BALDOR®
MOTORS AND DRIVES

Pre-Engineered
Control Panel

Installation & Operating Manual

Factory Programmed Date: _____

Specification No.: _____ **Serial No.:** _____

2/02 **MN709**

BALDOR ELECTRIC COMPANY
P.O. Box 2400
Ft. Smith, AR 72902–2400
(479) 646–4711
Fax (479) 648–5792

MN709

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Section 1
General Information

Overview

The Baldor Pre-engineered Control Panel is UL listed combination motor controllers. The power circuit contains a circuit breaker, Baldor Control and overload relay. The pre-engineered control panel is factory wired and with a few connections, it is ready for use as motor controller. However, care should be taken to read and follow all caution statements, verify circuit breaker, overload and pre-programmed control's parameter settings. Confirm that the motor voltage and horsepower ratings correctly match the ratings of the control panel.

⚠ **WARNING: Read and become familiar with the Safety Notice and Precautions in this section of the manual. Failure to do so can result in injury or equipment damage. If you have questions about this information, do not proceed until you contact your Baldor representative and fully understand the operating precautions.**

Refer to this manual for incoming line, motor leads and control circuit connections. Verify circuit breaker and overload dials are properly set. Refer to the motor nameplate for the full load amperes (FLA) rating. The Baldor Control Panel is designed to be installed according to applicable requirements of Nation Electric Code. It is responsibility of the installer to ensure that the installation is in compliance with the National Electric Code and any other regulations.

The document package shipped with the Control Panel contains an electrical schematic and records of parameter settings. Be sure to keep this information in a safe place for future reference.

Limited Warranty

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

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

Safety Notice

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

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

PRECAUTIONS

⚠ **WARNING: Bypass Control Panels are equipped with "across-the-line" combination starters. Verify that the direction of motor rotation in "Adjustable Speed mode" and "Bypass Mode" is the same. If rotation is opposite in these modes, safely disconnect the AC power and reverse the L1 and L2 connections.**

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

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

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

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

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

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

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

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

Continued on next page

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

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

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

⚠ **Caution:** **The trip level of the circuit breaker must remain as low as possible to avoid damage to equipment. If set too high, the circuit breaker may not trip during a high over-current condition.**

Section 2
Receiving & Installation

Receiving & Inspection

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

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

Storage

Control Panel

Temperature:	– 30°C to +65°C	
Humidity:	NEMA 3R: NEMA 12:	To 90% RH non-condensing
	NEMA 1: NEMA 4X Indoor:	To 90% RH non-condensing To 100% RH condensing
	NEMA 4:	To 100% RH condensing

Motor Storage

If the motor is not put into service immediately, the motor must be stored in a clean, dry and warm location. Several precautionary steps must be performed to avoid motor damage during storage.

1. Use a “Megger” periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant decrease in insulation resistance.
2. Do not lubricate bearings during storage. Motor bearings are packed with grease at the factory. Excessive grease can damage insulation quality.
3. Rotate motor shaft at least 10 turns every two months during storage (more frequently if possible). This will prevent bearing damage due to storage.
4. If the storage location is damp or humid, the motor windings must be protected from moisture. This can be done by applying power to the motors’ space heater (if available) while the motor is in storage.

Motor Unpacking

Each Baldor motor is packaged for ease of handling and to prevent entry of contaminants.

1. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
2. When the motor has reached room temperature, remove all protective wrapping material from the motor.

Motor Handling

The motor should be lifted using the lifting lugs or eye bolts provided. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft.

Physical Location

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

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

1. For effective cooling and maintenance, the control is mounted vertically on a level concrete pad or floor sills.
2. At least twelve inches clearance must be provided for enclosure sides that provide air intake and exhaust.
3. Front access must be provided to allow the panel to be opened or removed for service and to allow viewing of the Keypad Display and control devices.
4. **Altitude derating**. Up to 3300 feet (1000 meters) no derating required. Above 3300 ft, derate the continuous and peak output current by 2% for each 1000 ft.
5. **Temperature derating**. Up to 40°C no derating required. Above 40°C, derate the continuous and peak output current by 2% per °C. Maximum ambient is 55°C.

Physical Installation

The control must be securely fastened to the mounting surface.

