BALDOR®
MOTORS AND DRIVES

Series 35D
Inverter Control

Installation & Operating Manual

8/02 MN735

Table of Contents

Section 1
Quick Start

The basic steps for connection and setup are provided in this section. Detailed descriptions of each step and parameter settings are provided later in this manual. Be sure to comply with all applicable codes when installing this control.

Minimum Connection RequirementS Refer to Section 3 for cover removal procedure.

Power and Motor Connections

Figures 1-1and 1-2 show the minimum connections required at the power connector.

Figure 1-1 Power Connections

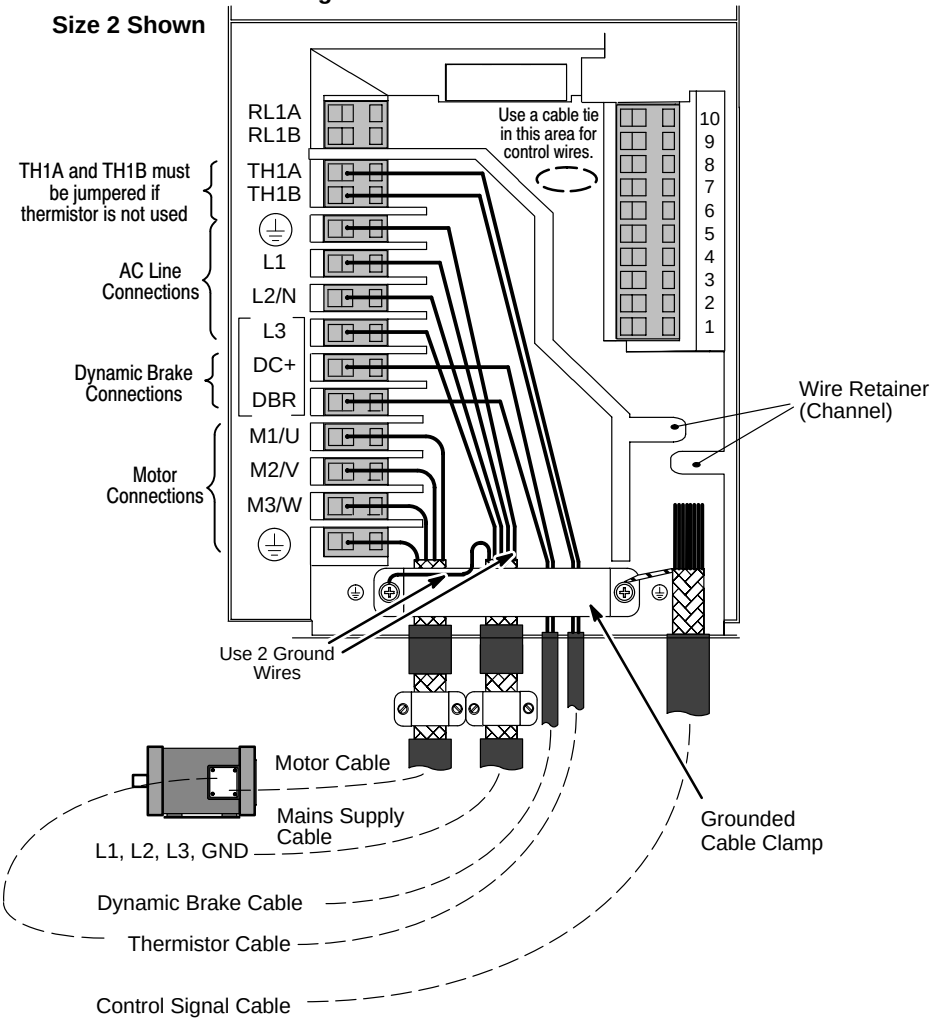
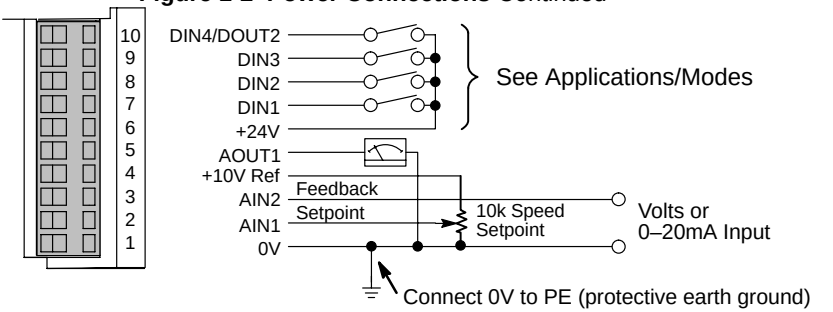
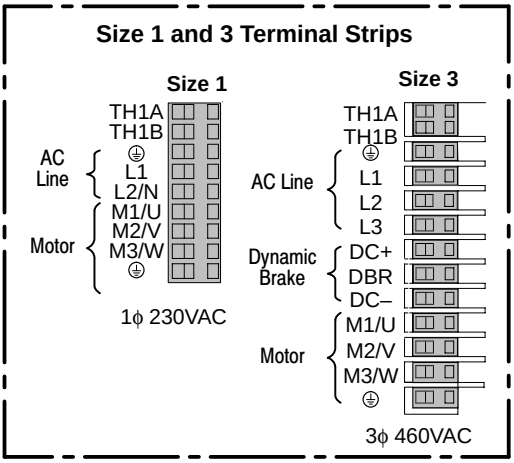


Figure 1-2 Power Connections Continued





Jumpers and Switches None

Control Terminal Connections See Table 1–2.

Local Mode

No connections are required.

Remote Mode

Control terminals 1 to 10 can be connected as shown in the application modes described in Section 3 of this manual.

Table 1–1 Power Connection Descriptions

Terminal	Description	Function	Range	
			230V 1–Phase	460V 3–Phase
RLY1	Relay Output	Normally open, programmable contact for a relay output.	Contact closes when the programmed condition (see Section 4) is true. No voltage is present on this contact. 6 conditions are available.	
TH1A	Thermistor	Connection to motor thermistor	It is good practice to protect motors by using thermistors. A typical resistance (up to a reference temperature of 125°C) is 200Ω, rising rapidly to 2000Ω above this temperature. Connect devices in series between TH1A and TH1B. Jumper TH1A and TH1B if temperature sensors are not used.	
TH1B	Thermistor	Connection to motor thermistor		
⏚	Reference Terminal	Supply protective earth (PE). This terminal must be connected to a protective (earth) ground for permanent ground.		
L1	Power Input	Single and three phase line connection	220/240VAC±10% with respect to L2/N.	380/460VAC±10% with respect to L2, L3.
L2/N L2	Power Input	Single phase neutral (or L2 three phase line connection)	220/240VAC±10% with respect to L1.	380/460VAC±10% with respect to L1, L3.
L3	Power Input	Three phase line connection	Not applicable	380/460VAC±10% with respect to L1, L2.
DC–	**No user connection**			
DC+	Dynamic Brake	Connection to external brake resistor	Not applicable	Frame 2 (high volt only) & 3. See "Internal Dynamic Brake Switch" table
DBR	Dynamic Brake	Connection to external brake resistor	Not applicable	Frame 2 (high volt only) & 3. See "Internal Dynamic Brake Switch" table
M1/U M2/V M3/W	Power Outputs	3–phase supply connection for motor	0 to 220/240VAC 0 to 240Hz	0 to 380/460VAC 0 to 240Hz
⏚	Reference Terminal	Supply protective earth (PE). This terminal must be connected to a protective (earth) ground for permanent ground.		

Parameter Settings (for Keypad Operation)

The factory settings should be sufficient to operate the control using the "Local" mode with the keypad. Only a few changes to the motor data parameters must be made. Before any parameters can be changed, set System::Configure I/O::Configure Enable to enable. All LEDs will blink during configuration. After parameter values are changed to meet the needs of your application, be sure to set System::Configure I/O::Configure Enable to Disable and do the Parameter Save procedure.

Table 1–2 Analog/Digital Signal Descriptions

Terminal (SELV)	Signal Name	Description	Range
RL1A	User Relay	Volt-free contact - 4A maximum, non-inductive	0-250VAC/24VDC
RL1B			
10	DIN4/ DOUT2	Configurable I/O, Digital Input 4 or Digital Output 2.	0-24V source open collector
9	DIN3	Digital Input 3.	0-24V source open collector
8	DIN2	Digital Input 2.	0-24V source open collector
7	DIN1	Digital Input 1.	0-24V source open collector
6	+24V	24V – 24V supply for digital I/O	50mA max
5	AOUT1	Analog Output – 10mA maximum	0-10V
4	10VREF	10V reference (10mA maximum loading)	10V
3	AIN2	Analog Input 2	0-10V, 4-20mA
2	AIN1	Analog Input 1 - Setpoint. If unused, connect to 0VDC.	0-10V
1	0V	0V - Reference for Analog/Digital I/O For single control installations, connect pin 1 (0V) to PE. For multiple control installations, connect the 0V terminals of each control together. Then connect only one control to PE.	0V

CE Compliance A custom unit may be required, contact Baldor. Compliance to Directive 89/336/EEC is the responsibility of the system integrator. A control, motor and all system components must have proper shielding, grounding, and filtering as described in MN1383. Please refer to MN1383 for installation techniques for CE compliance. For additional information, refer to Section 3 and Appendix B of this manual.

Limited Warranty

For a period of one (1) year from the date of original purchase, BALDOR will repair or replace without charge controls and accessories which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied. BALDOR shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, BALDOR's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to BALDOR with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses.

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

Product Notice Intended use:

These drives are intended for use in stationary ground based applications in industrial power installations according to the standards EN60204 and VDE0160. They are designed for machine applications that require variable speed controlled three phase brushless AC motors.

These drives are not intended for use in applications such as:

– Home appliances
– Mobile vehicles
– Ships
– Airplanes

Unless otherwise specified, this drive is intended for installation in a suitable enclosure. The enclosure must protect the control from exposure to excessive or corrosive moisture, dust and dirt or abnormal ambient temperatures.

In the event that a control fails to operate correctly, contact Baldor for return instructions.

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.

– System documentation must be available at all times.
– Keep non-qualified personnel at a safe distance from this equipment.
– Only qualified personnel familiar with the safe installation, operation and maintenance of this device should attempt start-up or operating procedures.
– Always remove power before making or removing any connections to this control.

PRECAUTIONS: Classifications of cautionary statements.

⚠ **WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in injury or death.**

⚠ **Caution: Indicates a potentially hazardous situation which, if not avoided, could result in damage to property.**

Continued on next page.

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.**

⚠ **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.**

⚠ **WARNING: Be sure all wiring complies with the National Electrical Code and all regional and local codes or CE Compliance. Improper wiring may cause a hazardous condition.**

⚠ **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 may cause violent motion of the motor and driven equipment. Be certain that unexpected movement will not cause injury to personnel or damage to equipment.**

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

⚠ **WARNING: If a motor is driven mechanically, it may generate hazardous voltages that are conducted to its power input terminals. The enclosure must be grounded to prevent a possible shock hazard.**

⚠ **WARNING: The user must provide an external hard-wired emergency stop circuit to disable the control in the event of an emergency.**

Continued on next page.

⚠ 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 the control immediately above or beside heat generating equipment, or directly below water or steam pipes.**

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

⚠ Caution: **Suitable for use on a circuit capable of delivering not more than the RMS symmetrical short circuit amperes listed here at rated voltage.**

Horsepower	RMS Symmetrical Amperes
1.5–50	5,000
51–200	10,000
201–400	18,000
401–600	30,000
601–900	42,000

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

⚠ Caution: **Logic signals are interruptible signals; these signals are removed when power is removed from the drive.**

⚠ Caution: **The safe integration of the driver into a machine system is the responsibility of the machine designer. Be sure to comply with the local safety requirements at the place where the machine is to be used. In Europe this is the Machinery Directive, the ElectroMagnetic Compatibility Directive and the Low Voltage Directive. In the United States this is the National Electrical code and local codes.**

⚠ Caution: **Controls must be installed inside an electrical cabinet that provides environmental control and protection. Installation information for the drive is provided in this manual. Motors and controlling devices that connect to the driver should have specifications compatible to the drive.**

⚠ Caution: **Do not tin (solder) exposed wires. Solder contracts over time and may cause loose connections.**

⚠ Caution: **Electrical components can be damaged by static electricity. Use ESD (electro-static discharge) procedures when handling this control.**

Section 3
Receiving & Installation

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 stated in this manual.

Location and Mounting

The location of the control is important. Installation should be 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.

