Trip Input wires to J1B-16 and GND_{ext} of the customer provided power supply for the opto inputs. Do not place these wires in the same conduit as the motor power leads.

To activate the External Trip input, the Level 2 Protection block, External Trip parameter must be set to “ON”.

Figure 3-17 Motor Temperature Relay



Opto-Isolated Outputs

Four programmable Opto-isolated outputs are available at terminals J1B-20 through J1B-27. See Figure 3-18.

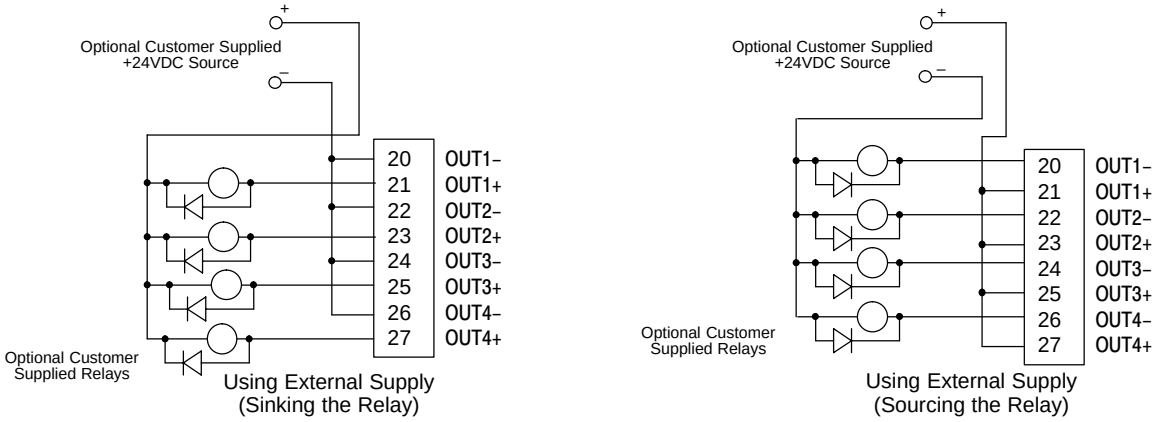
The Opto-isolated outputs may be configured for sinking or sourcing 50 mA each. However, all must be configured the same. The maximum voltage from opto output to common when active is 1.0 VDC (TTL compatible). The Opto-isolated outputs may be connected in different ways as shown in Figure 3-18.

If the opto outputs are used to directly drive a relay, a flyback diode rated at 1A, 100 V 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 J1B-20 and J1B-21.
2. Connect OPTO OUT #2 wires to J1B-22 and J1B-23.
3. Connect OPTO OUT #3 wires to J1B-24 and J1B-25.
4. Connect OPTO OUT #4 wires to J1B-26 and J1B-27.

Each Opto Output is programmed in the Level 1 Output programming block.

Figure 3-18 Opto-isolated Output Configurations



Note: Shows typical flyback diode rated at least 1Amp/100V (1N4002) across each relay coil (if coil does not have built in flyback).

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. Measure the AC line voltage and verify it matches the 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 biased 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.
2. Verify that all motor couplings are tight without backlash.
3. Verify the holding brakes if any, are properly adjusted to fully release.

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. You should have an understanding of the keypad programming & operation procedures.

Note: The control terminal strip does not require any connections to operate in the Keypad mode (with factory preset parameter values).

Initial Conditions

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

1. Disconnect the load (including coupling) from the motor shaft, if possible.
2. Verify that any enable inputs to J1B-8 are open.
3. Turn power on. Be sure no errors are displayed.
4. Set the Level 1 Input block, Operating Mode to “KEYPAD”.
5. Enter the following motor data in the Level 2 Motor Data block parameters:
   MOTOR RATED AMPS (from motor nameplate)
   MOTOR POLES
   Use the following:
   BSM 50/63/80 = 4 poles
   BSM 90/100 = 8 poles
   BSM 4F/6F/8F = 8 poles
   RESOLVER SPEEDS (Preset is “One”)
6. At the Level 2 Motor Data block, go to CALC Presets and select YES (using the ▲ key). Press ENTER and let the control calculate the preset values for the parameters that are necessary for control operation.
7. If the load cannot be disconnected, refer to Section 6 and manually tune the control. After manual tuning, proceed with steps 12 through 16.

⚠ **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.**

8. Go to Level 2 Autotune block, and do the following tests:
   CMD OFFSET TRIM
   CUR LOOP COMP
   RESOLVER ALIGN
9. Remove all power from the control.
10. Couple the motor to its load.
11. Turn power on. Be sure no errors are displayed.
12. Set the Level 2 Output Limits block, “MIN OUTPUT SPEED” parameter.
13. Set the Level 2 Output Limits block, “MAX OUTPUT SPEED” parameter.
14. Go to Level 2 Autotune block, and do the SPD CNTRLR CALC test.
15. Run the drive from the keypad using either the JOG mode, keypad entered speed commands or speed commands using the arrow keys.
16. Select and program additional parameters to suit your application.

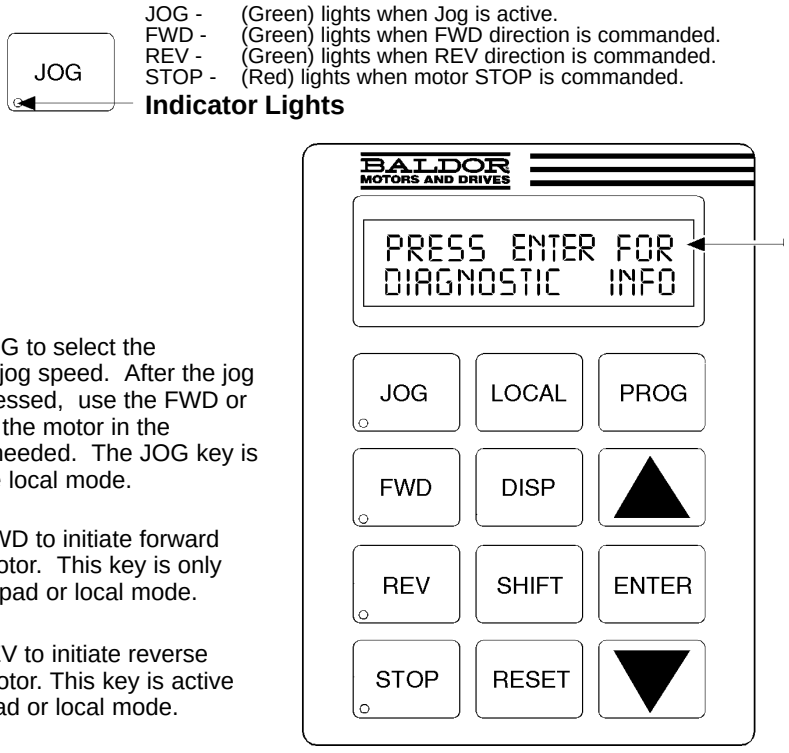
The control is now ready for use the in keypad mode. If a different operating mode is desired, refer to Section 3 Control Connections and Section 4 Programming and Operation.

Section 4
Programming and Operation

Overview

The keypad is used to program the control parameters; to operate the motor when programmed for the Keypad operating mode; and to monitor the status and outputs of the control by accessing the display options, diagnostic menus and the fault log.

Figure 4-1 Keypad



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 regen 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 J1B 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.

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

During normal operation, the control is in the DISPLAY MODE. In this mode, the Keypad Display shows the status of the control as in the following example.

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		
Press DISP Key	Places control in display mode		
Press SHIFT SHIFT	Allows display contrast adjustment		
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 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		STOP MOTOR SPEED LOCAL 0 RPM	First screen in Display Mode.
Press DISP key	Scroll to diagnostic info block.	PRESS ENTER FOR DIAGNOSTIC INFO	
Press ENTER key	Access diagnostic information.	STOP SPEED REF LOCAL 0 RPM	Displays commanded speed, direction of rotation, Local/ Remote.
Press DISP key	Display mode showing control temperature.	STOP CONTROL TEMP LOCAL 0.0° C	Displays operating temperature in degrees C.
Press DISP key	Display mode showing bus voltage.	STOP BUS VOLTAGE LOCAL 321V	
Press DISP key	Display mode showing % overload current remaining.	STOP OVRLD LEFT LOCAL 100.00%	
Press DISP key	Display mode showing opto inputs & outputs state. 0=Open, 1=Closed.	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 CONST TQ XXXV SERVO	
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	
Press DISP key	Display mode showing which Group1 or 2 expansion boards are installed.	I NOT INSTALLED II 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 software version and revision installed in the control.	SOFTWARE VERSION XXX-X.XX	
Press DISP key	Displays exit choice.	PRESS ENTER FOR DIAGNOSTIC EXIT	Press ENTER to exit diagnostic information.

Display Mode Continued

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	Press DISP several times 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	1 = Most Recent fault displayed. 2 = Next most recent etc.
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 or change parameter values.
2. Enter Motor Data.
3. Autotune the motor.

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 provides the following information:

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	Display mode.
	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. Then press ENTER to access Input Block.	PRESS ENTER FOR INPUT	Press ENTER to access INPUT block parameter.
Press PROG key	Access Operating Mode.	OPERATING MODE P: KEYPAD	Keypad mode shown is the factory setting.
Press ▲ key	Scroll to make your selection.	OPERATING MODE P: BIPOLAR	Typical selection.
Press ENTER or PROG	Save selection to memory.	OPERATING MODE P: BIPOLAR	Press RESET to cancel selection without saving to memory.
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.

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

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.

Program Mode Continued

Initialize New Software EEPROMs

After new EEPROMs are installed, the control must be initialized to the new software version and memory locations. Use the following procedure to Initialize the EEPROMs.

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 ▲ key	Scroll to diagnostic info block.	PRESS ENTER FOR 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 software version and revision installed in the control.	SOFTWARE VERSION XXX-X.XX	Verify new software version.
Press DISP key	Displays exit choice.	PRESS ENTER FOR DIAGNOSTIC EXIT	Press ENTER to exit diagnostic information.