Procedure:

1. Refer to Section 4 of this manual for drawings and dimensions for mounting. Use the information contained in these drawings to layout the appropriate mounting holes for your enclosure.
   OR
2. Locate and drill holes for mounting hardware as shown in the drawings.
3. Secure the Panel using the hardware recommended in the drawing.

AC Main Circuit

Protection Devices

Be sure a suitable input power protection device is installed. Use the recommended circuit breaker or fuses listed in Tables 2-1 through 2-3 (Wire Size and Protection Devices). Input and output wire size is based on the use of copper conductor wire rated at 75 °C. The table is specified for NEMA B motors.

Circuit Breaker:	3 phase, thermal magnetic. Equal to GE type THQ or TEB for 230 VAC or GE type TED for 460 VAC and 575 VAC.
Fast Action Fuses:	230 VAC, Buss KTN 460 VAC, Buss KTS to 600A (KTU 601 - 1200A) 575VAC, Buss FRS
Very Fast Action:	230 VAC, Buss JJN 460 VAC, Buss JJS 575 VAC, , Buss JJS
Time Delay Fuses:	230 VAC, Buss FRN 460 VAC, Buss FRS to 600A (KTU 601 - 1200A) 575 VAC, Buss FRS to 600A (KTU 601 - 1200A)

Wire Size and Protection Devices

Table 2-1 Wire Size and Protection Devices - 230 VAC Control Panels

*Catalog Number	Max CT HP	Feeder Breaker	Feeder Fuse		AC Main Circuit									
					Recommended Wire Size		Termination Lug Wire Size Range		Termination Lug Torque Value		Ground Lug Wire Size Range		Ground Lug Torque Value	
			Fast Acting	Time Delay	AWG	m^2	AWG	mm^2	lb-in	Nm	AWG	mm^2	lb-in	Nm
X2001	1	10A	10A	8A	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X2002	2	15A	15A	12A	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X2003	3	20A	25A	12.5A	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X2005	5	25A	30A	25A	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X2007	7.5	35A	40A	35A	10	6	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X2010	10	50A	60A	50A	8	10	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X2015	15	60A	80A	60A	4	25	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X2020	20	80A	100A	80A	4	25	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X2025	25	100A	125A	100A	3	30	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X2030	30	125A	150A	125A	1	50	2–3/0	35–95	150	16.9	14–1/0	2.5–54	50	5.6
X2040	40	150A	200A	150A	2/0	70	2–3/0	35–95	150	16.9	14–1/0	2.5–54	50	5.6
X2050	50	150A	200A	150A	2/0	70	2–3/0	35–95	150	16.9	14–1/0	2.5–54	50	5.6

Note: *Catalog number prefix “X” can be P15H, P17H, P18H, P21H or P22H depending on Baldor control installed.

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 2-2 Wire Size and Protection Devices - 460 VAC Control Panels

*Catalog Number	Max CT HP	Feeder Breaker (A)	Feeder Fuse (A)		AC Main Circuit									
					Recommended Wire Size		Termination Lug Wire Size Range		Termination Lug Torque Value		Ground Lug Wire Size Range		Ground Lug Torque Value	
			Fast Acting	Time Delay	AWG	m^2	AWG	mm^2	lb-in	Nm	AWG	mm^2	lb-in	Nm
X4001	1	10	5	4	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X4002	2	10	8	6	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X4003	3	10	12	9	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X4005	5	15	20	15	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X4007	7.5	20	25	17.5	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X4010	10	25	30	25	10	6	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X4015	15	30	40	30	8	10	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X4020	20	40	50	40	8	10	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X4025	25	45	60	45	8	10	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X4030	30	60	80	60	4	25	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X4040	40	70	100	75	4	25	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X4050	50	90	125	90	2	35	2–3/0	35–95	150	16.9	14–1/0	2.5–54	50	5.6
X4060	60	125	150	125	1/0	54	2–3/0	35–95	150	16.9	14–1/0	2.5–54	50	5.6
X4075	75	150	200	150	2/0	70	2–3/0	35–95	150	16.9	6–350mcm	16–185	275	31
X4100	100	175	250	175	2/0	70	2–3/0	35–95	150	16.9	6–350mcm	16–185	275	31
X4125	125	250	350	250	(2)1/0	(2)54	1/0–350mcm	54–185	275	31	6–350mcm	16–185	275	31
X4150	150	250	350	250	(2)1/0	(2)54	1/0–350mcm	54–185	275	31	6–350mcm	16–185	275	31
X4200	200	350	450	350	(2)3/0	(2)95	1/0–350mcm	54–185	275	31	6–350mcm	16–185	275	31
X4250	250	400	500	400	(2)4/0	(2)120	2/0–600mcm	70–300	200	22.5	6–350mcm	16–185	275	31
X4300	300	500	600	500	(2)350 mcm	(2)150	2/0–600mcm	70–300	200	22.5	6–350mcm	16–185	275	31
X4350	350	600	800	600	(2)400 mcm	(2)195	(2) 2/0–600mcm	70–150	200	22.5	6–350mcm	16–185	275	31
X4400	400	1000	1000	1000	(2)500 mcm	(2)240	(2) 2/0–600mcm	70–300	200	22.5	6–350mcm	16–185	275	31
X4450	450	1200	1200	1200	(2)600 mcm	(2)300	(2) 2/0–600mcm	70–300	200	22.5	6–350mcm	16–185	275	31