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

To maintain compliance with European Electrical Safety Standard VDE0160(1994)/EN50178 (1998) the control must be mounted inside an enclosure that requires a tool for opening. The enclosure should provide 15dB attenuation to radiated emissions between 30–100MHz.

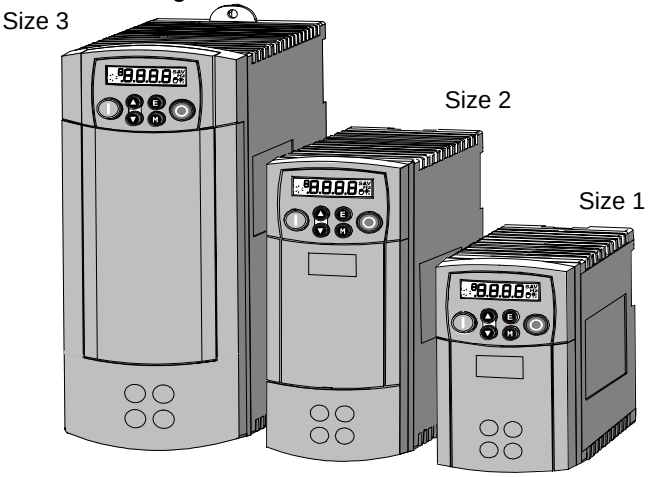
Mount the drive vertically on a solid, flat, non–flammable, vertical surface. It can be panel–mounted, or rail–mounted on a rail complying with EN50022 (35mm DIN). For DIN mount, hang the unit on the top DIN rail and push the unit onto the bottom DIN rail until it snaps in to position. Secure with a screw in the lower hole. See mounting drawing in Section 6 of this manual.

1. For effective cooling and maintenance, the control should be mounted vertically on a smooth non-flammable surface.
2. At least 4.0 inches (100mm) top and bottom clearance must be provided for air flow. At least 0.4 inches (10mm) clearance is required between controls (each side).
3. **Operating Altitude derating**. Up to 3300 feet (1000 meters) no derating required. Derate the continuous and peak output current by 1% for each 330 feet (100 meters) above 3300 feet. Maximum operating altitude 16,500 feet (5,000 meters).
4. **Operating Temperature derating**. 0°C to 40°C ambient. Linear derating to 50°C maximum ambient.

Table 3-1 Watts Loss Ratings

Catalog No.	Output Current (A)	Watts Loss (W)	Catalog No.	Output Current (A)	Watts Loss
ID35D8A1F5–CRH	1.5	26	ID35D4A1F5–CRH	1.5	26
ID35D8A2F2–CRH	2.2	32	ID35D4A02–CRH	2.0	32
ID35D8A03–CRH	3.0	41	ID35D4A2F5–CRH	2.5	40
ID35D8A04–CRH	4.0	52	ID35D4A4F5–CRH	4.5	61
ID35D8A07–CRH	7.0	82	ID35D4A5F5–CRH	5.5	70
ID35D8A10–CRH	10.5	116	ID35D4A09–CRH	9.0	100
ID35D8A16–CRH	16.5	181	ID35D4A12–CRH	12.0	140
			ID35D4A16–CRH	16.0	180

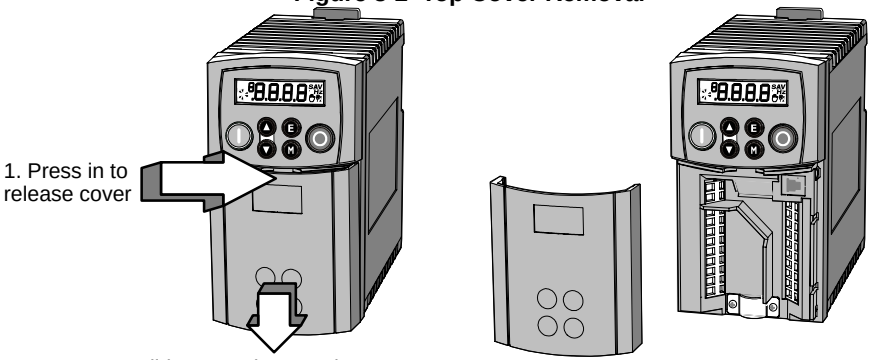
Figure 3-1 Inverter Sizes



Cover Removal To connect power and signal wires, the cover must be removed. This procedure describes how to access all terminal connections inside the control.

Using your thumbs, press in and slide the cover down as shown in Figure 3-2.

Figure 3-2 Top Cover Removal



Power Conditioning

System Grounding Baldor Controls are designed to be powered from standard three phase power lines that are electrically symmetrical with respect to ground. System grounding is an important step in the overall installation to prevent problems.

Ungrounded Distribution System

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

Input Power Conditioning

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

- If the feeder or branch circuit that provides power to the control has permanently connected power factor correction capacitors, an input AC line reactor or an isolation transformer must be connected between the power factor correction capacitors and the control.
- If the feeder or branch circuit that provides power to the control has power factor correction capacitors that are switched on line and off line, the capacitors must not be switched while the control is connected to the AC power line. If the capacitors are switched on line while the control is still connected to the AC power line, additional protection is required. TVSS (Transient Voltage Surge Suppressor) of the proper rating must be installed between the AC line reactor or an isolation transformer and the AC input to the control.

Line Impedance The Baldor control requires a 1% line impedance minimum . If the impedance of the incoming power does not meet the requirement for the control, a 3 phase line reactor can be used to provide the needed impedance in most cases. Line reactors are optional and are available from Baldor.

The input impedance of the power lines can be determined as follows:

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

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

Line Reactors Three phase line reactors are available from Baldor. The line reactor to order is based on the full load current of the motor (FLA). If providing your own line reactor, use the following formula to calculate the minimum inductance required.

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

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

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

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

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

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.

Protective Devices Recommended fuse sizes are based on the following:
115% of maximum continuous current for time delay.
150% of maximum continuous current for Fast or Very Fast action.

Note: These general size recommendations do not consider harmonic currents or ambient temperatures greater than 40°C.

Be sure a suitable input power protection device is installed. Use the recommended fuses and wire sizes shown in Table 3-2 is based on the use of copper conductor wire rated at 75 °C. The table is specified for NEMA B motors.

Reduced Input Voltage Derating All power ratings stated in Section 6 are for the stated nominal AC input voltages (230 or 460VAC). The power rating of the control must be reduced when operating at a reduced input voltage. The amount of reduction is the ratio of the voltage change.

Examples:

A 5hp, 230VAC control operating at 208VAC has a reduced power rating of 4.5hp.

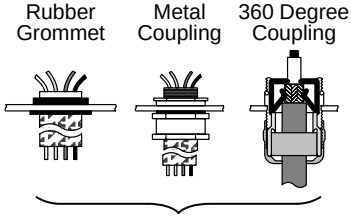
$$5HP \times \frac{208VAC}{230VAC} = 4.5hp$$

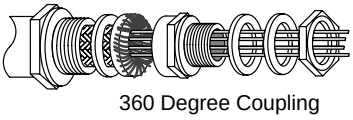
Likewise, a 3hp, 460VAC control operating at 380VAC has a reduced power rating of 2.47hp.

$$3HP \times \frac{380VAC}{460VAC} = 2.47hp$$

Electrical Installation All interconnection wires between the control, AC power source, motor, host control and any operator interface stations should be in metal conduits or shielded cable must be used. Use listed closed loop connectors that are of appropriate size for wire gauge being used. Connectors are to be installed using crimp tool specified by the manufacturer of the connector. Only class 1 wiring should be used.

Figure 3-3 Unshielded and Shielded Couplings




360 Degree Coupling

Holes are required in the enclosure assembly to allow connections to be made. Use the correct size rubber grommet, conduit coupling or 360 degree coupling.

Clamp Terminals To install a wire into a clamp terminal, first strip wire insulation to 0.20–0.24 in. (5–6mm). Insert a flat–blade screwdriver, maximum blade size 0.138 in. (3.5mm) into the adjacent hole. Do not twist or rotate the screwdriver as this action may damage the terminal. A very slight downward pressure on the screwdriver should open the terminals and allow the wire to be inserted. Insert the wire into the clamp opening (Figure 3-4). Remove the screwdriver. The terminal provides the correct force for a secure connection.

Figure 3-4 Clamp Terminal

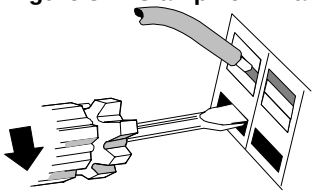


Table 3-2 Wire Size

Catalog Number	Size	Output Current		Wire Size					
		Cont. (Amps)	Peak (Amps)	L1, L2, L3, N, GND and Motor		DC+, DBR		TH1A, TH1B	
				AWG	MM^2	AWG	MM^2	AWG	MM^2
ID35D8A1F5-CRH	1	1.5	2.3	12	2.5			12	2.5
ID35D8A2F2-CRH	1	2.2	3.3	12	2.5			12	2.5
ID35D8A03-CRH	1	3.0	4.5	12	2.5			12	2.5
ID35D8A04-CRH	1	4.0	6.0	12	2.5			12	2.5
ID35D8A07-CRH	2	7.0	10.5	12	2.5			12	2.5
ID35D2A10-CRH	3	10.5	15.8	10	2.5	10	2.5	12	2.5
ID35D2A16-CRH	3	16.5	24.8	10	2.5	10	2.5	12	2.5
ID35D4A1F5-CRH	2	1.5	2.3	12	2.5	12	2.5	12	2.5
ID35D4A02-CRH	2	2.0	3.0	12	2.5	12	2.5	12	2.5
ID35D4A2F5-CRH	2	2.5	3.8	12	2.5	12	2.5	12	2.5
ID35D4A4F5-CRH	2	4.5	6.8	12	2.5	12	2.5	12	2.5
ID35D4A5F5-CRH	2	5.5	8.3	12	2.5	12	2.5	12	2.5
ID35D4A09-CRH	3	9.0	13.5	10	2.5	10	2.5	12	2.5
ID35D4A12-CRH	3	12.0	18.0	10	2.5	10	2.5	12	2.5
ID35D4A16-CRH	3	16.0	24.0	10	2.5	10	2.5	12	2.5

Note: All wire sizes based on 75°C copper wire, 40°C ambient temperature, 4-6 conductors per conduit or raceway.

Power Connections The signals are shown in Figure 3-5 and described in Table 3-3.

1. Remove the cover, shown in Figure 3-2.
2. Loosen the grounded cable clamp, Figure 3-5.
3. Connect the Mains Cable, Motor Cable, Dynamic Brake Cable and Thermistor Cable wires, if used to their proper clamp terminal, Figure 3-5. Be sure the shields of all shielded cables are in contact with the grounded cable clamp.

Note: This control must have two separate mains earth grounds connected as shown in Figures 3-5 and 3-6.

4. Tighten the grounded cable clamp screws to securely hold the cables.

Table 3-3 Power Connection Descriptions

Terminal	Description	Function	Range	
			230V 1–Phase	460V 3–Phase
RLY1	Relay Output	Normally open, programmable contact for a relay output.	Contact closes when the programmed condition (see Section 4) is true. No voltage is present on this contact. 6 conditions are available.	
TH1A	Thermistor	Connection to motor thermistor	It is good practice to protect motors by using thermistors. A typical resistance (up to a reference temperature of 125°C) is 200Ω, rising rapidly to 2000Ω above this temperature. Connect devices in series between TH1A and TH1B. Jumper TH1A and TH1B if temperature sensors are not used.	
TH1B	Thermistor	Connection to motor thermistor		
⏚	Reference Terminal	Supply protective earth (PE). This terminal must be connected to a protective (earth) ground for permanent ground.		
L1	Power Input	Single and three phase line connection	220/240VAC±10% with respect to L2/N.	380/460VAC±10% with respect to L2, L3.
L2/N L2	Power Input	Single phase neutral (or L2 three phase line connection)	220/240VAC±10% with respect to L1.	380/460VAC±10% with respect to L1, L3.
L3	Power Input	Three phase line connection	Not applicable	380/460VAC±10% with respect to L1, L2.
DC–	**No user connection**			
DC+	Dynamic Brake	Connection to external brake resistor	Not applicable	Frame 2 (high volt only) & 3. See “Internal Dynamic Brake Switch” table
DBR	Dynamic Brake	Connection to external brake resistor	Not applicable	Frame 2 (high volt only) & 3. See “Internal Dynamic Brake Switch” table
M1/U M2/V M3/W	Power Outputs	3–phase supply connection for motor	0 to 220/240VAC 0 to 240Hz	0 to 380/460VAC 0 to 240Hz
⏚	Reference Terminal	Supply protective earth (PE). This terminal must be connected to a protective (earth) ground for permanent ground.		