Parameter Adjustments

To make programming easier, parameters have been arranged into the two level structure shown in Table 4-1. Press the PROG key to enter the programming mode. The first programming block to be displayed is “Preset Speeds”. 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 in Appendix A of this manual. This list defines the programmable range and factory preset value for each parameter. The list has a 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**	**Motor Data**
Preset Speed #1	Operating Mode	MIN Output Speed	Motor Rated Amps
Preset Speed #2	Command Select	MAX Output Speed	Motor Poles
Preset Speed #3	ANA CMD Inverse	PK Current Limit	Resolver Speeds
Preset Speed #4	ANA CMD Offset	PWM Frequency	CALC Presets
Preset Speed #5	ANA 2 Deadband	CUR Rate Limit	
Preset Speed #6	ANA 1 CUR LIMIT		
Preset Speed #7			**Process Control**
Preset Speed #8	**Output**	**Custom Units**	Process Feedback
Preset Speed #9	Opto Output #1	Decimal Places	Process Inverse
Preset Speed #10	Opto Output #2	Value at Speed	Setpoint Source
Preset Speed #11	Opto Output #3	Units of Measure	Setpoint Command
Preset Speed #12	Opto Output #4		Set PT ADJ Limit
Preset Speed #13	Zero SPD Set PT	**Protection**	Process ERR TOL
Preset Speed #14	At Speed Band	Overload	Process PROP Gain
Preset Speed #15	Set Speed	External Trip	Process INT Gain
	Analog Out #1	Local Enable Input	Process DIFF Gain
Accel / Decel Rate	Analog Out #2	Following Error	Follow I:O Ratio
Accel Time #1	Analog #1 Scale		Follow I:O OUT
Decel Time #1	Analog #2 Scale	**Miscellaneous**	Master Encoder
S-Curve #1	Position Band	Restart Auto/Man	
Accel Time #2		Restart Fault/Hr	**Communications**
Decel Time #2	**Brushless Control**	Restart Delay	Protocol
S-Curve #2	Resolver Align	Factory Settings	Baud Rate
	Speed Filter	Homing Speed	Drive Address
Jog Settings	Feedback Align	Homing Offset	
Jog Speed	Current PROP Gain		
Jog Accel Time	Current INT Gain	**Security Control**	
Jog Decel Time	Speed PROP Gain	Security State	**Auto-Tuning**
Jog S-Curve Time	Speed Int Gain	Access Timeout	CALC Presets
	Speed DIFF Gain	Access Code	CMD Offset Trim
Keypad Setup	Position Gain		CUR Loop Comp
Keypad Stop Key			Resolver Align
Keypad Stop Mode			SPD CNTRLR CALC
Keypad Run FWD			
Keypad Run REV			
Keypad Jog FWD			
Keypad Jog REV			

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 J1B-11, J1B-12, J1B-13 and J1B-14. 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. Accel Time #2 is accessible in Standard Run 3 Wire and 15 Speed 2 Wire modes only. Example: Maximum Output Speed =1000 RPM; Preset Speed = 500 RPM, Accel Time=10 Sec. In this example, motor will be at 500 RPM 5 seconds after commanded because preset is half the max speed.
	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 or Decel time and provides smooth starts and stops. Figure 4-2 illustrates how motor acceleration is changed using a 40% S-Curve. 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 (Pot). Note: If faults (motor trips) occur during rapid Accel or Decel, selecting an S-curve may eliminate the faults without affecting the overall ramp time.
JOG SETTINGS	Jog Speed	Jog Speed changes motor speed to a new preset value for jog mode. To cause motor to operate at Jog Speed the FWD or REV key must be pressed or external command Forward (J1B-9) or Reverse (J1B-10). The motor will run at jog speed until FWD or REV key is released or external command signal is removed. Jog speed can be less than the minimum speed parameter setting.
	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 S-Curve Example

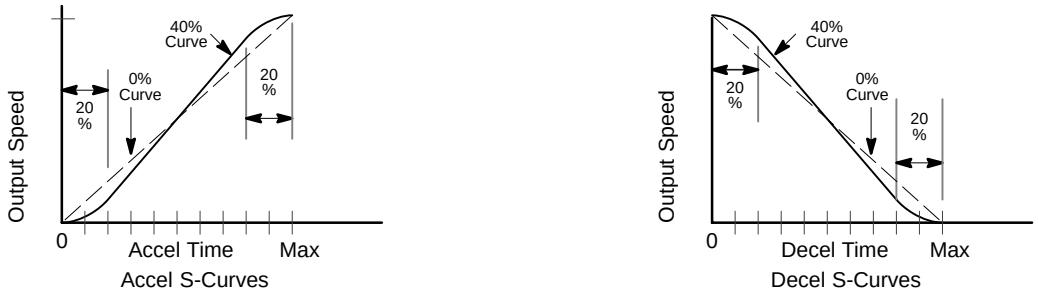


Table 4-2 Level 1 Parameter Block Definitions - Continued

Block Title	Parameter	Description
KEYPAD SETUP	Keypad Stop Key	Allows keypad "STOP" key to initiate motor stop during remote or serial operation (if Stop key is programmed to Remote ON). If active, pressing "STOP" automatically selects Local mode and initiates the stop command.
	Keypad Stop Mode	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". Note: In REGEN mode, it is possible to cause an Overvoltage Trip if "REGEN" to stop decelerates the motor too quickly. If a fault occurs, increase the DECEL time.
	Keypad Run FWD	Makes the keypad "FWD" key active in Local mode.
	Keypad Run REV	Makes the keypad "REV" key active in Local mode.
	Keypad Jog FWD	Makes the keypad "FWD" key active in Local Jog mode.
	Keypad Jog REV	Makes the keypad "REV" key active in Local Jog mode.
INPUT	Operating Mode	Eight "Operating Modes" are available. Choices are: Keypad, Standard Run, 15 Speed, 2 Wire Multi INP, 3 Wire Multi INP, Serial, Bipolar or Process Control. External connections to the control are made at the J1B terminal strip (wiring diagrams are shown in Section 3).
	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 J1A-1, J1A-2, and J1A-3. ±5 or ±10VDC input command can be applied to J1A-4 and J1A-5. 4 TO 20 mA - If long distance is required between the external speed control and the control, the 4-20mA selections at J1A-4 and J1A-5 should be considered. Current loop allows long cable lengths without attenuation of the command signal. Note: JP1 jumper on the main control board must be in the correct position for current or voltage operation. Refer to Figure 3-16. 10 VOLT W/TORQ FF - when a differential command is present at J1A-4 and 5, allows additional torque feedforward input at J1A-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. 5V EXB - selects optional High Resolution I/O expansion board if installed. 10V EXB - selects optional High Resolution I/O expansion board if installed. 4-20mA 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.
	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 J1A-2 (referenced to J1A-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 speed is below the programmed value of the "Zero SPD Set Pt" Level 1 Output parameter. At Speed - Active when output speed is within the speed range defined by the "At Speed Band" Level 1 Output parameter. Overload - Active 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. At Set Speed - Active when output speed is at or above the "Set Speed Point" Level 1 Output parameter. 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 ACCEL, DECEL, and S-Curve parameters. 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 tolerance band. Over Temp Warn - Active when control heatsink temperature is within 3°C of the INT. Overtemp value. Process Error - Active when the process feedback signal is outside the process error tolerance (PROC ERR TOL) parameter value. Turns off when process feedback error is within tolerance. Drive Run - Active when drive is Ready, Enabled, Speed or Torque command is received and FWD or REV command is issued.
	Zero SPD Set PT	Sets the RPM 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 allowable following error speed band 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 Point	Sets the RPM at which the AT Set Speed opto output becomes active (turns on). When the speed is greater than the SET SPEED POINT, the Opto Output becomes active. This is useful when another machine must not start 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 Linear Analog outputs may be configured to represent any of the following conditions: (note 0-10VDC or ±10VDC operation per condition) **Condition** — **Description** ABS Speed - Represents the absolute motor speed where 0VDC = 0 RPM and 10VDC = MAX RPM. ABS Torque - Represents the absolute value of torque where 10VDC = Torque at CURRENT LIMIT. Speed Command - Represents the absolute value of commanded speed where 0VDC=0 RPM and +10VDC = MAX RPM. PWM Voltage - Represents the amplitude of PWM voltage where 10VDC = MAX AC Voltage. Flux Current - 0-10VDC represents actual portion of total current used for excitation. 10VDC = Maximum flux current. CMD Flux CUR - 0-10VDC represents calculated portion of total current used for excitation. 10VDC = Maximum commanded flux current. Load Current - ± 10VDC represents actual portion of total current used to produce torque (CW and CCW torque). +10VDC=Maximum CW Torque, –10VDC= Maximum CCW Torque. CMD Load Current - 0-10VDC represents calculated portion of total current used to produce torque. 10VDC=Maximum commanded load current. Motor Current - Amplitude of continuous current including motor excitation current. 10V = rated Current. Load Component - Amplitude of load current not including the motor excitation current. 10V = rated current. Quad Voltage - Load controller output. Useful when diagnosing control problems. Direct Voltage - 0-10VDC represents flux controller output. Useful to troubleshoot control problems. AC Voltage - PWM control voltage which is proportional to AC line to line motor terminal voltage. 0VDC = Neg. Peak PWM voltage, 5V centered, 10VDC = Pos. Peak PWM voltage. At rated motor voltage, a full 0 to 10V sinusoidal waveform at or greater than the motor base frequency would be present. At half the motor base frequency, a 2.5V to 7.5V sinusoidal waveform would be present. The waveform is centered around 5V. Bus Voltage - Amplitude of control bus voltage, 10V = 1000VDC. Torque - Bipolar torque output. 0V = Max negative torque, 5V centered, 10V = Max Positive Torque. Power - Bipolar power output. 0V = negative rated peak power, 5V = Zero Power, 10V = Positive rated peak power. Velocity - Represents motor speed scaled to 0V = negative max RPM, 5V = Zero Speed, 10V = positive max RPM. Overload - $(\text{Accumulated current})^2 \times (\text{time})$, Overload indication occurs at 10V. PH 2 Current - Sampled AC phase 2 motor current. 0V = negative rated peak amps, 5V = zero amps, 10V = positive rated peak amps. PH 1 Current - Sampled AC phase 1 motor current. 0V = negative rated peak amps, 5V = zero amps, 10V = positive rated peak amps. Process FDBK - ± 10VDC represents ±100% of Process Feedback signal. Setpoint CMD - ± 10VDC represents ±100% of Setpoint signal. Position - Position within a single revolution. 10V = 1 complete revolution. The counter will reset to 0 every revolution.
	Analog Scale #1 and #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
Brushless Control	Resolver Alignment	A numerical alignment value. The autotune procedure aligns the motor and resolver positions. 22.3 degrees is correct for all Baldor BSM motors.
	Speed Filter	The number of input samples by the control microprocessor over which to filter and determine the resolver speed. It is automatically set to suit the resolver resolution. The preset filter may be reduced to obtain smoother slow speed operation. The greater the number, the more filtered the signal becomes and the bandwidth is also reduced.
	Feedback Align	Sets the electrical direction of rotation of the resolver. May be set to forward or reverse to match the motor rotation.
	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.
LEVEL 2 BLOCK		ENTERS LEVEL 2 MENU