Note: *Catalog number prefix “X” can be P15H, P17H, P18H, P21H or P22H depending on Baldor control installed.

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 2-3 Wire Size and Protection Devices - 575 VAC Control Panels

*Catalog Number	Max CT HP	Feeder Breaker (A)	Feeder Fuse (A)		AC Main Circuit									
					Recommended Wire Size		Termination Lug Wire Size Range		Termination Lug Torque Value		Ground Lug Wire Size Range		Ground Lug Torque Value	
			Fast Acting	Time Delay	AWG	m^2	AWG	mm^2	lb-in	Nm	AWG	mm^2	lb-in	Nm
X5001	1	10	4	3	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X5002	2	10	6	4.5	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X5003	3	10	10	7	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X5005	5	10	15	10	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X5007	7	15	15	12	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X5010	10	20	25	20	12	4	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X5015	15	25	35	25	10	6	12–10	4–6	35	4	14–1/0	2.5–54	50	5.6
X5020	20	30	40	30	8	10	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X5025	25	35	50	35	8	10	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X5030	30	45	60	45	6	16	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X5040	40	60	80	60	4	25	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X5050	50	70	90	70	4	25	8–3	10–30	100	11.3	14–1/0	2.5–54	50	5.6
X5060	60	70	90	70	2	35	2–3/0	35–95	150	16.9	14–1/0	2.5–54	50	5.6
X5075	75	110	150	110	1/0	54	2–3/0	35–95	150	16.9	14–1/0	2.5–54	50	5.6
X5100	100	150	200	150	2/0	70	2–3/0	35–95	150	16.9	6–350mcm	16–185	275	31
X5150	150	175	225	175	2/0	70	2–3/0	35–95	150	16.9	6–350mcm	16–185	275	31

Note: *Catalog number prefix “X” can be P15H, P17H, P18H, P21H or P22H depending on Baldor control installed.

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

AC Connections

Be sure all power to the control is disconnected before proceeding.

The AC power and motor connections are shown in Figure 2-1.

1. Connect the supply power wires to the Circuit Breaker terminals L1, L2 and L3. Be sure the wire is the correct size and torque the termination Lug as specified (refer to Tables 2-1, 2-2, and 2-3).
2. Connect the supply ground terminal to the GND terminal of the enclosure. Be sure the wire is the correct size and torque the Ground Lug as specified (refer to Tables 2-1, 2-2, and 2-3).
3. Connect the motor leads to the Overload Relay terminals T1, T2 and T3. Be sure the wire is the correct size and torque the termination Lug as specified (refer to Tables 2-4, 2-5 and 2-6).
4. Connect the motor ground terminal to the GND terminal of the enclosure. Be sure the wire is the correct size and torque the Ground Lug as specified (refer to Tables 2-4, 2-5 and 2-6).