Figure 3-5 Power and Ground Connections

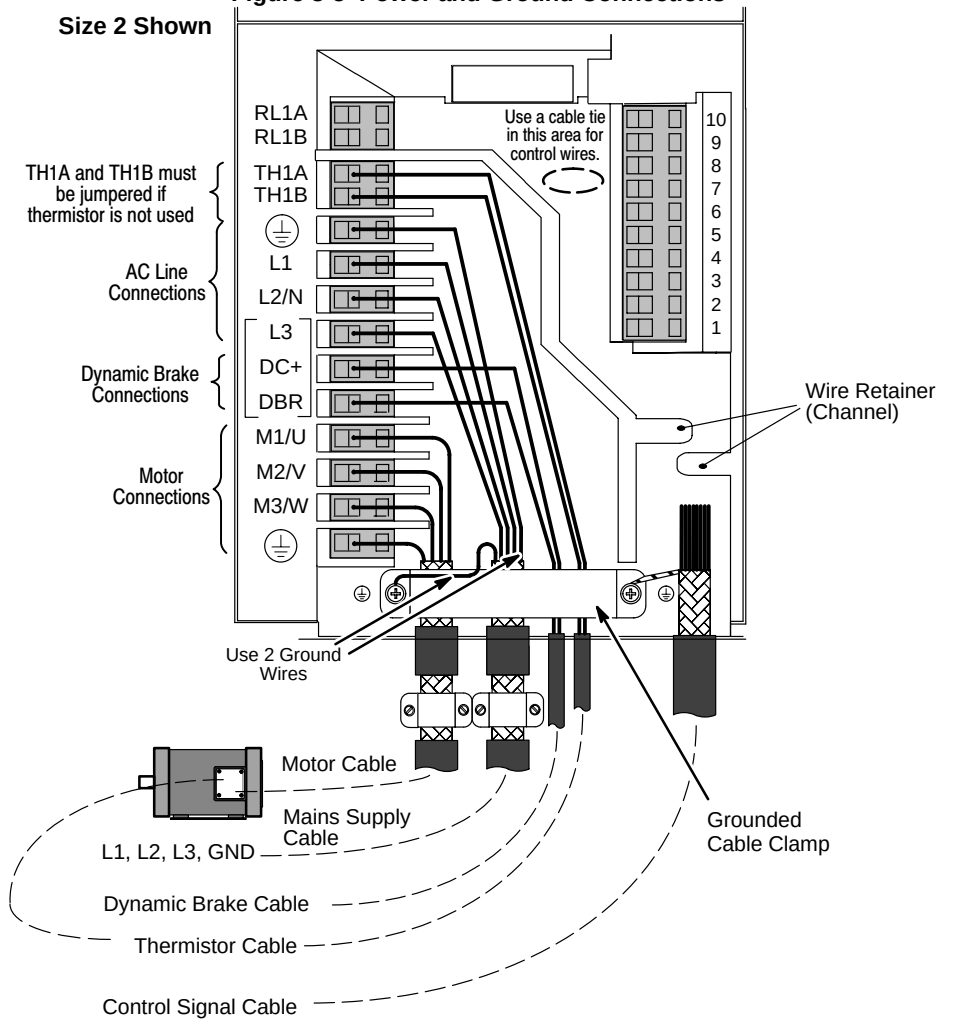
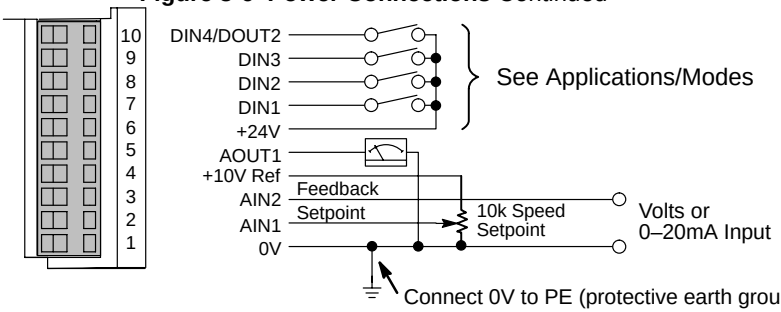
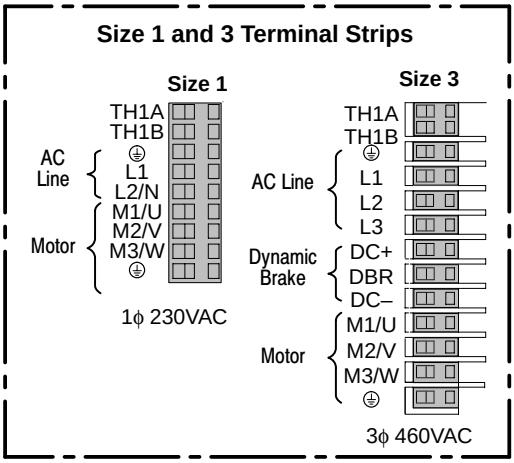


Figure 3-6 Power Connections Continued





Thermistor Connections (connections are shown in Figure 3-5).

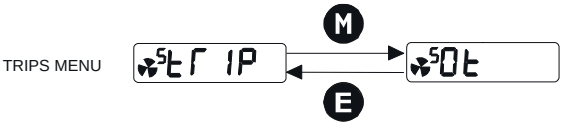
This input is provided for over–temperature detection for motors that have an internal thermistor. There is no polarity to the thermistor connections.

This provides “Basic” insulation only to the SELV control circuits and assumes the motor has “Basic” insulation to the windings/mains circuits. The thermistor type supported is PTC ‘Type A’ as defined in IEC 34–11 Part 2. The resistance thresholds are:

Rising temperature trip resistance:	1650 to 4000 ohms
Falling temperature trip reset resistance	750 to 1650 ohms

If the motor does not have an internal thermistor, you should disable the thermistor trip function by:

1. Connecting a jumper wire between the thermistor terminals TH1A and TH1B. or
2. Set the parameter Invert Thermistor Input $^{5}0\text{E}$ to 1.



Signal Connections Wire sizes between 12AWG and 28AWG (2.5mm^2 to 0.08mm^2) can be used.

1. With the cover removed, connect the analog and digital inputs and outputs as shown in Figure 3-5.
   The signals are described in Table 3-4.
2. Install the front cover.

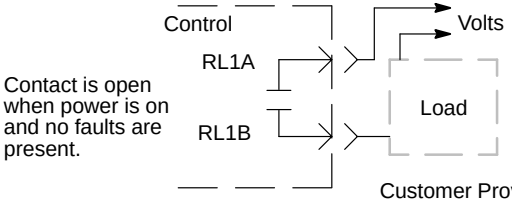
Table 3-4 Analog/Digital Signal Descriptions

Terminal (SELV)	Signal Name	Description	Range
RL1A	User Relay	Volt-free contact - 4A maximum, non-inductive	0-250VAC/24VDC
RL1B			
10	DIN4/ DOUT2	Configurable I/O, Digital Input 4 or Digital Output 2.	0-24V source open collector
9	DIN3	Digital Input 3.	0-24V source open collector
8	DIN2	Digital Input 2.	0-24V source open collector
7	DIN1	Digital Input 1.	0-24V source open collector
6	+24V	24V – 24V supply for digital I/O	50mA max
5	AOUT1	Analog Output – 10mA maximum	0-10V
4	10VREF	10V reference (10mA maximum loading)	10V
3	AIN2	Analog Input 2	0-10V, 4-20mA
2	AIN1	Analog Input 1 - Setpoint. If unused, connect to 0VDC.	0-10V
1	0V	0V - Reference for Analog/Digital I/O For single control installations, connect pin 1 (0V) to PE. For multiple control installations, connect the 0V terminals of each control together. Then connect only one control to PE.	0V

External Brake Resistor

Connect the dynamic brake resistor between terminals DC+ and DBR as shown in Figure 3-5 and 3-6.

User Relay A customer provided, external DC or AC power supply must be used if relay output is to be used.



Note: Contact is rated to 250V @ 4A resistive (non–inductive).

Applications/Modes

There are 6 operating modes. Each mode configures the terminal strip wiring for a specific application. The following diagrams document the terminal strip wiring for each (Application 0 to Application 5).

Note: Parameter values are not changed by loading a new Application.

How to Load an Application

In the PAr menu, go to P 1 and press the M key.
The Applications are stored in this menu.

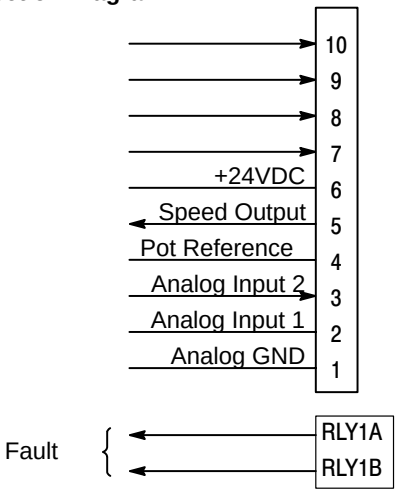
Use the ▲ ▼ keys to select the appropriate Application by number.

Press the E key to load the Application.

1 – Keypad Mode

In Keypad mode, the control is operated by the keypad and opto isolated inputs and the analog command inputs are ignored. The analog output remain active.

Figure 3-7 Keypad Connection Diagram



1 Analog GND. Reference for analog inputs.
2 Not used.
3 Not used.
4 +10VDC reference voltage for potentiometer.
5 Analog output that represents the commanded speed output.
6 +24VDC for Optical Inputs power.
7 Not used.
8 Not used.
9 Not used.
10 Not used.
RLY1 Digital output that represents the fault status.

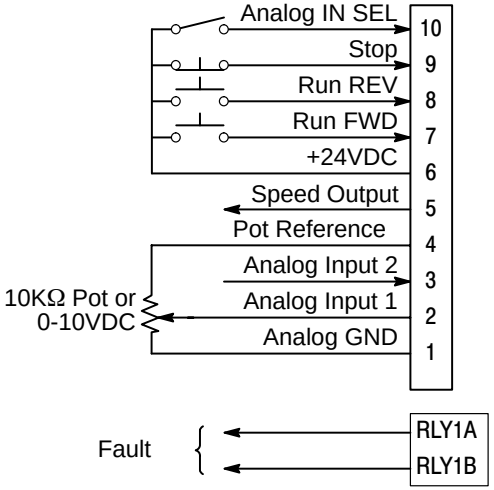
2 – Standard Run 3 Wire Mode

In Standard Run mode, the control is operated by the opto isolated inputs and the analog command input. The opto inputs can be switches as shown in Figure 3-8 or logic signals from another device.

Figure 3-8 Standard Run Connection Diagram

Analog IN Select	Command
Open	Analog Input 1
Closed	Analog Input 2

Analog Input 1 = 0–10VDC Setpoint
Analog Input 2 = 4–20mA Setpoint



1 Analog GND. Reference for analog inputs.
2 Setpoint 0–10VDC. Single ended analog voltage input, referenced to 1.
3 Setpoint 4–20mA. Single ended analog current input, referenced to 1.
4 +10VDC reference voltage for potentiometer.
5 Analog output that represents the commanded speed output.
6 +24VDC for Optical Inputs power.
7 Momentary CLOSED starts motor operation in the Forward direction.
8 Momentary CLOSED starts motor operation in the Reverse direction.
9 Momentary OPEN motor decels to stop.
10 Analog IN Select. OPEN selects Analog Input 1 (2).
CLOSED selects Analog Input 2 (3).

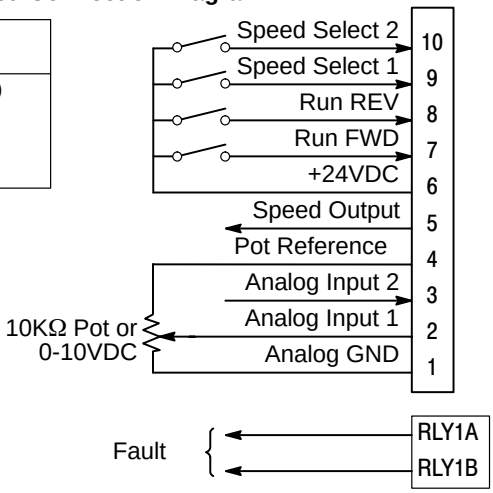
RLY1 Digital output that represents the fault status.