Table 4-3 Level 2 Parameter Block Definitions

Block Title	Parameter	Description
OUTPUT LIMITS	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 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.
	CUR Rate Limit	Limits the rate of change of 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 and using the arrow keys.
	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.
	External Trip	OFF - External Trip is Disabled. ON - A normally closed contact at J1B-16 is opened will cause an External Trip fault and will cause the drive to shut down.
	Local Enable INP	OFF – Local Enable Input is disabled. ON – Input is enabled and a normally closed contact is required at J1B-8 (to J1B–17 common) for control operation.
	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. Operation outside the tolerance range will cause a fault and the drive will shut down.

Table 4-3 Level 2 Parameter Block Definitions Continued

Block Title	Parameter	Description
MISCELLANEOUS	Restart Auto/Man	Manual - If a fault occurs, the control must be manually reset to resume operation. Automatic - If a fault 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.
	Homing Speed	In the BIPOLAR and SERIAL Operating Modes, this control features an ability to rotate (ORIENT) the motor shaft to a ”home” position when the Orient input switch (J1B-11) is activated. This parameter sets the speed at which the motor will rotate in the Forward direction when the Orient input switch is closed. The speed can be faster or slower than your ”normal” operating speed.
	Homing Offset	In Bipolar mode, this parameter sets the distance past the index marker at which the motor will stop. The distance is set by the number of digital pulses that the control expects before stopping motor rotation. The control has 4096 digital pulses per resolver speed per revolution of the motor shaft. The recommended minimum offset is at least 100 encoder counts to provide deceleration distance for a smooth stop. Note: Homing direction is always forward direction only.
SECURITY CONTROL	Security State	Off - No security Access Code required to change parameter values. Local - Requires security Access Code to be entered (using the keypad) before parameter changes can be made using the Keypad. Total - Requires security Access Code to be entered (using the keypad) before parameter changes can be made using the Keypad. Note: If security is set to Local 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). Only active with Local security.
	Access Code	A 4 digit number code. Only persons that know the code can change secured parameter values. When changing the code, the new number will not be displayed. 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 your local Baldor office. 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 Rated Amps	The rated current of the motor (listed on the rating plate). If the motor current exceeds this value for a period of time, an Overcurrent fault will occur.
	Motor Poles	The number of motor poles. This value is for correct electronic commutation of the brushless motor. Standard Baldor motor poles are: BSM50= 4 poles BSM 63/80 = 4 poles BSM 90/100= 8 poles BSM4F/6F/8F= 8 poles
	Resolver Speed	The number of speeds of the resolver. All standard BSM motors use a 1 speed resolver.
	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
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.
	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 or torque (within the Set PT ADJ Limit) is made to reduce process error.
	Process INT Gain	Sets the PID loop Integral gain. This determines how quickly the motor speed or torque is adjusted to correct long term error.
	Process DIFF Gain	Sets the PID loop differential gain. This determines how much adjustment to motor speed or torque (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. Ratio limits are (1-65,535) : (1-65,535). Note: The Master Encoder parameter must be defined if a value is entered in the Follow I:O Ratio 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 and the Level 1 Input block, Command Select parameter is set to MPR/F EXB. Defines the number of pulses per revolution of the master encoder. Programmed into follower drives only.
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. 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 offset voltage at the differential analog input at J1A-4 and J1A-5.
	CUR Loop COMP	Measures current response while running motor at one half the rated motor current.
	Resolver Align	This procedure checks the electrical alignment of the resolver with respect to the motor stator. This test locks the motor rotor into a reference position and proceeds to check are re-adjust if necessary.
	SPD CNTRLR CALC	Should be performed with the load coupled to the motor shaft. Sets the motor current to acceleration ratio, Integral gain and Differential 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 motor is loaded, adjust the PK Current Limit parameter to a greater value and repeat this test.
LEVEL 1 BLOCK		ENTERS LEVEL 1 MENU

Section 5
Troubleshooting

Overview

The Baldor Series 29M 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 insure 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 should 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 megohm. 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.

The control has a “Ready” LED on the panel (see Figure 3-3) and this LED is normally GREEN. If a fault occurs, the Ready LED will be RED and the control is disabled. Additional troubleshooting procedures are described on the following pages “Control Troubleshooting Procedure”.

The DB LED is on whenever Dynamic Brake power is dissipated into the DB (Dynamic Brake) resistor. DB resistor is also called a Regen resistor.

Control Troubleshooting Procedure

No Keypad Display - Display Contrast Adjustment

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

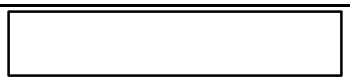
Action	Description	Display	Comments
Apply Power	No visible display.		
Press DISP key	Ensures control in Display mode.		Display mode.
Press SHIFT key 2 times	Allows display contrast adjustment.		
Press ▲ or ▼ key	Adjusts display contrast (intensity).		
Press ENTER key	Saves display contrast adjustment level and exits to display mode.		

Table 5-4 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.
Feedback Loss	Check resolver connections; noise on resolver lines or resolver power supply loss.
External Trip	An external over temperature condition occurred or open circuit on J1-16.
Following ERR	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.
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	EPROM 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	Output current exceeded 2.5 second rating.
Over speed	Motor RPM exceeded 110% of programmed MAX Motor Speed.
μP Reset	Power cycled before the residual Bus voltage reached 0VDC.
Power Supply	Affects shared bus multi axis systems only. Indicates power supply fault condition.
PWR Base FLT	Desaturation of power device occurred or bus current threshold exceeded.
Torque Prove FLT	Unbalanced current between all 3 motor phases.
User Fault Text	Custom software operating fault occurred.
Co-Processor FLT	Fault detected in the Co-Processor function.
Feedback	Indicates a problem with the feedback device (resolver).
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	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 and reset the internal timer.

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 output frequency	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 showing motor speed (based on output frequency).	STOP MOTOR SPEED LOCAL 0 RPM	
Press DISP key	Scroll to diagnostic info block.	PRESS ENTER FOR 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 control temperature.	STOP CONTROL TEMP LOCAL 0.0° C	Displays operating temperature in degrees C.
Press DISP key	Display mode showing bus voltage.	STOP BUS VOLTAGE LOCAL 321V	
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 since last power up.	TIME FROM PWR UP 0000000.01.43	HR.MIN.SEC format.
Press DISP key	Display mode showing operating zone, voltage and control type.	QUIET CONST TQ XXXV SERVO	
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	
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 software version and revision installed in the control.	SOFTWARE VERSION XXX-X.XX	
Press DISP key	Displays exit choice.	PRESS ENTER FOR DIAGNOSTIC EXIT	Press ENTER to exit diagnostic information.

Table 5-5 Troubleshooting

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
No Display	Lack of input voltage.	Check input power for proper voltage.
	Loose connections.	Check input power termination. Verify connection of operator keypad.
	Adjust display contrast.	See Adjust Display Contrast in Sec. 5.
Auto Tune Resolver Test failed	Resolver miswired.	Correct wiring problems. Check resolver speed. Check the number of motor poles.
	Excessive noise on resolver lines.	Check resolver connections. Separate resolver leads from power wiring. Cross resolver wires and power leads at 90° angles.
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 DB power.	Increase the DECEL time. Add optional DB resistor.
	DB resistor wiring problem.	Check DB resistor wiring.
	Input voltage too high.	Verify proper AC line voltage. Use step down transformer if needed. Use line reactor to minimize spikes.
DC Bus Low	Input voltage too low.	Disconnect DB resistor and repeat operation. Verify proper AC line voltage. Use step up 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.

Table 5-5 Troubleshooting Continued

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
External Trip	Motor ventilation insufficient.	Check external blower for operation.
	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 J1B-9 (External Trip Input).
	Poor thermostat connections.	Check thermostat connections.
	External trip parameter incorrect.	Verify connection of external trip circuit at J1B-9. Set external trip parameter to “OFF” if no connection made at J1B-9.
Following ERR	Speed proportional gain set too low.	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.
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 access ”Diagnostic Info” and compare reported ID number with Table 5-6. If different, call 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 your local Baldor office.
Low INIT Bus V	Improper AC line voltage.	Disconnect DB resistor and retry test. Check input AC voltage level.
Memory Error	EPROM memory fault occurred.	Press “RESET” key on keypad. If fault remains, contact your local Baldor office.
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, contact your local Baldor office.