Table 2-4 Motor Lead Termination – 230VAC Control Panels

*Catalog Number	Max CT HP	Motor Full Load Amperes (NEC Table 430-150)	Motor Leads (T1, T2 and T3)									
			Recommended Wire Size		Termination Lug Wire Size Range		Termination Lug Torque Value		Ground Lug Wire Size Range		Ground Lug Torque Value	
			AWG	m^2	AWG	mm^2	lb-in	Nm	AWG	mm^2	lb-in	Nm
X2001	1	4.2	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X2002	2	6.8	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X2003	3	9.6	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X2005	5	15.2	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X2007	7.5	22	10	6	14–8	2.5–10	20	2.5	14–1/0	2.5–54	50	5.6
X2010	10	28	10	10	14–8	2.5–10	20	2.5	14–1/0	2.5–54	50	5.6
X2015	15	42	4	25	14–1/0	2.5–54	30	3.3	14–1/0	2.5–54	50	5.6
X2020	20	54	4	25	10–3	6–30	40	4.5	14–1/0	2.5–54	50	5.6
X2025	25	68	3	30	10–1/0	6–54	50	5.6	14–1/0	2.5–54	50	5.6
X2030	30	80	1	50	10–1/0	6–54	50	5.6	14–1/0	2.5–54	50	5.6
X2040	40	104	2/0	70	10–1/0	6–54	50	5.6	14–1/0	2.5–54	50	5.6
X2050	50	130	2/0	70	6–250mcm	11–125	150	17	14–1/0	2.5–54	50	5.6

Note: *Catalog number prefix “X” can be P15H, P17H, P18H, P21H or P22H depending on Baldor control installed.

Note: All wire sizes based on 75°C copper wire. 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 2-5 Motor Lead Termination – 460VAC Control Panels

*Catalog Number	Max CT HP	Motor Full Load Amperes (NEC Table 430-150)	Motor Leads (T1, T2 and T3)									
			Recommended Wire Size		Termination Lug Wire Size Range		Termination Lug Torque Value		Ground Lug Wire Size Range		Ground Lug Torque Value	
			AWG	m^2	AWG	mm^2	lb-in	Nm	AWG	mm^2	lb-in	Nm
X4001	1	2.1	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X4002	2	3.4	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X4003	3	4.8	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X4005	5	7.6	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X4007	7.5	11	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X4010	10	14	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X4015	15	21	10	6	14–8	2.5–10	20	2.5	14–1/0	2.5–54	50	5.6
X4020	20	27	10	6	14–8	2.5–10	20	2.5	14–1/0	2.5–54	50	5.6
X4025	25	34	6	16	14–1/0	2.5–54	40	4.5	14–1/0	2.5–54	50	5.6
X4030	30	40	6	16	14–1/0	2.5–54	40	4.5	14–1/0	2.5–54	50	5.6
X4040	40	52	4	25	10–3	6–30	50	5.6	14–1/0	2.5–54	50	5.6
X4050	50	65	4	25	10–3	6–30	50	5.6	14–1/0	2.5–54	50	5.6
X4060	60	77	2	35	10–1/0	6–54	50	5.6	14–1/0	2.5–54	50	5.6
X4075	75	96	2	35	10–1/0	6–54	50	5.6	6–350mcm	16–125	275	31
X4100	100	124	2/0	70	6–250mcm	16–125	375	42	6–350mcm	16–125	275	31
X4125	125	156	2/0	70	6–250mcm	16–125	375	42	6–350mcm	16–125	275	31
X4150	150	180	4/0	54	6–250mcm	16–125	375	42	6–350mcm	16–125	275	31
X4200	200	240	4/0	95	6–350mcm	16–185	375	42	6–350mcm	16–125	275	31
X4250	250	302	250 mcm	125	6–350mcm	16–185	375	42	6–350mcm	16–125	275	31
X4300	300	361	250 mcm	125	2/0–600mcm	70–300	375	42	6–350mcm	16–125	275	31
X4350	350	414	350 mcm	185	2/0–600mcm	70–300	375	42	6–350mcm	16–125	275	31
X4400	400	477	500 mcm	240	2/0–600mcm	70–300	375	42	6–350mcm	16–125	275	31
X4450	450	515	600 mcm	300	2/0–600mcm	70–300	375	42	6–350mcm	16–125	275	31

Note: *Catalog number prefix “X” can be P15H, P17H, P18H, P21H or P22H depending on Baldor control installed.

Note: All wire sizes based on 75°C copper wire. 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.