3 – 3 Speed 2 Wire Mode

In 3 speed 2 wire mode, the control is operated by the opto isolated inputs and the analog command input. The opto inputs can be switches as shown in Figure 3-9 or logic signals from another device.

Figure 3-9 3 Speed Connection Diagram

Speed Select 1	Speed Select 2	Command
Open	Open	Analog Input 1 & 2 (Add)
Open	Closed	Preset Speed 1
Closed	Open	Preset Speed 2
Closed	Closed	Preset Speed 3



Related Parameters

p302 Preset Speed 1
p303 Preset Speed 2
p304 Preset Speed 3

Analog Input 1 = 0–10VDC Setpoint
Analog Input 2 = 4–20mA Setpoint

1 Analog GND. Reference for analog inputs.
2 Setpoint 0–10VDC. Single ended analog voltage input, referenced to 1.
3 Setpoint 4–20mA. Single ended analog current input, referenced to 1.
4 +10VDC reference voltage for potentiometer.
5 Analog output that represents the commanded speed output.
6 +24VDC for Optical Inputs power.
7 CLOSED starts motor operation in the Forward direction.
8 CLOSED starts motor operation in the Reverse direction.
9 Speed Select input 1. Inputs 9 & 10 select preset speeds 1 to 3.
10 Speed Select input 2. Inputs 9 & 10 select preset speeds 1 to 3.
RLY1 Digital output that represents the fault status.

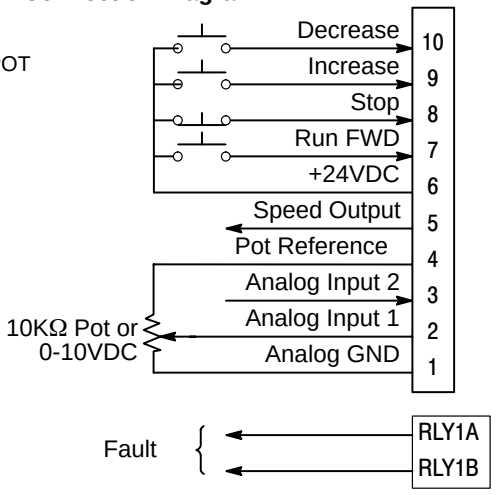
4 – EPOT 3 Wire Mode (Electronic Potentiometer)

In EPOT 3 wire mode, the control is operated by the opto isolated inputs and the analog command input. The opto inputs can be switches as shown in Figure 3-10 or logic signals from another device.

Figure 3-10 EPOT Connection Diagram

Note:
Speed Command = Analog1 + Analog2 + EPOT

Analog Input 1 = 0–10VDC Setpoint
Analog Input 2 = 4–20mA Setpoint



1 Analog GND. Reference for analog inputs.
2 Setpoint 0–10VDC. Single ended analog voltage input, referenced to 1.
3 Setpoint 4–20mA. Single ended analog current input, referenced to 1.
4 +10VDC reference voltage for potentiometer.
5 Analog output that represents the commanded speed output.
6 +24VDC for Optical Inputs power.
7 Momentary CLOSED starts motor operation in the Forward direction.
8 Momentary OPEN motor decels to stop.
9 Momentary CLOSED increases motor speed while contact is closed.
10 Momentary CLOSED decreases motor speed while contact is closed.
RLY1 Digital output that represents the fault status.

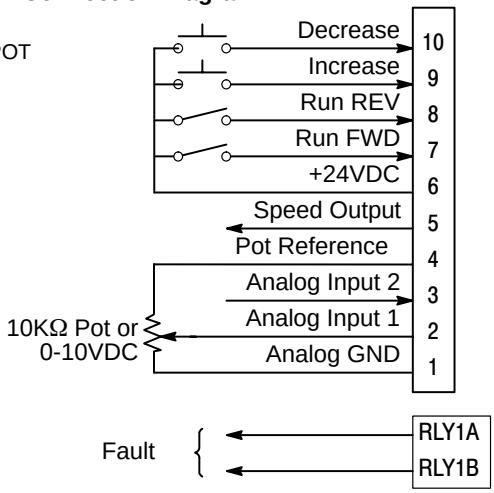
5 – EPOT 2 Wire Mode (Electronic Potentiometer)

In EPOT 2 wire mode, the control is operated by the opto isolated inputs and the analog command input. The opto inputs can be switches as shown in Figure 3-11 or logic signals from another device.

Figure 3-11 EPOT Connection Diagram

Note:
Speed Command = Analog1 + Analog2 + EPOT

Analog Input 1 = 0–10VDC Setpoint
Analog Input 2 = 4–20mA Setpoint



1 Analog GND. Reference for analog inputs.
2 Setpoint 0–10VDC. Single ended analog voltage input, referenced to 1.
3 Setpoint 4–20mA. Single ended analog current input, referenced to 1.
4 +10VDC reference voltage for potentiometer.
5 Analog output that represents the commanded speed output.
6 +24VDC for Optical Inputs power.
7 CLOSED starts motor operation in the Forward direction.
8 CLOSED starts motor operation in the Reverse direction.
9 Momentary CLOSED increases motor speed while contact is closed.
10 Momentary CLOSED decreases motor speed while contact is closed.
RLY1 Digital output that represents the fault status.

6 – PID 2 Wire Mode

In PID 2 wire mode, the control is operated by the opto isolated inputs and the analog command input. The opto inputs can be switches as shown in Figure 3-12 or logic signals from another device.

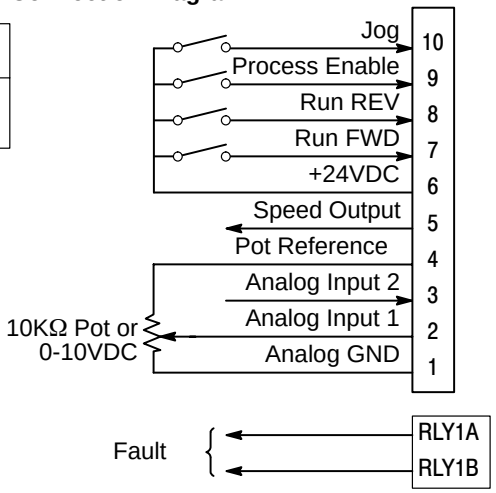
Figure 3-12 PID Connection Diagram

Process Enable	Command
Open	Analog Input 1 (Speed Ref)
Closed	PID

Analog Input 1 = 0–10VDC Setpoint
Analog Input 2 = 4–20mA Feedback

Related Parameters

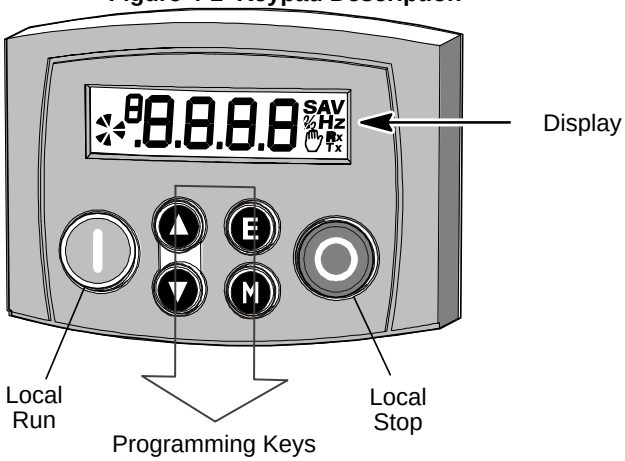
p8 Jog Speed
St01 Jog Accel
St02 Jog Decel

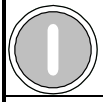
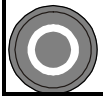


1 Analog GND. Reference for analog inputs.
2 PID Setpoint 0–10VDC. Single ended analog voltage input, referenced to 1.
3 PID Feedback 4–20mA. Single ended analog current input, referenced to 1.
4 +10VDC reference voltage for potentiometer.
5 Analog output that represents the commanded speed output.
6 +24VDC for Optical Inputs power.
7 Momentary CLOSED starts motor operation in the Forward direction. In Jog mode (10 Closed), jogs motor in forward direction as long as switch is closed.
8 Momentary CLOSED starts motor operation in the Reverse direction. In Jog mode (10 Closed), jogs motor in reverse direction as long as switch is closed.
9 CLOSED enables process mode. OPEN selects Analog Input 1 setpoint.
10 CLOSED places control in Jog mode. Forward and Reverse run are used to Jog the motor at Jog speed.
RLY1 Digital output that represents the fault status.

Keypad Description

Figure 4-1 Keypad Description



Key	Operation	Description
	Escape	Navigation – Displays the previous level's menu Parameter – Returns to the parameter list Trip Acknowledge – Acknowledges displayed Trip or Error message
	Menu	Navigation – Displays the next menu level, or the first parameter of the current Menu Parameter – Moves cursor to the left when the parameter is adjustable
	Increment	Navigation – Move upwards through the menu system Parameter – Increase value of the displayed parameter Local Mode – Increase value of the local setpoint
	Decrement	Navigation – Move down through the menu system Parameter – Decrease value of the displayed parameter Local Mode – Decrease value of the local setpoint
	Run	Local Mode – Run the drive
	Stop	Local Mode – Stops the drive. Trip Reset in all modes Navigation – Press and hold to toggle between Local and Remote Control modes (refer to Special Menu Features)

The keypad provides local control and monitoring of the Inverter. Remove it by simply pulling it from the drive. To install it, push it back into place.

Display

P when in the Parameter menu

S when in the Setup menu

A when displaying an Alarm code

– a negative parameter value

Displays the units for the value:

S for time in seconds, ***A*** for current in Amps

V for voltage in Volts, ***%*** for percentage

Hz for frequency in Hertz

Represents a rotating motor shaft:
CW = forward rotation
CCW = reverse rotation.

Parameter numbers or values, trip information, error codes etc. See Drive Status Indications.

Local mode.
(Remote mode when hand is not visible.

Not Used

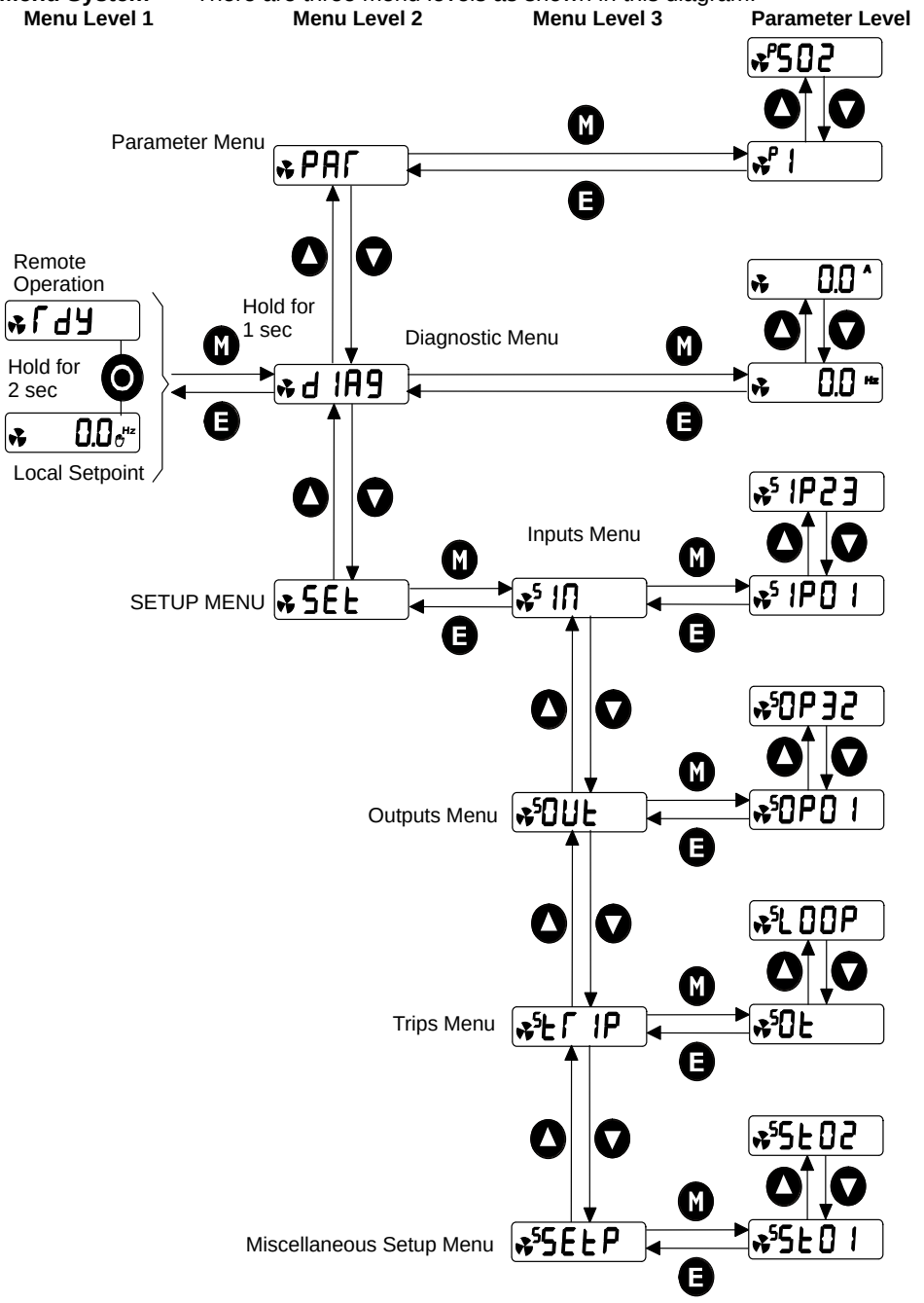
Drive Status Indications (shown on keypad)