Table 5-5 Troubleshooting Continued

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
Motor has wrong response to Speed Command	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 J1A-4 and J1A-5 is ±15VDC referenced to chassis common.
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.
	Incorrect Command Select parameter.	Change Command Select parameter to match wiring at J1A and J1B.
	Incorrect speed command.	Verify control is receiving proper command signal at J1A and J1B.
Motor Will Not Reach Maximum Speed	Max Output Speed parameter 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 receiving proper command signal at input terminals. Verify control is set to proper operating mode to receive speed command.
	Speed potentiometer failure.	Replace potentiometer.
Motor Will Not Stop Rotation	MIN Output Speed parameter value set too high.	Reduce 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 5-5 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. Reset parameter values to factory settings. Re-enter the Parameter Block Values you recorded in the User Settings at the end of this manual. Autotune the control.
Over Current FLT	Current Limit parameter set too low.	Increase PK Current Limit parameter in the Level 2 Output Limits block.
	ACCEL/DECEL time too short.	Increase ACCEL/DEC parameters in the Level 1 ACCEL/DECEL Rate block.
	Excessive noise on resolver 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 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	Peak output current exceeded 2.5 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.
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 Brushless Control block.

Table 5-5 Troubleshooting Continued

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
PWR Base FLT	Excessive current usage.	Disconnect motor leads from control and retry test. If problem persists, contact your local Baldor office.
	Excessive noise on resolver lines.	Check resolver connections. Separate resolver leads from power wiring. Cross resolver wires and power leads at 90°. Electrically isolate resolver from motor. Install optional Isolated resolver 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.	Correct motor load. Verify proper sizing of control and motor.
	Excessive power in DB circuit.	Verify proper Ohm and Watt parameters of DC Injection Braking. Increase decel time. Add optional DB resistor.
Feedback	Resolver failure.	Check resolver to motor coupling (align or replace if needed). Verify correct wiring.
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 5-6 Power Base ID

115 VAC Control Catalog Numbers	Power Base ID No.	230 VAC Control Catalog Numbers	Power Base ID No.
SD29M1A02-PR	49	SD29M2A02-PR	09
SD29M1A05-PR	4B	SD29M2A05-PR	0B

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

Electrical Noise Considerations All electronic devices 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.

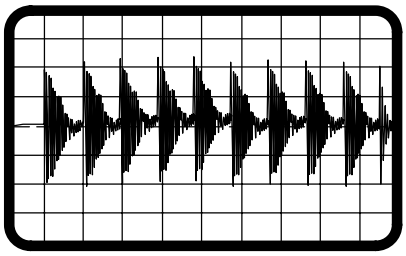
At the extreme level, significant noise can cause damage to the drive. Therefore, it is advisable to prevent noise generation and to follow wiring practices that prevent noise generated by other devices from reaching sensitive circuits. In a control, such circuits include inputs for speed, torque, control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

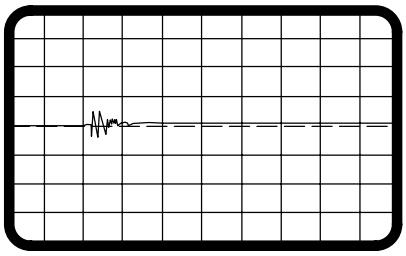


Relay and Contactor Coils

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.

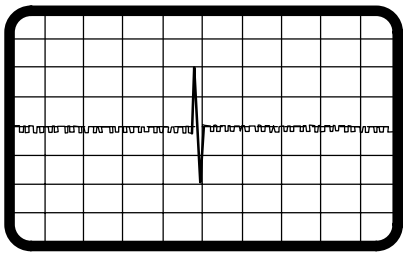
To suppress these noise generators, add an R–C snubber across each relay and contactor coil. A snubber consisting of a 33kΩ resistor in series with a 0.47μF capacitor usually works well. The snubber reduces the rate of rise and peak voltage in the coil when current flow is interrupted. This eliminates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

Figure 5-2 R-C Snubber Circuit



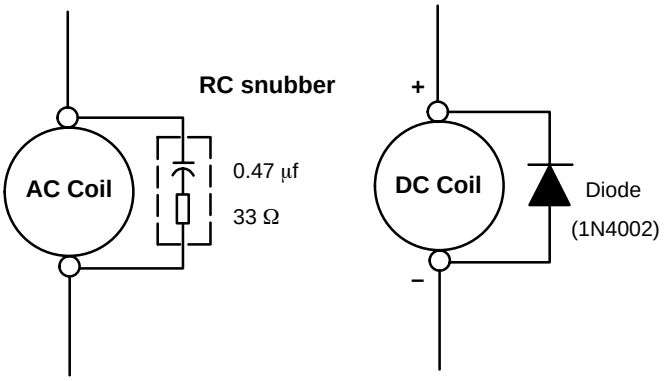
Using an R-C snubber and twisted-pair shielded cable keeps the voltage in a circuit to less than 2 V for a fraction of a millisecond. Note that the vertical scale is 1 V/div., rather than the 20 V/div. in figures 5-1 and 5-2.

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 and DC Coil Noise Suppression

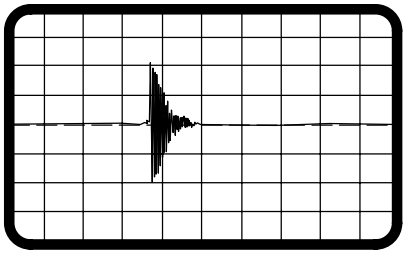


Electrical Noise Considerations Continued

Wires between Controls and Motors

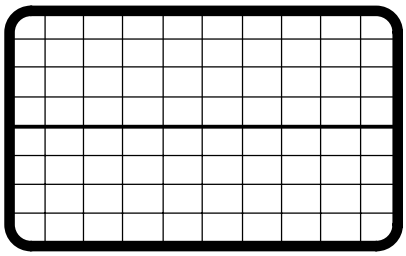
Output leads from a typical 460 VAC drive controller contain rapid voltage rises created by power semiconductors switching 650V in less than a microsecond, 1,000 to 10,000 times a second. These noise signals can couple into sensitive drive circuits as shown in Figure 5-5. For this waveform, a transient 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



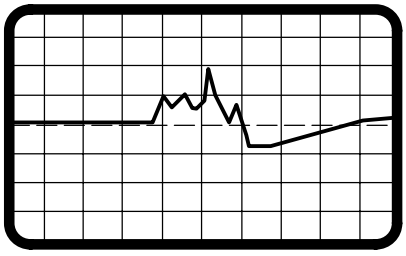
If the shielded pair cable is used, the coupling is reduced by nearly 90%, Figure 5-6.

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



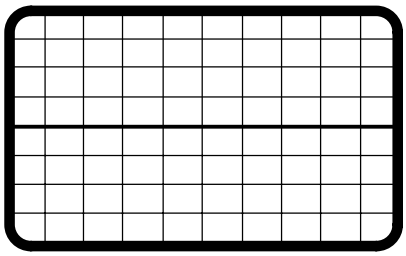
The motor leads of DC motors contain similar voltage transients. The switching rate is about 360 times a second. Noise transients can produce about 2V of noise induced in a wire adjacent to the motor lead. A 30HP, 500VDC Drive, as shown in Figure 5-7. Scope is set at 1 V/div. and 5 µsec/div.

Figure 5-7 30HP, 500VDC Drive



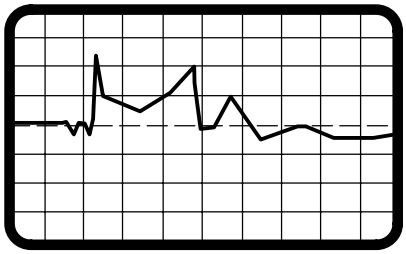
Again, Replacing a single wire with a shielded pair cable reduces the induced noise to less than 0.3 V, Figure 5-8.

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



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 the AC input power wire of a 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. 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. Manufactured by such companies as TCI (Milwaukee, WI) and MTE (Menomonee Falls, WI) these reactors also reduce ripple current in the motor windings and often improve motor life. For maximum benefit, the reactors should be mounted in the drive enclosure with short leads between the control and the reactors.

Drive Power Lines

The same type of reactor 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.

Electrical Noise Considerations Continued

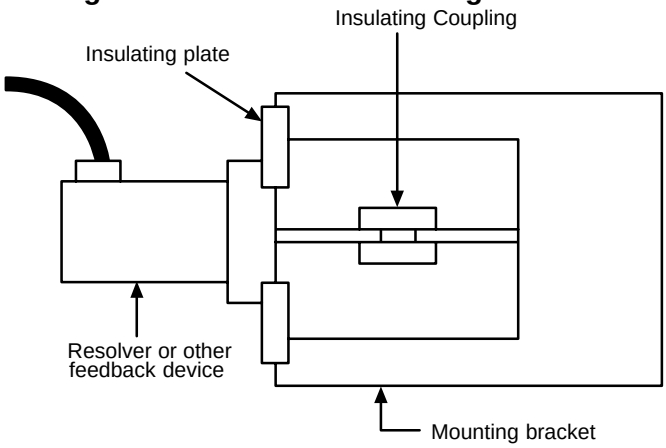
Control Enclosures The cure for some electrical noise may be a grounded metallic control enclosure. The enclosure should be grounded to the building ground with a short, heavy gauge wire. Also, the power conduit, motor lead conduit and signal wire conduit must be grounded to the enclosure. Sometimes paint and seals prevent electrical contact between conduit and the cabinet. Sometimes wire or straps are used to ensure good electrical grounding.

Special Motor Considerations Motor frames are also on the required grounding list. As with control enclosures, motors should be grounded directly to 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 low current levels. Therefore, these wires should be routed away from sensitive signal wires and contained within conduits or bundled away from open power and signal wires.

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.

Optical Isolation

Two methods of optical isolation are commonly used; optical couplers and fiber optics.

Optical Couplers

The common term for optical couplers, 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/µsec, which is adequate for most control logic signals. High performance opto couplers with common mode ratings up to 5,000 V/µsec are installed for the most severe noise environments.

Fiber Optics

Special plastic or glass fiber stands 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 strands.

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 is not ground. Result: equipment malfunctions or electrical shock hazard exists.