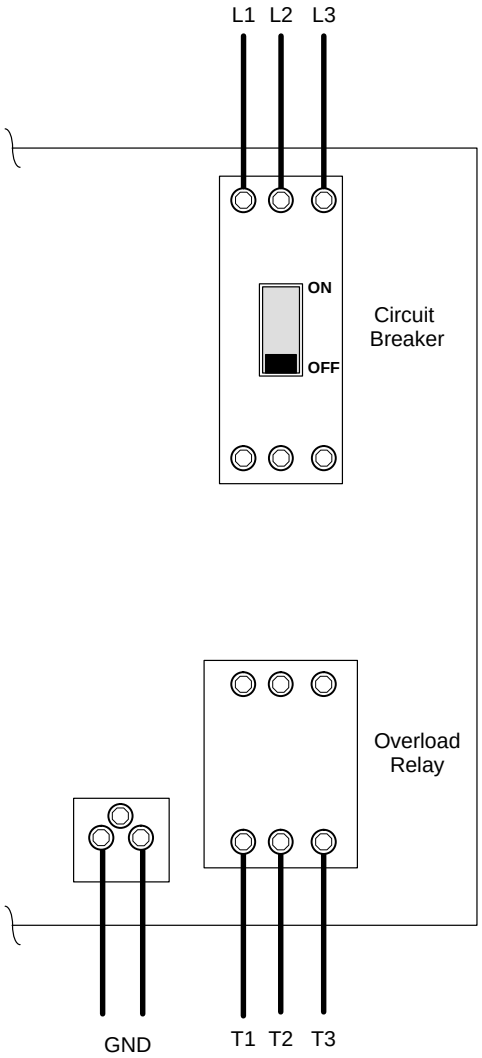
Table 2-6 Motor Lead Termination – 575VAC Control Panels

*Catalog Number	Max CT HP	Motor Full Load Amperes (NEC Table 430-150)	Motor Leads (T1, T2 and T3)									
			Recommended Wire Size		Termination Lug Wire Size Range		Termination Lug Torque Value		Ground Lug Wire Size Range		Ground Lug Torque Value	
			AWG	m^2	AWG	mm^2	lb-in	Nm	AWG	mm^2	lb-in	Nm
X5001	1	1.7	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X5002	2	2.7	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X5003	3	3.9	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X5005	5	6.1	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X5007	7	9	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X5010	10	11	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X5015	15	17	12	4	14–8	2.5–10	15	1.7	14–1/0	2.5–54	50	5.6
X5020	20	22	10	6	14–8	2.5–10	20	2.5	14–1/0	2.5–54	50	5.6
X5025	25	27	10	6	14–8	2.5–10	20	2.5	14–1/0	2.5–54	50	5.6
X5030	30	32	6	16	14–10	2.5–6	40	4.5	14–1/0	2.5–54	50	5.6
X5040	40	41	6	16	14–10	2.5–6	40	4.5	14–1/0	2.5–54	50	5.6
X5050	50	52	4	25	10–3	6–30	50	5.6	14–1/0	2.5–54	50	5.6
X5060	60	62	4	25	10–3	6–30	50	5.6	14–1/0	2.5–54	50	5.6
X5075	75	77	2	35	10–1/0	6–54	50	5.6	14–1/0	2.5–54	50	5.6
X5100	100	99	2	35	10–1/0	6–54	50	5.6	6–350mcm	16–185	275	31
X5125	125	125	2/0	70	6–250mcm	11–125	375	42	6–350mcm	16–185	275	31
X5150	150	144	2/0	70	6–250mcm	11–125	375	42	6–350mcm	16–185	275	31

Note: *Catalog number prefix “X” can be P15H, P17H, P18H, P21H or P22H depending on Baldor control installed.

Note: All wire sizes based on 75°C copper wire. 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.

Figure 2-1 AC Power And Motor Connections



Encoder Installation

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

Cable Preparation

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

Control End (See Figure 2-2.)