Display	Status Indication and Meaning	Possible Cause
rdy	READY/HEALTHY No alarms present. Remote mode selected	
PASS	PASSWORD Current password must be entered before this parameter may be altered.	Enter password to change the parameter. (See password protection).
LOC	LOCAL Local mode selected	Added or removed from the display letter–by–letter to indicate entering or leaving Local mode

Diagnostics Menu

Display	Name	Description
0.0 Hz	FREQUENCY	The current output frequency in Hertz
0.0 %	SPEED SPT	The set point as a percentage of MAX SPEED
0.0 V	DC LINK VOLTS	VAC √2 = dc link Volts
0.0 A	MTR CURRENT	The current load value in Amps

Menu System There are three menu levels as shown in this diagram:



Power Up On initial power–up, the drive is in Local control mode and the keypad will display the Local Setpoint.

All parameters are at factory settings. Any changes to these conditions are automatically saved. The drive will initialize on subsequent power–ups with the previously saved settings and control mode.

How to Change a Parameter Value

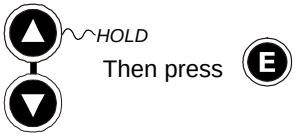
You can change the values of parameters stored in the PAr and SEt menus. Refer to “Parameter Definitions” for further information.

- View the parameter to be edited and press M to display the parameter’s value.
- Select the digit to be changed (pressing the M key moves the cursor from right to left).
- Use the ▲ ▼ keys to adjust the value. Hold the key momentarily to adjust the value marginally, or hold the key to make rapid changes; the rate of change varies with the time held.
- Press E to return to the parameter display. The new value is stored.

Special Menu Features

Reset to Factory Settings (2 button Reset)

Turn power on while pressing the ▲ and ▼ keys. This loads or restores the factory settings and application 1.



Select Local or Remote

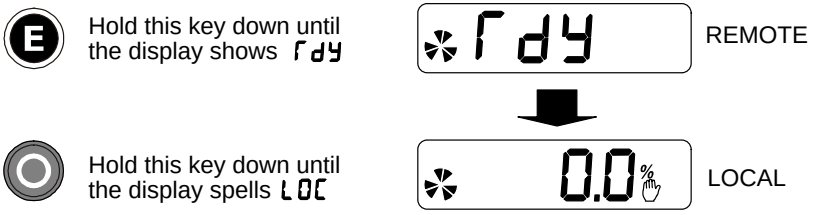
Remote Control Mode: Allows control using digital and analog inputs and outputs. Local control keys are inactive when Remote control mode is selected. In remote mode, the control uses a remote setpoint (analog Input 1).

Local Control Mode: Provides local control and monitoring of the drive using the keypad. In local mode, the control uses the local setpoint parameter (value is adjusted using the keypad).

Note: You can only change between Local and Remote control when the Inverter is “stopped”, and either rdy or the Local Setpoint is displayed.

Remote to Local

Note: For safety reasons, the control will not return to Remote mode if this will cause the drive to start. Verify that the RUN and JOG inputs are low.



Password Protection
When activated, the password prevents unauthorized parameter modification by making all parameters “read–only”. Password protection is set–up using the P 99 parameter.

Steps	ACTIVATE		TEMPORARY DE–ACTIVATION		REMOVE PASSWORD	
	Actions	Display	Actions	Display	Actions	Display
1	P 99	0000	Try to edit any parameter with password activated	PASS	P 99	PASS
2	▲	0001	▲	0001	▲	0001
3	E	rdy	E	Original parameter displayed, password de–activated	E	0000
4	E	rdy	A drive will power–up with the last password status. Temporary de–activation is lost on power–down.		E	P 99
	Default = 0000, de–activated Any other value is a password					

Quick Application Selection

Press and hold theStop key.
Power up the control.
Continue to hold the key for at least 1 second.
You can navigate immediately to the APPLICATION parameter, P1, from this power–up condition.

Then, press the M key to display the current Application.

Use the ▲ ▼ keys to select the appropriate Application by number.

Press the E key to load the Application.

Parameter Definitions You can program the Inverter for specific applications. The Inverter is supplied with pre–programmed applications that can be used as starting points for application–specific programming. Programming is simply selecting an application, changing some of the parameter values and finally saving the changes. Each application configures the terminal wiring for a differently. The Inverter retains the new settings during power–down. The next time the inverter is powered up, the new settings will be used.

Note: Motor parameters are not changed when a new application is loaded.

Table 4-1 Parameter Definitions

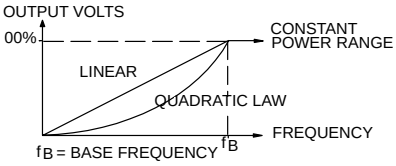
Display	Parameter	Description	Range	Factory Setting
P 1	APPLICATION	Selects the applicaton to be used Application 1: Keypad mode Application 2: Standard Run 3–Wire Application 3: 3 Speed 2–Wire Application 4: EPOT 3–Wire Application 5: EPOT 2–Wire Application 6: PID 2–Wire	0= Application 0 1= Application 1 2= Application 2 3= Application 3 4= Application 4 5= Application 5 6= Application 6	1
P 2	MAX SPEED	The frequency at which the control will run when maximum setpoint is applied	7.5 to 240.0Hz	60.0Hz
P 3	MIN SPEED	The minimum frequency at which the control will run.	–100.0 to 100.0%	0.0%
P 4	ACCEL TIME	The time taken for the control output frequency to ramp up from zero to MAX SPEED	0.0 to 3000.0s	5.0s
P 5	DECEL TIME	The time taken for the control output frequency to ramp down from MAX SPEED to zero	0.0 to 3000.0s	5.0s
P 6	MOTOR CURRENT	This parameter contains the motor nameplate full–load line current	Product code dependent	Product code dependent
P 7	BASE FREQUENCY	The output frequency at which maximum voltage is reached. The default is Product Code dependent.	25.0 to 240.0Hz	60.0Hz
P 8	JOG SETPOINT	Speed the control will run at if the Jog input is high	–100.0 to 100.0%	12.0%
P 9	RUN STOP MODE	RAMP : The motor speed is reduced to zero at a rate set by DECEL TIME (P5). A 2 second pulse is applied at end of ramp COAST : The motor is allowed to freewheel to a standstill INJECTION : On a stop command, the motor volts are rapidly reduced at constant frequency to deflux the motor. A low frequency braking current is then applied until the motor speed is almost zero. This is followed by a timed DC pulse to hold the motor shaft.	0=RAMP 1=COAST 2=INJECTION	0
P 11	V/F SHAPE		0=LINEAR 1=FAN	0

Table 4-1 Parameter Definitions Continued

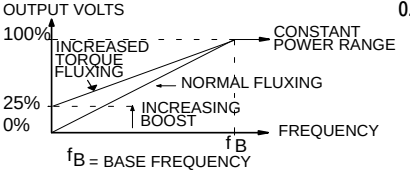
Display	Parameter	Description	Range	Factory Setting
P 12	NORMAL DUTY	HEAVY DUTY: the current limit is set to 150% motor current, inverse time delay is set to 30s NORMAL DUTY: the current limit is set to 110% motor current, inverse time delay is set to 10s When P11 is changed from FAN to LINEAR, P12 is set to 0 (Heavy Duty) When P11 is changed from LINEAR to FAN, P12 is set to 1 (Normal Duty) P12 can be changed independently	0=False 1=True	0
P 13	FIXED BOOST		0.00 to 25.00%	5.00%
P 99	PASSWORD	A password may be set to prohibit unauthorised adjustment of parameters. When P99 is set to non-zero you will be required to match this value before parameters can be adjusted	0000 – FFFF	0000
Parameters P301 to P308 are visible in the PAR menu when Application 3 is selected in parameter P1				
P 301	PRESET 0	Preset 0 is normally connected to Setpoint.	-100.00 to 100.00%	-
P 302	PRESET 1	A user-adjustable speed preset	-100.00 to 100.00%	20.00%
P 303	PRESET 2	A user-adjustable speed preset	-100.00 to 100.00%	50.00%
P 304	PRESET 3	A user-adjustable speed preset	-100.00 to 100.00%	100.00%
P 305	PRESET 4	A user-adjustable speed preset	-100.00 to 100.00%	-10.00%
P 306	PRESET 5	A user-adjustable speed preset	-100.00 to 100.00%	-20.00%
P 307	PRESET 6	A user-adjustable speed preset	-100.00 to 100.00%	-50.00%
P 308	PRESET 7	A user-adjustable speed preset	-100.00 to 100.00%	-100.00%
Parameters P401 to P404 are visible in the PAR menu when Application 4 is selected in parameter P1				
P 401	R/L RAMP TIME	The time taken to ramp the Raise/Lower output from 0.00% to 100.00% of its value	0.0 to 600.0s	10.0s
P 402	R/L MAX VALUE	The maximum value for the ramp output	-100.0 to 100.0%	100.0%
P 403	R/L MIN VALUE	The minimum value for the ramp output	-100.0 to 100.0%	0.0%
P 404	R/L RESET VALUE	The value the output is set to when Reset is TRUE, when DIN4 (terminal 10) is 24V in Application 4	-100.00 to 100.00%	0.00%

Table 4-1 Parameter Definitions Continued

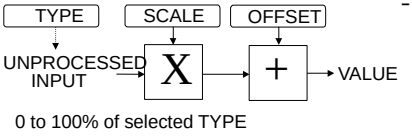
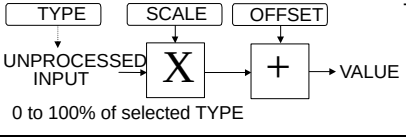
Display	Parameter	Description	Range	Factory Setting
Parameters P501 and P502 are visible in the PAR menu when Application 5 is selected in parameter P1				
P 501	PI P GAIN	The PID "P"roportional gain	0.00 to 100.00	1.00
P 502	PI I GAIN	The PID "I"ntegral gain	0.00 to 100.00	0.00
P 503	PID D GAIN	The PID "D"erivative gain	0.00 to 100.00	0.00
P 504	PID D FILTER TC	A first order lag filter to help attenuate high frequency noise on the derivative term. This parameter determines the filter time constant.	0.05 to 10.00s	0.05s
P 505	PID FEEDBACK GAIN	A multiplier applied to the PID feedback signal	-10.00 to 10.00	1.00
P 506	PID LIMIT	Determines the maximum positive and negative excursion (Limit) of the PID output	0.00 to 300.00%	0.00
P 507	PID SCALING	An overall scale factor which is applied after the PID positive and negative limit clamps	-3.0000 to 3.0000	0.00
P 508	PID ERROR	Error=(Setpoint-Feedback) x (Feedback Gain)	x.xx %	x.xx %
P 509	PID OUTPUT	The output of the PID function block	x.xx %	x.xx %
		SET::IN Menu		
S IP01	DIN 1 INVERT	True =Inverts the input signal.	0= False 1= True	0
S IP02	DIN 2 INVERT	True =Inverts the input signal.	0= False 1= True	0
S IP03	DIN 3 INVERT	True =Inverts the input signal.	0= False 1= True	0
S IP04	DIN 4 INVERT	True =Inverts the input signal.	0= False 1= True	0
S IP 11	AIN 1 SCALE	 0 to 100% of selected TYPE	-150.0 to 150.0%	100.0%
S IP 12	AIN 1 OFFSET		-100.0 to 100.0%	0.00%
S IP 13	AIN 1 TYPE		0= 0-10V 1= 0-5V	0
S IP21	AIN 2 SCALE	 0 to 100% of selected TYPE	-150.0 to 150.0%	100.0%
S IP22	AIN 2 OFFSET		-100.0 to 100.0%	0.0%
S IP23	AIN 2 TYPE		0= 0-10V 1= 0-5V 2= 0-20mA 3= 4-20mA	3