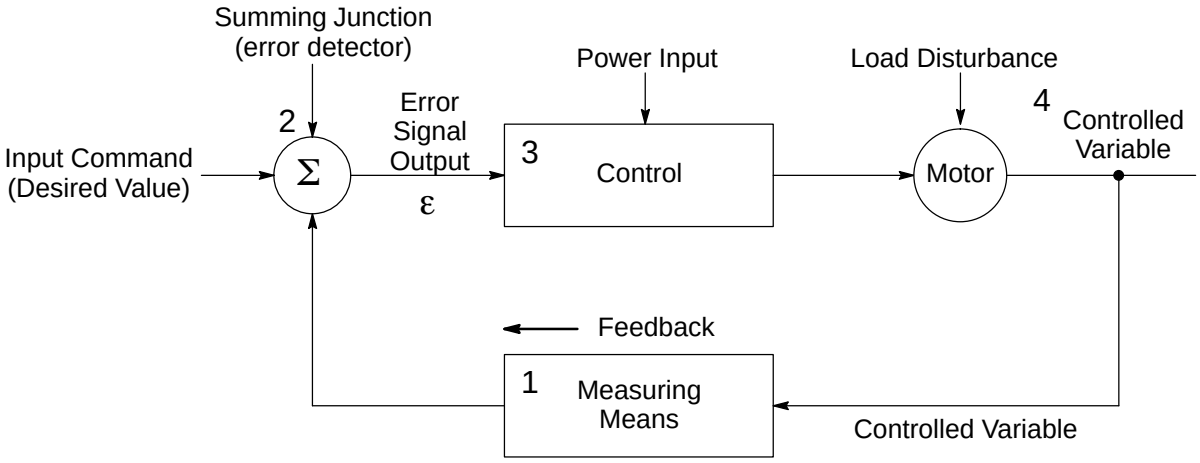
It may be necessary to retain the services of an electrical consultant, who is also a licensed professional engineer experienced in grounding practices to make the necessary measurements to establish if the plant ground is really grounded.

Section 6
Manually Tuning the Series 29M Control

Explanation of Closed Loop Block Diagrams

Control systems are usually represented by a series of interconnected blocks. The blocks represent the individual functions of the system. The blocks are interconnected by a series of lines, which represent the variable or quantity involved with directional arrows showing the direction of information flow. See Figure 6-1.

Figure 6-1 Block Diagram of a Closed Loop System



Any closed loop system can be divided into four basic operations:

1. Measurement of the controlled variable. The controlled variable can be velocity, torque, etc. This measuring means is accomplished using a sensor that converts the variable to an electrical signal that is compatible with the control inputs, usually voltage or current. This signal now represents the controlled variable (Feedback).
2. Determination of the error. The summing junction compares the measured value of the controlled variable (Feedback Input) with the Input Command (desired value) and generates a error signal. The operation is a simple mathematical subtraction operation as follows:

   Error Signal (ε) = Input Command - Feedback
3. The error signal is then used by the control to change the motor speed or torque.
4. The motor speed or torque is then used to reduce the error signal by driving the control, and the final controlled variable, so that the actual value of the controlled variable approaches the Input Command value or desired value. It should be noted that closed loop control systems are error actuated. In other words, an error must be present before the system will try to correct for it.

Definition of Input Command (Desired value)

The Input Command is the input signal set by the operator. This can represent speed or torque level.

Definition of Feedback Feedback is the signal which represents the actual measured value from the controlled variable. This can represent a pressure, flow, speed, torque, level or temperature sensor. This input is usually a sensor voltage or current representing the measured value.

Definition of Error Error is the result of subtracting the Input Command and Feedback signals.

Error is mathematically defined as:

Error Signal (ε) = Input Command - Feedback

Definition of "P" (Proportional gain)

Proportional gain is the amplification that is applied to the process error signal, which will result in a particular control output.

Proportional gain is mathematically defined as;

$A_{out} = K_p \varepsilon$

Where;

A_{out} = Control output

K_p = Proportional gain

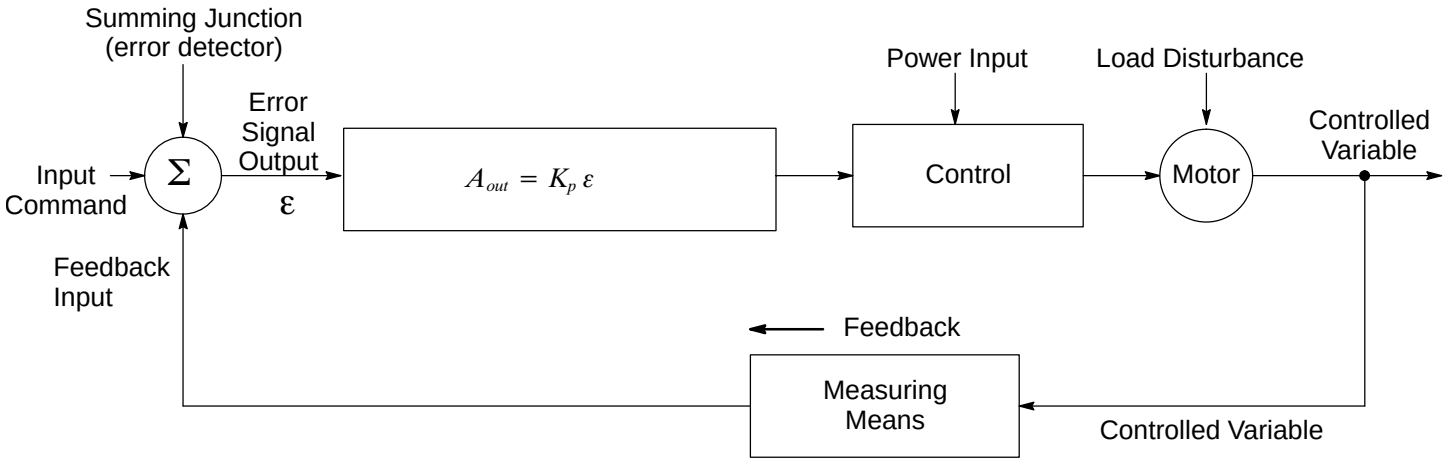
ε = Error signal = (Input Command - feedback)

In Figure 6-2 we see that the amplitude of the output of the control is dependent on the error, multiplied by the proportional gain.

For a given amount of error, the greater the proportional gain, the greater the output.

It is also true that, for a given amount of proportional gain, the greater the error, the greater the output.

Figure 6-2 Block Diagram of the P Element



Definition of "I" (Integral gain)

Integral gain (like proportional gain) is amplification of the process error signal, but is time dependent. If a steady state error exists for long periods of time, it is known as an offset. Integral gain compensates for this long term error or offset. Generally speaking, if you were to use only proportional control in a process, the control output would never get the controlled variable exactly equal to the input command. You would always have some small amount of error. This is often called offset. The Integral term senses this long term offset, and corrects the control output to reduce the effect of offset.

Integral gain is mathematically defined as:

$$A_{out} = K_i \int \varepsilon \, \Delta t$$

Where A_{out} = Controller output

K_i = Integral gain

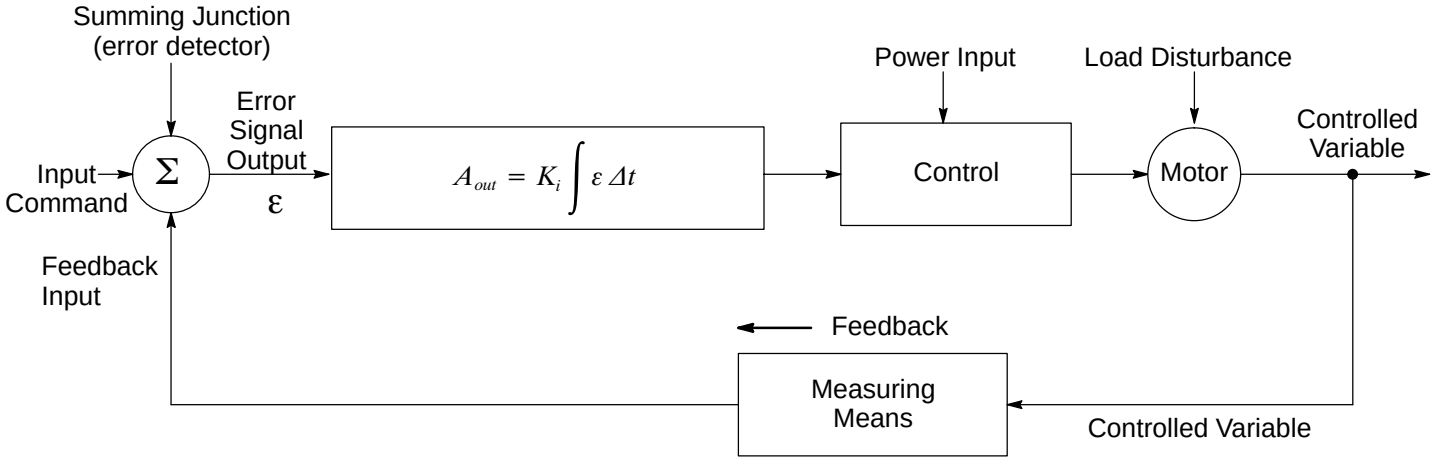
$\int$ = Integrator symbol

ε = Process error signal = (setpoint - feedback)

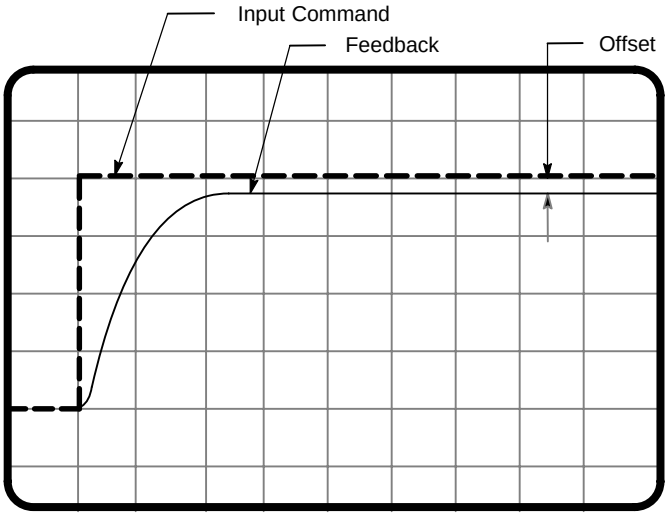
Δt = Change in time

This formula states that a given control output (A_{out}) is equal to integral gain (K_i), multiplied by the integral ($\int$) of the error (ε), multiplied by the change (Δ) in time (t). What all of this says is simply that in an Integrator loop is used and error is accumulated over time (or integrated), and integral gain is used to reduce long term error. Figure 6-3 shows this process.

Figure 6-3 Block Diagram of the I Element



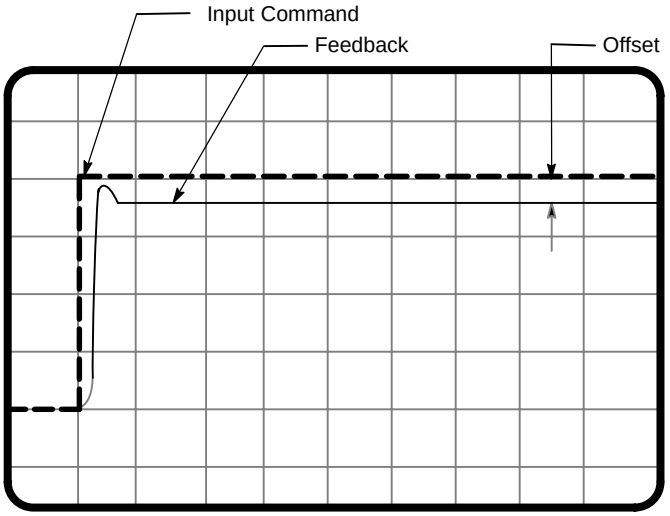
To illustrate the concept of offset, refer to the following waveform. When the feedback has stabilized, it is not equal to input command. In this case, the difference between the input command and the feedback is the offset. Note that the integral gain is set to zero.



Gain Settings:
Proportional gain=25
Integral gain=0.00 Hz

(Oscilloscope set to:
vertical=1 V/ division
horizontal=1.0 sec/division

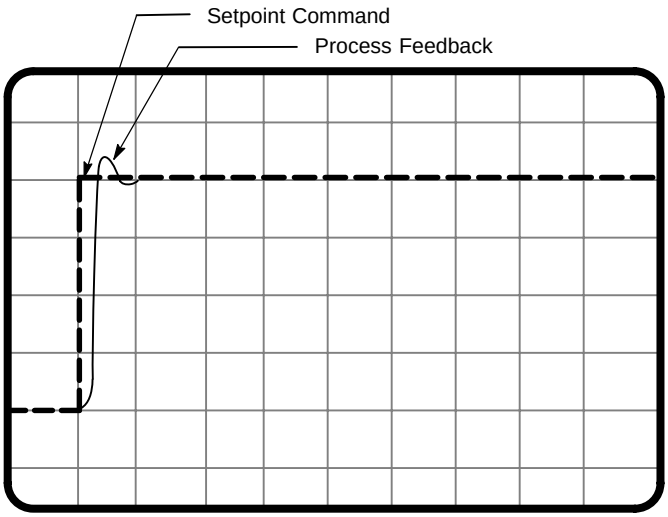
The next waveform illustrates what happens when the proportional gain is increased from 25 to 100. An increase in the proportional gain causes the controlled variable to respond more quickly as indicated by the feedback signal.



Process Gain Settings:
Proportional gain=100
Integral gain=0.00 Hz

(Oscilloscope set to:
vertical=1 V/ division
horizontal=1.0 sec/division

The next waveform illustrates what happens to the system offset when we apply integral gain. With the addition of integral gain (2.00 Hz), the system offset is reduced to zero.



Process Gain Settings:
Proportional gain=100
Integral gain=2.00 Hz

(Oscilloscope set to:
vertical=1 V/ division
horizontal=1.0 sec/division

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

Current Prop Gain Parameter This parameter is located in the Level 1, Brushless 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:

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

Where:

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

Motor line to neutral 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 control 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 60 will yield adequate performance.

Current Int Gain Parameter

The Current Int Gain parameter located in the Level 1 Brushless 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 Brushless 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 Brushless Control Block is set to 3 Hz and may be set at any value from zero to 9.99 Hz.

Setting the Speed Int Gain parameter to 0Hz removes integral compensation. This results in a proportional loop only. This selection is ideal for systems where overshoot must be avoided and substantial stiffness (ability of the control 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 control. An excessive integral gain setting will cause overshoot for transient speed commands and may lead to oscillation. If the Speed Prop Gain parameter and the Speed Int Gain parameter are set too high, an overshoot condition can also occur.

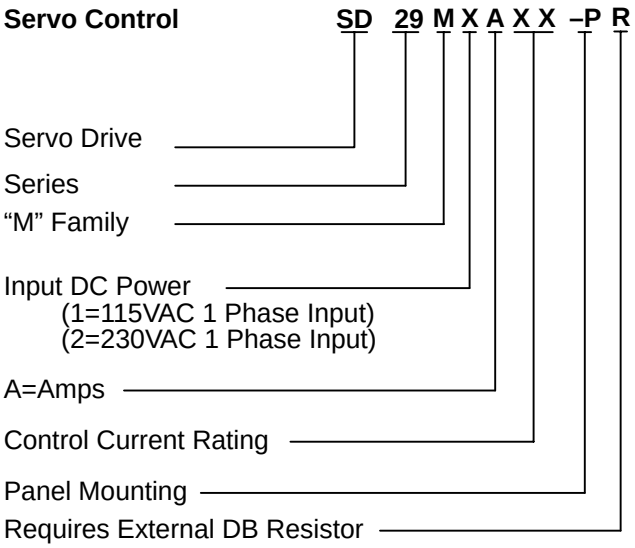
To manually tune the control, the following procedure is used:

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.

Section 7
Specifications and Product Data

Identification



Servo Control Specifications: (115VAC)

Description	Unit	SD29M1A02–PR	SD29M1A05-PR
Nominal Input Voltage (Range)	VAC	115 (97-125) 1Ø	
Input Frequency	Hz	50/60 ±5%	
Nominal Output Bus Voltage (Range)	VDC	160 (50-176)	
Nominal Output Bus Current	A_{RMS}	2.5	5.0
Peak Output Bus Current (±10%); 2.5s ±.5s	A_{RMS}	5.0	10.0
Nominal Output Power	KW	0.5	1.0
Efficiency	%	>97	
Minimum Load Inductance	µH	400	
Nominal Switching Frequency	KHz	8.0	
Mounting	–	Panel	
Weight	lb(Kg)	2.73 (1.24)	4.69 (2.13)
Operating Altitude	Ft(M)	To 3300ft (1000M). Above 3300 ft, derate 11% per 1000ft (300M).	
Operating Shock	G	1G	
Operating Vibration	G	1.0G (10-60Hz)	
Operating Temperature Range	°C	5 to 40°C.	
Maximum Operating Temperature	°C	40°C Maximum.	
Storage Temperature Range	°C	–25 to +70°C	

All values at ambient temperature of 25°C unless otherwise stated.

Servo Control Specifications: (230VAC)

Description	Unit	SD29M2A02–PR	SD29M2A05–PR
Nominal Input Voltage (Range)	VAC	230 (220-250) 1Ø	
Input Frequency	Hz	50/60 ±5%	
Nominal Output Bus Voltage (Range)	VDC	300 (50-350)	
Nominal Output Bus Current	A_{RMS}	2.5	5
Peak Output Bus Current (±10%); 2.5s ±.5s	A_{RMS}	5.0	10.0
Nominal Output Power	KW	1.01	2.17
Efficiency	%	>97	
Minimum Load Inductance	µH	400	
Nominal Switching Frequency	KHz	8.0	
Mounting	–	Panel	
Weight	lb(Kg)	2.73 (1.24)	4.69 (2.13)
Operating Altitude	Ft(M)	To 3300ft (1000M). Above 3300 ft, derate 11% per 1000ft (300M).	
Operating Shock	G	1G	
Operating Vibration	G	1.0G (10-60Hz)	
Operating Temperature Range	°C	5 to 40 °C	
Maximum Operating Temperature	°C	40°C Maximum	
Storage Temperature Range	°C	–25 to +70°C	

All values at ambient temperature of 25°C unless otherwise stated.

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 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 max from control

Control Signal Levels:

Description	Unit	SD29M Series
Command Input	VDC	0-10, ±5, ±10 or (4-20mA)
Command Signal Resolution	bits	9 bits plus sign
Feedback System	–	Resolver
Feedback Resolution	bits	12
Resolver Pole Pairs	–	1 - 8
Resolver Winding Ratio	–	0.5
Simulated Encoder Output	–	RS422 (5V @ 500KHz maximum)
Encoder Simulation Resolution	ppr	1024 (Differential Driver)

Differential Analog Input:

Description	Unit	SD29M Series
Common Mode Rejection	db	40 db
Full Scale Range	VDC	±5VDC, ±10VDC, 4-20 mA
Resolution	bits	9 bits + sign
Update rate	msec	.480

Other Analog Input:

Description	Unit	SD29M Series
Full Scale Range	VDC	0 - 10 VDC
Resolution	bits	9 bits + sign
Update Rate	msec	.480

Analog Outputs:

Description	Unit	SD29M Series
Analog Outputs		2 Assignable
Full Scale Range	VDC	±10 VDC
Source Current	mA	1 mA maximum
Resolution	bits	9 bits + sign
Update Rate	msec	1.92

Digital Inputs:

Description	Unit	SD29M Series
Opto-isolated Logic Inputs		9 Assignable
Rated Voltage	VDC	10 - 30 VDC (closed contacts std)
Input Impedance	KΩ	6.8 K Ohms
Leakage Current	μA	10 μA maximum
Update Rate	msec	15.36