Table 4-1 Parameter Definitions Continued

Display	Parameter	Description	Range	Factory Setting
		SET::IN Menu Continued		
SIPd1	DIN 1 VALUE	The input signal after inversion (if any).	0= False 1= True	0
SIPd2	DIN 2 VALUE	The input signal after inversion (if any).	0= False 1= True	0
SIPd3	DIN 3 VALUE	The input signal after inversion (if any).	0= False 1= True	0
SIPd4	DIN 4 VALUE	The input signal after inversion (if any).	0= False 1= True	0
SIPA1	AIN 1 VALUE	The analog input signal with scaling and offset.	x.x%	x.x%
SIPA2	AIN 2 VALUE	The analog input signal with scaling and offset.	x.x%	x.x%
		SET::OUT Menu		
SOP01	AOUT 1 SOURCE	**ANALOG OUTPUT** 0 NONE 1 DEMAND % 2 CURRENT % 3 PI ERROR % 4 RAISE/LOWER OUTPUT% Scale SOP02 Offset SOP03 Absolute SOP04 → 0–10V	0= NONE 1= DEMAND 2= CURRENT 3= PI ERROR 4= RAISE/LOWER OUTPUT	1
SOP02	AOUT 1 SCALE	SCALE → OFFSET → ABS Value → X → + → |X| → Output	-300.0 to 300.0	100.0%
SOP03	AOUT 1 OFFSET		-300.0 to 300.0%	0.00%
SOP04	AOUT 1 ABSOLUTE		0= False 1= True	0
SOP05	AOUT 1 VALUE		-300.0 to 300.0%	0.0%
SOP21	DOUT 2 SOURCE	**DIN4 / DOUT2** 0 NONE 1 HEALTH 2 TRIPPED 3 RUNNING 4 AT ZERO 5 AT SPEED 6 AT LOAD Invert Output SIP04	0= NONE (DIN4) 1= HEALTH 2= TRIPPED 3= RUNNING 4= AT ZERO 5= AT SPEED 6= AT LOAD	0
SOP22	DOUT 2 INVERT	(OUTPUT) As SIP01. Set to 0 for applications 1 & 5.	As SIP01	0
SOP22	DOUT 2 VALUE	The output signal that represents the OP21 choice.	0= False 1= True	0
SOP31	RELAY SOURCE	**RELAY** 0 NONE 1 HEALTH 2 TRIPPED 3 RUNNING 4 AT ZERO 5 AT SPEED 6 AT LOAD Invert Output SOP32	0= NONE 1= HEALTH 2= TRIPPED 3= RUNNING 4= AT ZERO 5= AT SPEED 6= AT LOAD	2

Table 4-1 Parameter Definitions Continued

Display	Parameter	Description	Range	Factory Setting
SOP32	RELAY INVERT	True =Inverts the input signal.	0= False 1= True	0
SOP33	RELAY VALUE	The output signal that represents the OP31 choice.	0= False 1= True	0
		SET::TRIP Menu		
SLOOP	DISABLE LOOP	Disables LOST I LOOP trip (4-20mA)	0= Trip Enabled 1= Trip Disabled	1
S t 3	AIN2 OVERLOAD	Disables the overload trip (Terminal 3)	0= Trip Enabled 1= Trip Disabled	0
SStLL	DISABLE STALL	Disables STALL trip	0= Trip Enabled 1= Trip Disabled	0
SOt	DISABLE MOTOR OVERTEMP	Disables the motor thermistor trip	0= Trip Enabled 1= Trip Disabled	0
		SET::SETP Menu		
SI t	Inverse Time	Disables the inverse time trip	0= Trip Enabled 1= Trip Disabled	1
Sdi SP	Display (Keypad)	Disables the display (keypad) trip	0= Trip Enabled 1= Trip Disabled	0
SSt01	Jog Accel Time	As P4, for Jog	0.0 to 3000.0s	1.0
SSt02	Jog Decel Time	As P5, for Jog	0.0 to 3000.0s	1.0
SSt03	Ramp Type	Selects the ramp type	0=LINEAR 1=S	0
SSt04	S Ramp Jerk	Rate of change of acceleration of the curve in units per second^3	0.01 to 100.00s^3	10.00s^3
SSt05	S Ramp Continuous	When True and the S Ramp is selected, forces a smooth transition if the speed setpoint is changed when ramping. The curve is controlled by the S Ramp Jerk parameter. When False, there is an immediate transition from the old curve to the new curve	0=FALSE 1=TRUE	1
SSt 11	Skip Frequency 1	The center frequency of skip band 1 in Hz	0.0 to 240.0 Hz	0.0
SSt 12	Skip Frequency Band 1	The width of skip band 1 in Hz	0.0 to 60.0 Hz	0.0
SSt 13	Skip Frequency 2	The center frequency of skip band 2 in Hz	0.0 to 240.0 Hz	0.0
SSt 14	Skip Frequency Band 2	The width of skip band 2 in Hz	0.0 to 60.0 Hz	0.0
SSt 21	Auto Restart Attempts	Determines the number of restarts that will be permitted before requiring an external fault reset	0 to 10	0
SSt 22	Auto Restart Delay	The delay between restart attempts for a trip included in Auto Restart Triggers and Auto Restart Triggers+. The delay is measured from all error conditions clearing	0.0 to 600.0 s	10.0s
SSt 23	Auto Restart Triggers	Allows Auto Restart to be enabled for a selection of trip conditions. Refer to Section 5	0x0000 to 0xFFFF	0x0000

Table 4-1 Parameter Definitions Continued

Display	Parameter	Description	Range	Factory Setting
SEt 24	Auto Restart Triggers+	Allows Auto Restart to be enabled for a selection of trip conditions. Refer to Section 5	0x0000 to 0xFFFF	0x0000
SEt 51	Local MIN Speed ◯	The magnitude of the minimum setpoint that will	0.0 to 100.0 %	0.0%
SEt 52	Enabled Keys ◯			0
SEt 98	Application Lock ◯	True prevents editing of parameter P1.	0=FALSE 1=TRUE	0
SEt 99	Detailed Menus	True allows Full menu display. False hides parameters indicated with ◯	0=FALSE 1=TRUE	0

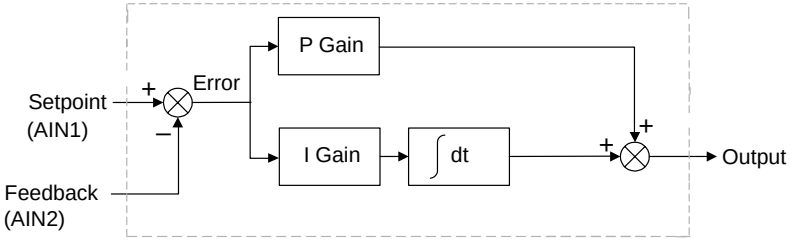
PI Terms PI is used to control the response of any closed loop system. It is used specifically in system applications involving the control of drives to provide zero steady state error between Setpoint and Feedback, together with good transient performance.

Proportional Gain (P501)

This is used to adjust the basic response of the closed loop control system. The PI error is multiplied by the Proportional Gain to produce an output.

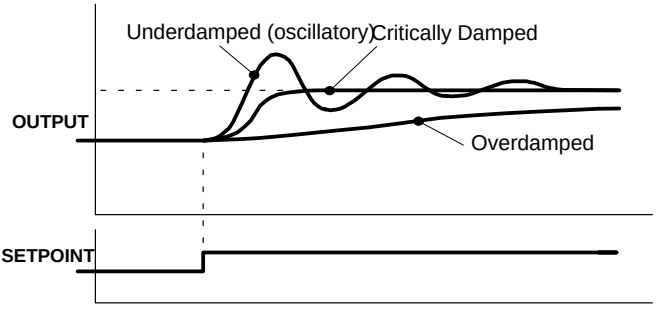
Integral (P502)

The Integral term is used to reduce steady state error between the setpoint and feedback values of the PI. If the integral is set to zero, then there will always be a steady state error.



- Functions as P, PI controller
- Single symmetric limit on output

A Method for Setting–up the PI Gains



The gains should be set–up so that a critically damped response is achieved for a step change in setpoint. An underdamped or oscillatory system can be thought of as having too much gain, and an overdamped system has too little.

To set up the P gain, set the I gain to zero. Apply a step change in setpoint that is typical for the System, and observe the response. Increase the gain and repeat the test until the system becomes oscillatory. At this point, reduce the P gain until the oscillations disappear. This is the maximum value of P gain achievable.

If a steady state error is present, i.e. the feedback never reaches the setpoint value, the I gain needs to be increased. As before, increase the I gain and apply the step change. Monitor the output. If the output becomes oscillatory, reduce the P gain slightly. This should reduce the steady state error. Increasing the I gain further may reduce the time to achieve zero steady state error.

These values of P and I can now be adjusted to provide the exact response required for this step change.

Product Related Parameter Values

Frequency Dependent Parameters

		50Hz default	60Hz default
P 2	MAX SPEED	50	60
P 7	BASE FREQUENCY	50	60

Power Dependent Parameters

		Inverter Size	Factory Setting
P 6	MOTOR CURRENT	Size 1 : 0.25kw 230V Size 1 : 0.37kw 230V Size 1 : 0.55kw 230V Size 1 : 0.75kw 230V	1.5A 2.2A 3.0A 4.0A
		Size 2 : 1.1kw 230V Size 2 : 1.5kw 230V	5.5A 7.0A
		Size 2 : 1.5kw 460V Size 2 : 2.0kw 460V Size 2 : 2.5kw 460V Size 2 : 3.5kw 460V Size 2 : 4.5kw 460V Size 2 : 5.5kw 460V	1.5A 2.0A 2.5A 3.5A 4.5A 5.5A
		Size 3 : 6.8kw 460V Size 3 : 9.0kw 460V Size 3 : 12.0kw 460V Size 3 : 16.0kw 460V	6.8A 9.0A 12.0A 16.0A

Routine Maintenance

Periodically inspect the Inverter for build–up of dust or obstructions that may affect cooling. Remove any build–up using dry air.

Saving Your Application Data

In the event of a repair, application data will be saved whenever possible. However, you should record your application settings before returning the unit. You should actually record the settings after programming. When a failure occurs, you may not be able to access the parameter values. Contact Baldor to arrange for the repair.

Disposal

This product contains materials which are consignable waste under the Special Waste Regulations 1996 which complies with the EC Hazardous Waste Directive – Directive 91/689/EEC. We recommend you dispose of the appropriate materials in accordance with the valid environmental control laws. The following table shows which materials can be recycled and which have to be disposed of in a special way.

Material	Recycle	Disposal
metal	yes	no
plastic materials	yes	no
printed circuit board	no	yes

The printed circuit board should be disposed of in one of two ways:

1. High temperature incineration (minimum temperature 1200°C) by an incinerator authorized under parts A or B of the Environmental Protection Act.
2. Disposal in an engineered land fill site that is licensed to take aluminium electrolytic capacitors. Do not dispose of in a land fill site set aside for domestic waste.

Packaging

During transport our products are protected by suitable packaging. This is entirely environmentally compatible and should be taken for central disposal as secondary raw material.

Section 5
Troubleshooting

Trips

The trip display message is briefly displayed repeatedly (flashing) on the screen to warn of an imminent trip. Some trip conditions need time to take effect. The warning can allow you time to resolve the situation. The message will clear when you use the keypad, but after a short time will reappear until the problem is resolved, or the drive trips.

When a trip occurs, the control's power stage is immediately disabled causing the motor and load to coast to a stop. The trip is latched until action is taken to reset it. This ensures that trips due to transient conditions are captured and the Inverter is disabled, even when the original cause of the trip is no longer present. At this time, the activated alarm is displayed on the keypad display.

Reset a Trip

All trips must be reset before the Inverter can be re–enabled. A trip can only be reset once the trip condition is no longer active, i.e. a trip due to a heatsink over–temperature will not reset until the temperature is below the trip level. You can reset the trip as follows:

1. Press the  (STOP) key to reset the trip and clear the alarm from the display.
2. Remove and then re–apply the RUN command and the drive will run normally.

Success is indicated by either rdy or the Local Setpoint being displayed.