Digital Outputs:

Description	Unit	SD29M Series
Opto-isolated Logic Outputs		4 Assignable
ON Current Sink	mA	60 mA Max
ON Voltage Drop	VDC	2 VDC Max
Update Rate	msec	30.72

Diagnostic Indications:

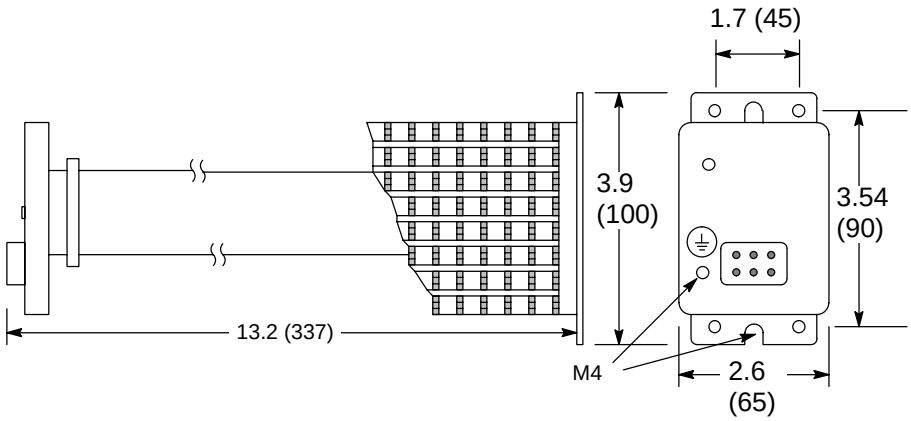
Current Sense Fault	
Instantaneous Over Current	Under Voltage
Invalid Power Base ID	Ready
Line Power Loss	Parameter Loss
Microprocessor Failure	Overload
Over temperature (Motor or Control)	Overvoltage
Over speed	Torque Proving
Following Error	Co-Processor

Note: All specifications are subject to change without notice.

DB Resistor Selection

Table 7-1 DB Resistor

Control Catalog No.	Input Voltage (VAC)	Continuous Dynamic Braking Watts	Catalog No.
SD29M1A02-PR	115	44	RG27
SD29M1A05-PR	115	44	RG27
SD29M2A02-PR	230	44	RG56
SD29M2A05-PR	230	44	RG56

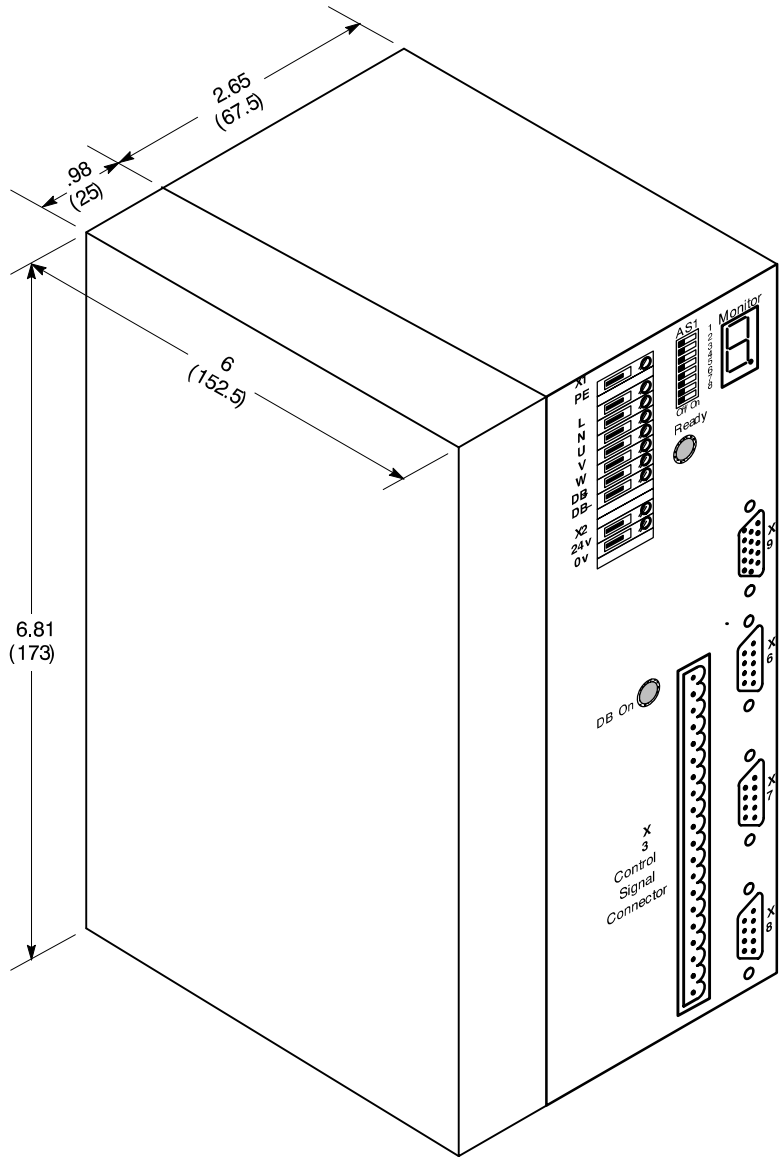


Terminal Tightening Torque Specifications

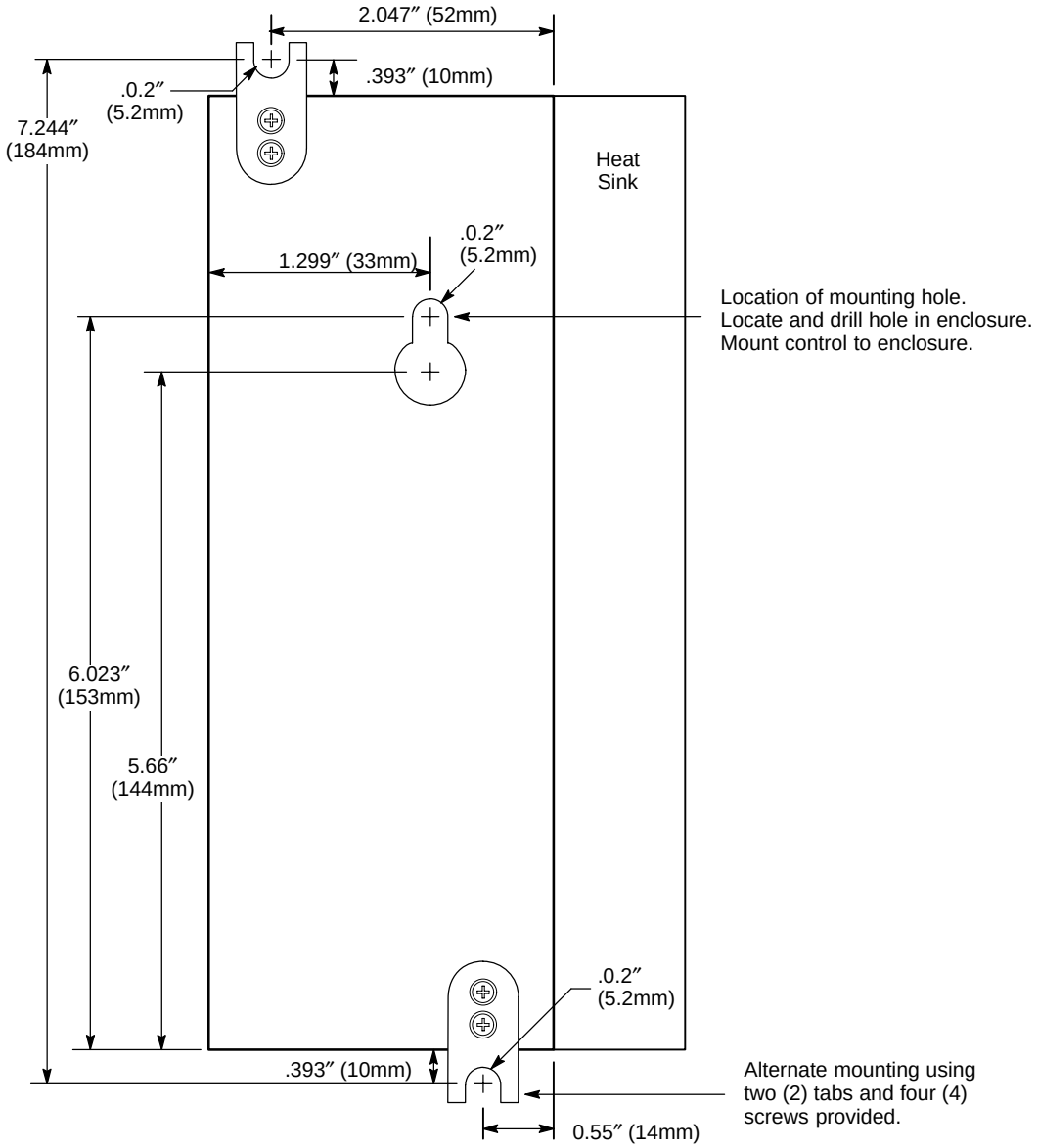
Table 7-2 Tightening Torque Specifications

VAC Control	Tightening Torque			
	L, N, PE, DB +,DB–		Logic J1A, J1B	
	Lb-in	Nm	Lb-in	Nm
115	7	0.8	7	0.8
230	7	0.8	7	0.8

Dimensions


2.65
(67.5)
.98
(25)
6
(152.5)
6.81
(173)
X1
PE
L
N
U
V
W
DB+
DB-
X2
24V
0V
AS1
Monitor
Ready
DB On
X9
X6
X7
X8
X3
Control
Signal
Connector

Mounting Hole Location (Rear View)



Note: Heat sink installed on 5 amp models only.

Appendix A

Parameter Values

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 ON (Stop key active during remote operation). REMOTE OFF (Stop key inactive during remote operation).	REMOTE ON	
	KEYPAD STOP MODE	1302	COAST, REGEN	REGEN	
	KEYPAD RUN FWD	1303	ON, OFF	ON	
	KEYPAD RUN REV	1304	ON, OFF	ON	
	KEYPAD JOG FWD	1305	ON, OFF	ON	
	KEYPAD JOG REV	1306	ON, OFF	ON	

Parameter Block Values Level 1 Continued

Level 1 Blocks - Continued					
Block Title	**Parameter**	P#	**Adjustable Range**	**Factory Setting**	**User Setting**
INPUT	OPERATING MODE	1401	KEYPAD STANDARD RUN 15SPD 2 WIRE MULTI INP 3 WIRE MULTI INP 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 10V EXB 4-20mA EXB 3-15 PSI EXB TACHOMETER EXB SERIAL NONE	+/-10 VOLTS	
	ANA CMD INVERSE	1403	ON, OFF	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	ON, OFF	OFF	
OUTPUT	OPTO OUTPUT #1	1501	READY ZERO SPEED AT SPEED OVERLOAD KEYPAD CONTROL AT SET SPEED FAULT FOLLOWING ERR MOTR DIRECTION DRIVE ON CMD DIRECTION AT POSITION OVER TEMP WARN PROCESS ERROR DRIVE RUN SERIAL	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	

Parameter Block Values Level 1 Continued

Level 1 Blocks - Continued					
Block Title	**Parameter**	P#	**Adjustable Range**	**Factory Setting**	**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	1 - 32767	CALC	
BRUSHLESS CONTROL	RESOLVER ALIGN	1601	0-360 degrees	CALC	
	SPEED FILTER	1602	0-7	CALC	
	FEEDBACK ALIGN	1603	Forward, Reverse	FORWARD	
	CURRENT PROP GAIN	1604	0-1000	100	
	CURRENT INT GAIN	1605	0-400	150Hz	
	SPEED PROP GAIN	1606	0-1000	10	
	SPEED INT GAIN	1607	0-9.99Hz	1.00HZ	
	SPEED DIFF GAIN	1608	0-100	0	
	POSITION GAIN	1609	0-9999	CALC	
LEVEL 2 BLOCK	ENTERS LEVEL 2 MENU				
PRESS ENTER FOR PROGRAMMING EXIT	Exit programming mode and return to display mode.				

Parameter Block Values Level 2

Level 2 Blocks					
Block Title	**Parameter**	**P#**	**Adjustable Range**	**Factory Setting**	**User Setting**
OUTPUT LIMITS	MIN OUTPUT SPEED	2001	0-MAX Speed	0 RPM	
	MAX OUTPUT SPEED	2002	0-22500 RPM	Rated Motor Speed	
	PK CURRENT LIMIT	2003	0-PEAK RATED CURRENT	PK Control Rating	
	PWM FREQUENCY	2004	1 - 16KHz	8.5KHz	
	CUR RATE LIMIT	2005	0-10.00 SEC	0.004 SEC	
CUSTOM UNITS	DECIMAL PLACES	2101	0-5	0	
	VALUE AT SPEED	2102	0-65535	00000/ 01000 RPM	
	UNITS OF MEASURE	2103	Selection of 9 Character Sets	-	
PROTECTION	OVERLOAD	2201	FAULT, FOLDBACK	FOLDBACK	
	EXTERNAL TRIP	2202	ON, OFF	OFF	
	LOCAL ENABLE INPUT	2204	ON, OFF	OFF	
	FOLLOWING ERROR	2203	ON, OFF	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 RATED AMPS	2502	0-999.9	Factory Set	
	MOTOR RATED POLES	2503	0 - 100	4 POLES	
	RESOLVER SPEEDS	2504	0-10	1 SPEED	
	CALC PRESETS	2505	YES, NO	NO	

Parameter Block Values Level 2 Continued

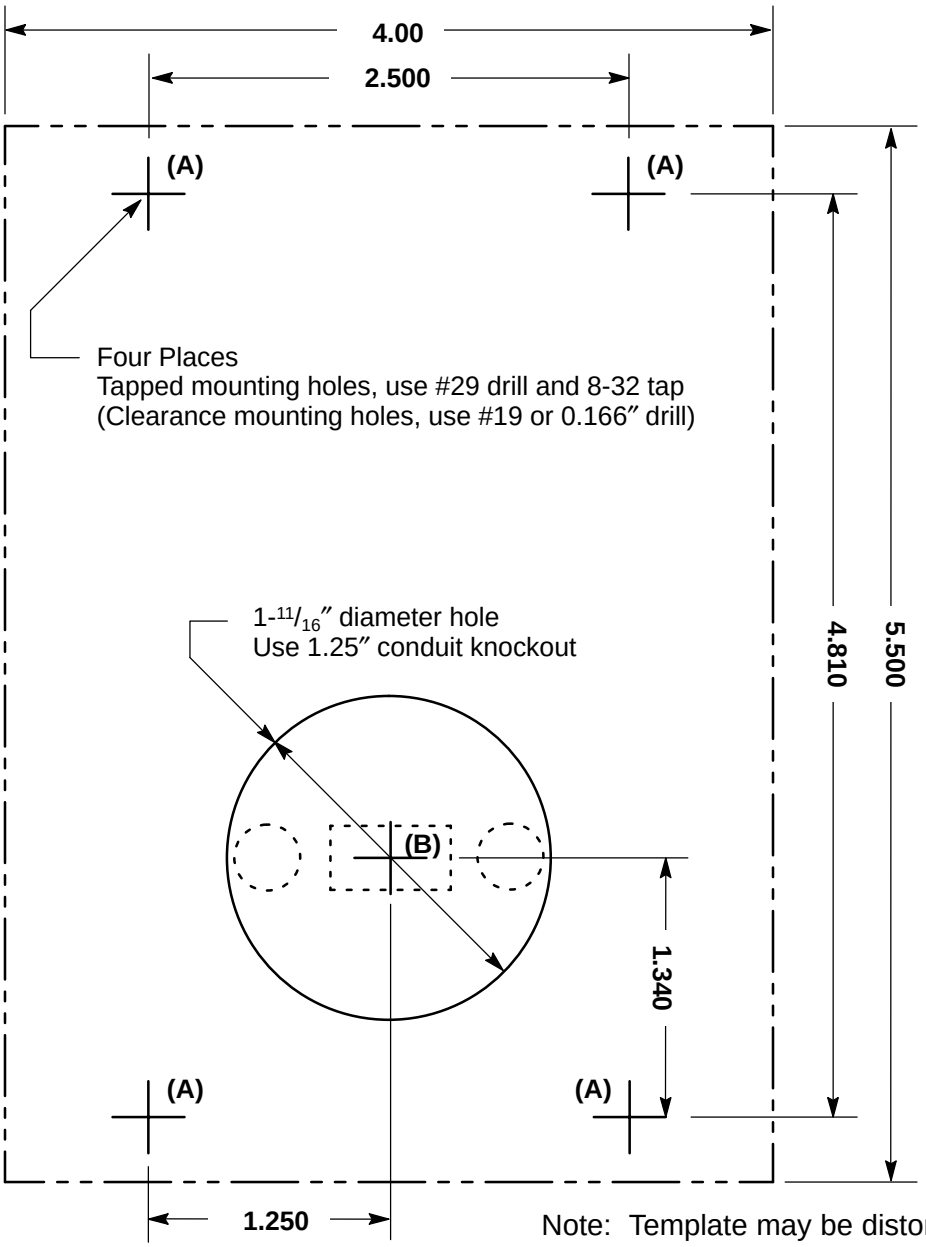
Level 2 Blocks - Continued					
Block Title	**Parameter**	**P#**	**Adjustable Range**	**Factory Setting**	**User Setting**
PROCESS CONTROL	PROCESS FEEDBACK	2601	POTENTIOMETER +/-10VOLTS +/-5 VOLTS 4 TO 20 mA 5V EXB 10V EXB 4-20mA EXB 3-15 PSI EXB TACHOMETER EXB NONE	NONE	
	PROCESS INVERSE	2602	ON, OFF	OFF	
	SETPOINT SOURCE	2603	SETPOINT CMD POTENTIOMETER +/-10VOLTS +/-5 VOLTS 4 TO 20 mA 5V EXB 10V EXB 4-20mA EXB 3-15 PSI EXB TACHOMETER EXB NONE	SETPOINT CMD	
	SETPOINT COMMAND	2604	–100% to +100%	0.0 %	
	SET PT ADJ LIMIT	2605	0-100%	10.0 %	
	PROCESS ERR TOL	2606	0-100%	10 %	
	PROCESS PROP GAIN	2607	0-2000	0	
	PROCESS INT GAIN	2608	0-9.99 HZ	0.00 HZ	
	PROCESS DIFF GAIN	2609	0-1000	0	
	FOLLOW I:O RATIO	2610	(1-65535) : (1-65535)	1:1	
	FOLLOW I:O OUT	2611	(1-65535) : (1-65535)	1:1	
	MASTER ENCODER	2612	50 - 65535	1024PPR	
COMMUNICATIONS	PROTOCOL	2701	RS232 ASCII, RS 485 ASCII	RS232 ASCII	
	BAUD RATE	2702	9600, 19.2KB, 38.4KB, 57.6KB, 115.2KB, 230.4KB	9600	
	DRIVE ADDRESS	2703	0 - 31	0	

Parameter Block Values Level 2 Continued

Level 2 Blocks - Continued					
Block Title	**Parameter**	**P#**	**Adjustable Range**	**Factory Setting**	**User Setting**
AUTO-TUNING	**CALC PRESETS**	CALC	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	-	-	
	RESOLVER ALIGN Sets the Motor Mag Amps.	AU3	-	-	
	SPD CNTRLR CALC Measures the motor current to acceleration ratio during motor rotation. This procedure adjusts the Process INT Gain and Process DIFF Gain parameters.	AU4		-	
LEVEL 1 BLOCK	Enters Level 1 Menu				
PRESS ENTER FOR PROGRAMMING EXIT	Exit programming mode and return to display mode.				

Appendix B

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

MN1230

Printed in USA
1/98 C&J2500