Display	Trip Message and Meaning	Possible Reason for Trip
dCH I	DC LINK HIGH The Inverter internal dc link voltage is too high	The supply voltage is too high Trying to decelerate a large inertia load too quickly; DECEL TIME time too short The brake resistor is open circuit (400V unit only)
dCLO	DC LINK LOW	DC LINK low trip. Supply is too low/power down
OC	OVERCURRENT The motor current being drawn from the Inverter is too high	Trying to accelerate a large inertia load too quickly; ACCEL TIME time too short Trying to decelerate a large inertia load too quickly; DECEL TIME time too short Application of shock load to motor Short circuit between motor phases Short circuit between motor phase and earth Motor output cables too long or too many parallel motors connected to the Inverter FIXED BOOST level set too high
HOt	HEATSINK OVERTEMPERATURE Drive heatsink temperature > 100ºC	The ambient air temperature is too high Poor ventilation or spacing between Inverters
LOOP	SLOOP	A current of less than 1mA is present when 4–20mA setpoint is selected – look for a wire break

Display	Trip Message and Meaning	Possible Reason for Trip
StLL	SStLL	Motor loading too great FIXED BOOST level set too high
dCrP	DC LINK RIPPLE A dc link ripple alert	Supply imbalance in a 3–phase system Poor supply regulation in a 1–phase system
I HI	CURRENT LIMIT Software overcurrent trip	See OVERCURRENT above
t 3	TERMINAL 3 OVERLOAD	AIN2 overload – overcurrent applied in Current mode
t 4	TERMINAL 4 OVERLOAD	+10V REF overload warning – 10mA maximum
t 5	TERMINAL 5 OVERLOAD	AOUT overload – 10mA maximum
t 9	TERMINAL 9 OVERLOAD	DIN3 overload – 20mA maximum
t 10	TERMINAL 10 OVERLOAD	DOUT2 overload – 20mA maximum
CodE	Product Code Error	Switch unit off/on. If persistent, return unit to factory
CAL	Calibration Data Error	Switch unit off/on. If persistent, return unit to factory
dAtA	Configuration Data Error	E

General Failures

Problem	Possible Cause	Remedy
Inverter will not power–up	Fuse blown	Check supply details, fit correct fuse. Check Product Code against Model No.
	Faulty cabling	Check all connections are correct/secure. Check cable continuity
Inverter fuse keeps blowing	Faulty cabling or connections wrong	Check for problem and rectify before replacing with correct fuse
	Faulty Inverter	Contact Eurotherm Drives
Cannot obtain power–on state	Incorrect or no supply available	Check supply details
Motor will not run at switch–on	Motor jammed	Stop the Inverter and clear the jam
Motor runs and stops	Motor becomes jammed	Stop the Inverter and clear the jam
	Open circuit speed reference potentiometer	Check terminal

Section 6
Specifications & Product Data

General Specifications:

Enclosure:		Open Type (Protected Chassis)
Enclosure rating:	Europe	IP20
	North America / Canada	Chassis/IP20
Mounting method:		Panel mount or DIN rail mounting (35mm).
Enclosure emissions:		Enclosure provides 15dB attenuation to radiated emissions between 30–100MHz. It must also require a security tool for opening.
Horsepower:		1/3–2 HP @ 230VAC, 1 Phase 3–5 HP @ 230VAC, 3 Phase 1/2–10 HP @ 460VAC, 3 Phase
Voltage Range:	230 VAC Models	198-264 VAC 1ϕ 60 Hz / 198-264 VAC 1ϕ 50 Hz
	460 VAC Models	198-264 VAC 3ϕ 60 Hz / 198-264 VAC 3ϕ 50 Hz 342-506 VAC 3ϕ 60 Hz / 342-506 VAC 3ϕ 50 Hz
Input Line Impedance:		1%
Service Factor:		1.0
Duty:		Continuous
Ambient Operating Temperature:		0 to +40 °C with linear derating to 50 °C (maximum).
Cooling:		Forced air included when required.
Rated Storage Temperature:		– 25 °C to +55 °C
Humidity:		10 to 85% RH @ 40 °C Non-Condensing
Altitude:		Sea level to 3300 Feet (1000 Meters) Derate 1% per 330 Feet (100 Meters) above 3300 Feet
Shock:		1G
Vibration:		0.5G at 10Hz to 60Hz
Climatic conditions:		Class 3k3, as defined by EN50178 (1998)
Safety:	Europe	EN50178 (1998), when installed inside suitable enclosure.
	North America / Canada	UL508C
	Overvoltage Category	Category III (3 phase power), Category II (1 phase Logic power)
	Pollution Degree	Pollution Degree 2
EMC Compliance:	Immunity:	EN50082–1 (1992), EN50082–2 (1992), EN61800–3
	Radiated Emissions:	EN50081–1(1992) and EN61800–3 when mounted inside the specified enclosure. Control and motor cables must be screened and correctly installed with shielded couplings where they exit the enclosure. Control 0V must be connected to protective earth/ground.
Conducted Emissions:		EN50081–1(1992), EN61800–3 unrestricted distribution, maximum motor cable length is 25m.

Control Specifications:

Control method:	Random carrier input, 0–240Hz PWM output.
Output rating:	Peak overload capacity of 150% for 30 seconds for constant torque;
PWM Frequency:	Random PWM for quiet motor operation.
V/Hz Ratio:	Linear squared reduced; base frequency; min frequency limit; max frequency limit.
Torque Boost	Adjustable 0–25% of input voltage.
Brake Torque:	Optional external braking resistors available for 460VAC controls.
Frequency Setting:	0–5VDC, 0–10VDC, 0–20mA, 4–20mA, digital using keypad or RS232.
Accel/Decel:	Separate Accel and Decel rates from 0–3000 seconds to maximum frequency.
Protective Features:	Adjustable time base overload, display fault condition, isolated control circuitry, heatsink thermal sensor and motor thermal monitoring.
Outputs:	Analog meter output, opto isolated output, relay output.

Keypad Display:

Display:		7 segment and custom character display.
Keys:		10 key membrane with tactile response
Display Function:	Running	Output frequency, set speed %, DC link voltage, motor current
	Setting	Parameter values for setting and viewing
	Trip	Separate message for each trip

Analog Inputs:

Operating range	0–5VDC and 0–10VDC (no sign), set with parameter SIP13 (AIN1) 0–5VDC, 0–10VDC, 0–20mA and 4–20mA (no sign), set with parameter SIP23 (AIN2) 25mA maximum input current; 24VDC maximum input voltage
Input impedance	40k ohms (current input <6VDC @ 20mA)
Resolution	10 bits (1 in 1024)
Sample rate	10mseconds

Analog Outputs:

Operating range	0–10VDC (no sign); maximum rated output current 10mA with short circuit protection
Resolution	10 bits (1 in 1024)
Dynamic response	Bandwidth 15Hz

Digital Inputs:

Operating range	0–5VDC=OFF; 15–24VDC=ON (30VDC max.)
Input impedance	6k ohms
Rated output current	20mA

Digital Outputs: DOut2 (DOut1 is reserved)

Nominal open circuit output volts	22.95VDC (19VDC minimum)
Nominal output impedance	82 ohms
Rated output current	20mA

Relay Output:

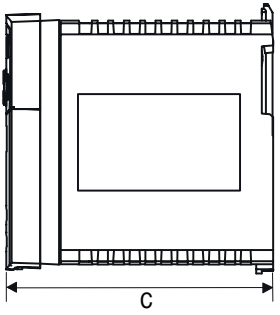
Operating range	250VAC maximum
Maximum current	4A resistive (non–inductive)
Sample rate	10mseconds

Ratings

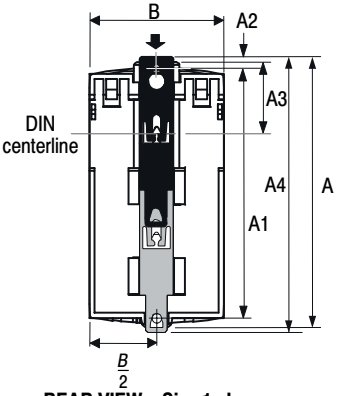
Catalog Number	Input		Size	Max. Output				Weight lbs
	VAC	PH		HP @230VAC	HP @460VAC	Cont Amps	Peak Amps	
ID35D8A1F5-COD	230	1	1	0.33		1.5	2.3	2.8
ID35D8A2F5-COD	230	1	1	0.50		2.2	3.3	2.8
ID35D8A03-COD	230	1	1	0.75		3.0	4.5	2.8
ID35D8A04-COD	230	1	1	1.0		4.0	6.0	2.8
ID35D8A07-COD	230	1	2	2.0		7.0	10.5	4.1
ID35D2A10-COD	230	3	3	3.0		10.5	15.8	6.9
ID35D2A16-COD	230	3	3	5.0		16.5	24.8	6.9
ID35D4A1F5-CRD	460	3	2		0.50	1.5	2.3	4.1
ID35D4A02-CRD	460	3	2		0.75	2.0	3.0	4.1
ID35D4A2F5-CRD	460	3	2		1.0	2.5	3.8	4.1
ID35D4A4F5-CRD	460	3	2		2.0	4.5	6.8	4.1
ID35D4A5F5-CRD	460	3	2		3.0	5.5	8.3	4.1
ID35D4A09-CRD	460	3	3		5.0	9.0	13.5	6.9
ID35D4A12-CRD	460	3	3		7.5	12.0	18.0	6.9
ID35D4A16-CRD	460	3	3		10.0	16.0	24.0	6.9

Dimensions

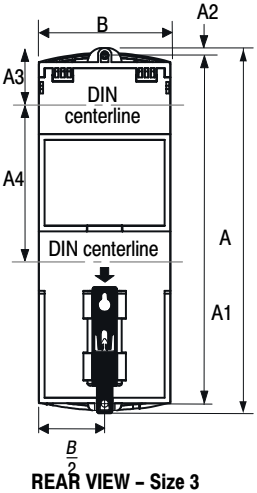
For Size 1 and 2 controls,the DIN clip can be repositioned to provide the upper mounting hole for wall mounting.



SIDE VIEW – Size 1 shown (Size 2 is similar)



REAR VIEW – Size 1 shown (Size 2 is similar)



REAR VIEW – Size 3

Size	Dimensions							Weight lbs
	A	A1	A2	A3	A4	B	C	
1	5.6 (143)	5.2 (132)	0.2 (6)	1.4 (35)	5.5 (139)	2.9 (73)	5.6 (142)	1.9
2	7.9 (201)	7.4 (188)	0.24 (6.5)	1.4 (35)	7.7 (194)	2.9 (73)	6.8 (173)	3.1
3	10.2 (260)	9.5 (242)	0.2 (6)	1.5 (38)	4.4 (112)	3.8 (96)	7.9 (200)	5.9

Appendix A
Dynamic Brake

230VAC 1 & 3 Phase Controls All controls are supplied without braking resistors.

Size 1 and 2 – 230VAC 1 Phase

Size 1 and 2 230VAC controls have no external dynamic brake capability.

Size 3 – 230VAC 3 Phase

Size 3 230VAC controls have internal brake circuit and can accept external brake resistor.

460VAC 3 Phase Controls

Size 2 and 3 – 460VAC

Size 2 and 3 460VAC controls have internal brake circuit and can accept external brake resistor. The dynamic brake circuit is designed for short term stopping or braking only. It is not rated for a continuously overhauling load.

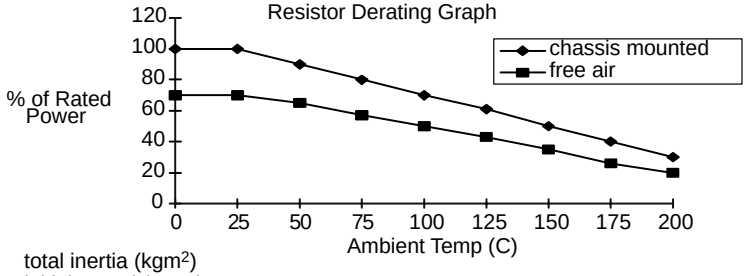
All controls are supplied without braking resistors. The dynamic brake switch terminals allow easy connection of an external resistor. These resistors should be mounted on a heatsink (enclosure panel) and covered to prevent severe buring.

Brake Calculations

Brake assemblies must be rated to absorb the peak brake power during deceleration and the average power over the complete cycle.

$$P_{pk} = \frac{0.0055 \times J \times (n_1^2 - n_2^2)}{t_b} \text{ (W)}$$

$$P_{av} = \frac{P_{pk}}{t_c} \times t_b$$



where:
- J = total inertia (kgm^2)
- n_1 = initial speed (RPM)
- n_2 = final speed (RPM)
- t_b = brake time (seconds)
- t_c = cycle time (seconds)

The minimum resistance of the combination (series/parallel resistor connections) must be as specified in Table A-1.

RGA and RGJ Assemblies

Assemblies include braking resistors completely assembled and mounted in a NEMA 1 enclosure. A listing of available resistor assemblies is provided in Table A-1. The minimum resistance “Min Ohms” shown in the table is the minimum resistor value that can be connected to the control without causing damage to the internal dynamic brake switch.

Table A-1 External Brake Resistor Selection

Input Volts	HP	Size	Min Ohms	Continuous Rated Watts 100	200	300	600
230	3	3	30	RGJ130	RGJ230	RGJ330	RGA630
230	5	3	30	RGJ130	RGJ230	RGJ330	RGA630
460	0.5–1	2	500	RGJ1500	RGJ2500		
460	2–3	2	200	RGJ1200	RGJ2200	RGJ3200	RGA6200
460	5	3	100	RGJ1120	RGJ2120	RGJ3120	RGA6120
460	7.5 – 10	3	56	RGJ160	RGJ260	RGJ360	RGA660

Contact Baldor for information on resistor kits that are not shown.

Appendix B
CE Guidelines

CE Declaration of Conformity

Baldor indicates that the products are only components and not ready for immediate or instant use within the meaning of “Safety law of appliance”, “EMC Law” or “Machine directive”.

The final mode of operation is defined only after installation into the user’s equipment. It is the responsibility of the user to verify compliance.

The product conforms with the following standards:

DIN VDE 0160 / 05.88	Electronic equipment for use in electrical power installations
DIN VDE 0100	Erection of power installations with nominal voltages up to 1000V
DIN IEC 326 Teil 1 / 10.90	Design and use of printed boards
DIN VDE 0110Teil 1-2 / 01.89	Dimensioning of clearance and creepage
DIN VDE 0110Teil 20 / 08.90	distances
EN 60529 / 10.91	Degrees of protection provided by enclosures

EMC – Conformity and CE – Marking

The information contained herein is for your guidance only and does not guarantee that the installation will meet the requirements of the council directive 89/336/EEC.

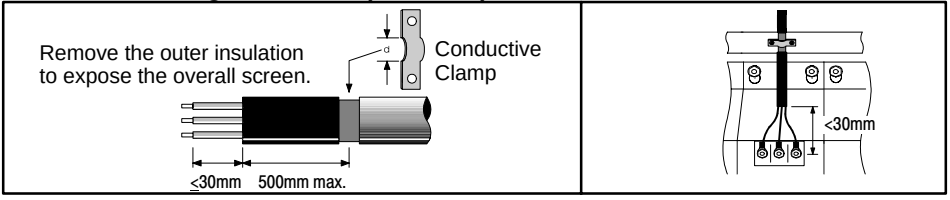
The purpose of the EEC directives is to state a minimum technical requirement common to all the member states within the European Union. In turn, these minimum technical requirements are intended to enhance the levels of safety both directly and indirectly.

Council directive 89/336/EEC relating to Electro Magnetic Compliance (EMC) indicates that it is the responsibility of the system integrator to ensure that the entire system complies with all relative directives at the time of installing into service.

Motors and controls are used as components of a system, per the EMC directive. Hence all components, installation of the components, interconnection between components, and shielding and grounding of the system as a whole determines EMC compliance.

The CE mark does not inform the purchaser which directive the product complies with. It rests upon the manufacturer or his authorized representative to ensure the item in question complies fully with all the relative directives in force at the time of installing into service, in the same way as the system integrator previously mentioned. Remember, it is the instructions of installation and use, coupled with the product, that comply with the directive.

Wiring of Shielded (Screened) Cables

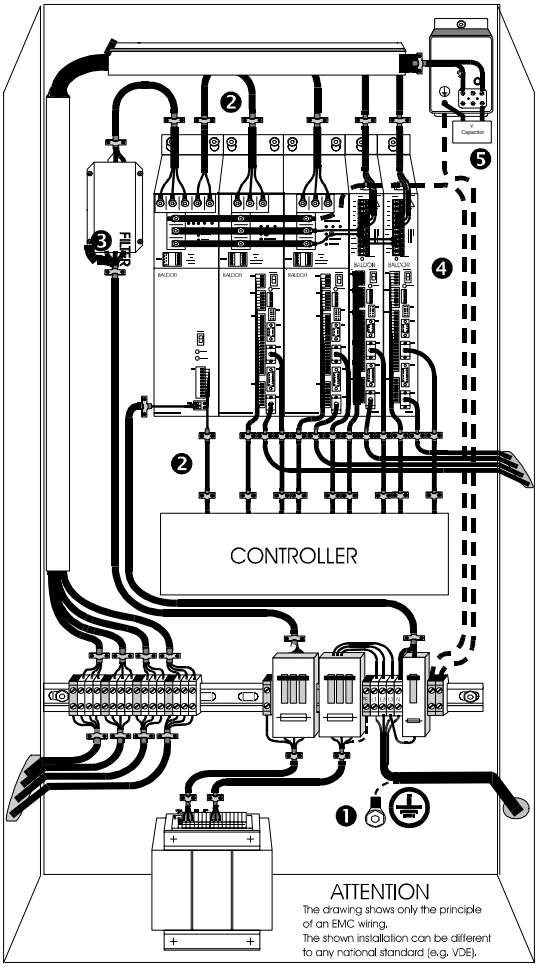


Using CE approved components will not guarantee a CE compliant system!

1. The components used in the drive, installation methods used, materials selected for interconnection of components are important.
2. The installation methods, interconnection materials, shielding, filtering and grounding of the system as a whole will determine CE compliance.
3. The responsibility of CE mark compliance rests entirely with the party who offers the end system for sale (such as an OEM or system integrator).

Baldor products which meet EMC directive requirements are indicated by a "CE" mark. A duly signed CE declaration of conformity is available from Baldor.

EMC Wiring Technique



1 **CABINET**
The drawing shows an electroplated zinc coated enclosure, connected to ground. This enclosure has the following advantages:
– All parts mounted on the back plane are connected to ground.
– All shield (screen) connections are connected to ground.
Within the cabinet there should be a spatial separation between power wiring (motor and AC power cables) and control wiring.

2 **SCREEN CONNECTIONS**
All connections between components must use shielded cables. The cable shields must be connected to the enclosure. Use conductive clamps to ensure good ground connection. With this technique, a good ground shield can be achieved.

3 **EMC – FILTER**
The EMI or main filter should be mounted next to the power supply (here BPS). For the connection to and from the main filter screened cables should be used. The cable screens should be connected to screen clamps on both sides. (Exception: Analog Command Signal).

4 **Grounding (Earth)**
For safety reasons (VDE0160), all BALDOR components must be connected to ground with a separate wire. The diameter of the wire must be at minimum AWG#6 (10mm^2). Ground connections (dashed lines) must be made from the central ground to the regen resistor enclosure and from the central ground to the Shared Power Supply.

5 **Y–CAPACITOR**
The connection of the regeneration resistor can cause RFI (radio frequency interference) to be very high. To minimize RFI, a Y–capacitor is used. The capacitor should only be connected between the dynamic brake resistor housing and terminal pin R1 (lead from Lin).
Recommendation:
0,1µF / 250VAC Type: PME265
BALDOR–Ordering–No.: ASR27104

EMC Installation Instructions

To ensure electromagnetic compatibility (EMC), the following installation instructions should be completed. These steps help to reduce interference. Consider the following:

- Grounding of all system elements to a central ground point
- Shielding of all cables and signal wires
- Filtering of power lines

A proper enclosure should have the following characteristics:

A) All metal conducting parts of the enclosure must be electrically connected to the back plane. These connections should be made with a grounding strap from each element to a central grounding point . [1]

B) Keep the power wiring (motor and power cable) and control wiring separated. If these wires must cross, be sure they cross at 90 degrees to minimize noise due to induction.

C) The shield connections of the signal and power cables should be connected to the screen rails or clamps. The screen rails or clamps should be conductive clamps fastened to the cabinet. [2]

D) The cable to the regeneration resistor must be shielded. The shield must be connected to ground at both ends.

E) The location of the AC mains filter has to be situated close to the drive so the AC power wires are as short as possible.

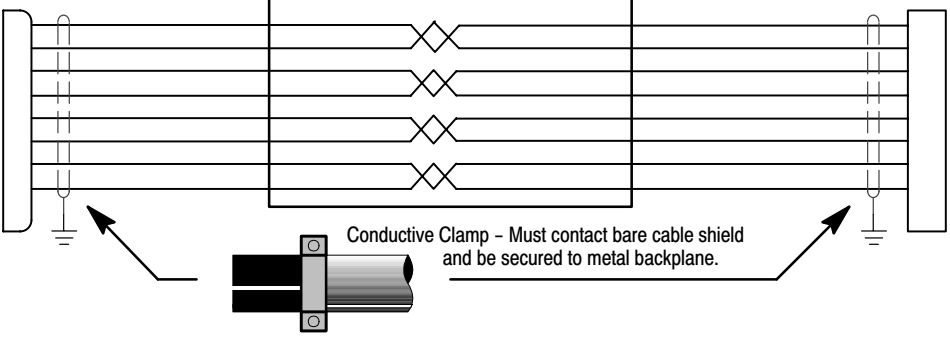
F) Wires inside the enclosure should be placed as close as possible to conducting metal, cabinet walls and plates. It is advised to terminate unused wires to chassis ground. [1]

G) To reduce ground current, use at least a 10mm^2 (6 AWG) solid wire for ground connections.

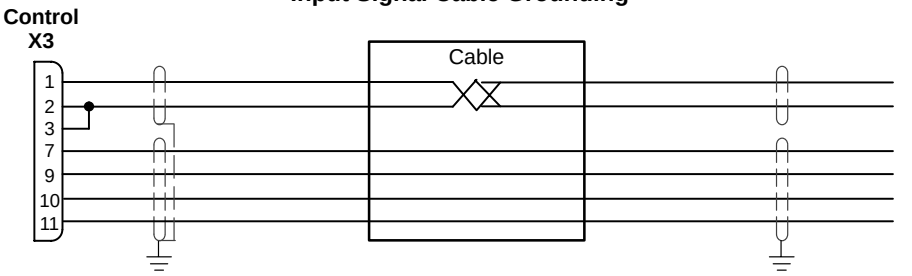
[1] Grounding in general describes all metal parts which can be connected to a protective conductor, e.g. housing of cabinet, motor housing, etc. to a central ground point. This central ground point is then connected to the main plant (or building) ground.

[2] Or run as twisted pair at minimum.

Cable Screens Grounding



Input Signal Cable Grounding



BALDOR
MOTORS AND DRIVES

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Date: 1/5/02 **EC Declarations of Conformity** Ref: DE00013–000

This is to certify that Baldors Inverter products comply with the requirements of CE Directive as described below and being one of:–

35D Family 37D Family 38D Family

When used in accordance with the guidance and instructions given in the corresponding Product Installation Manual, the above Electronic Products conform with the protection requirements of Council Directive 89/336/EEC and amended by 92/31/EEC and 93/68/EEC, Article 10 and Annex 1, relating to the EMC Directive and Manufacturers Declaration for EMC, by the application of the relevant clauses of the following standards:

Standard	EMC Directive	Manufacturers Declaration
BSEN 500081–1: 1992 &/or BSEN50081–2	✓	✓
(1994): 1996	✓	✓
BSEN 50082–1#: 1998	✓	✓
BSEN 50082–2#: 1995	✓	✓
BSEN 61800–3 : 1996	✓	✓
BSEN 61000–3–2: 1995	✓	✓

compliant with these immunity standards without specifed EMC Filters and with the protection requirements of Council Directive 72/23/EEC (amended by 93/68/EEC) article 13 and Annex III relating to Low Voltage Equipment, by following the guidance found in the relevant clauses of the following standard:–

Standard	Title
EN50178: 1997	Electronic equipment for use in power installations

Machinery Directive
The above Electronic Products are components to be incorporated into machinery and may not be operated alone. The complete machinery or installation using this equipment may only be put in to service when the safety considerations of the Directive 89/392/EEC are fully adhered to. Particular reference should be made to EN60204–1 (Safety of Machinery – Electrical Equipment of Machines). All instructions, warnings and safety information of the Product Installation Manual must be adhered to.

Signed: .....
Dr. Gerry Boast
Engineering Manager

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