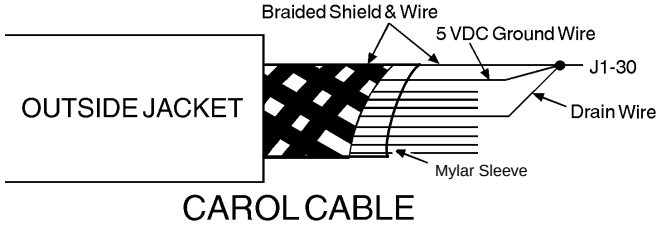
1. Strip the outside jacket approximately 0.375″ (9.5mm) from the end.
2. Solder a #22 AWG (0.34mm^2) wire to the braided shield.
3. Connect all shields to J1-30. To do this, solder a “Drain Wire” from each shield to the wire soldered to the braided shield in step 2.
4. Insulate or tape off ungrounded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

Encoder End

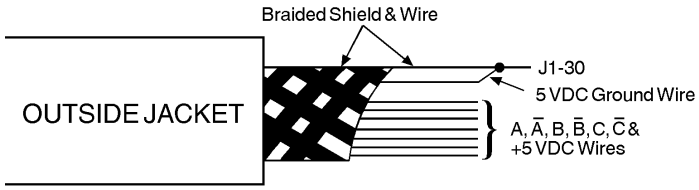
1. Strip the outside jacket approximately 0.375″ (9.5mm) from the end.
2. Identify each of the four twisted pair and label or use the color codes shown in Figure 2-3 for the optional Baldor Encoder Cable.
3. Insulate or tape off ungrounded end of shields and unused conductors to prevent contact with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

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

Figure 2-2 Encoder Cables

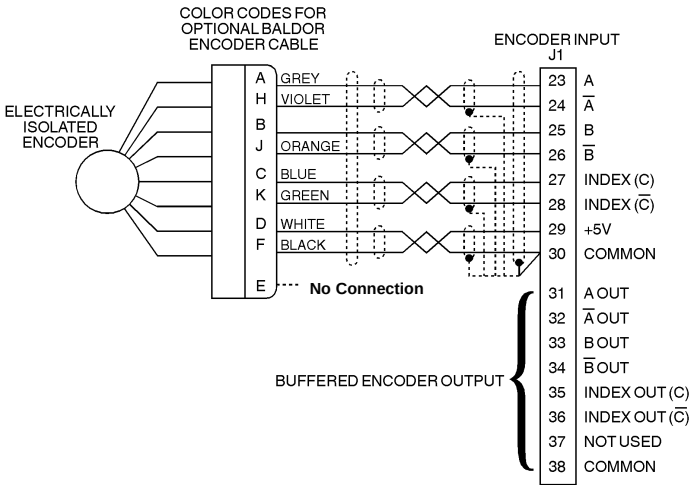


CAROL CABLE



BELDEN CABLE No. 9891

Figure 2-3 Encoder Connections



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

Encoder Cable Connection

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

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

1. Feed the control end of the cable through one of the "Knock-out" holes in the control case so connections can be made inside the control.

2. **Differential Connections**
   Connect the cable braided shield to J1-30 at control end.

   Connect the cable ends as follows: (See Figure 2-3.)

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

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

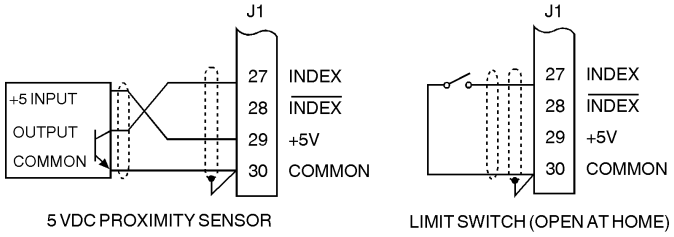
Home (Orient) Switch Input The Home or Orient function causes the motor shaft to rotate to a predefined home position. The home position is located when a machine mounted switch or the encoder "Index" pulse is activated (closed). Home is defined by a rising signal edge at terminal J1-27. The shaft will continue to rotate only in a CW direction for a user defined offset value. The offset is programmed in the Level 2 Miscellaneous Homing Offset parameter.

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

A single ended solid-state switch or limit switch should be wired as shown in Figure 2-4. Regardless of the type of switch used, clean rising and falling edges at J1-27 are required for accurate positioning.

Note: Control requires dynamic brake hardware for Orient (Homing) function to work. Control will trip without dynamic brake hardware installed.

Figure 2-4 Typical Home or Orient Switch Connections



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

Control Circuit Connections Six different wiring configurations are available. Each configuration defines the basic motor control setup and the operation of the input and output terminals. Each of these configurations can be identified by the last two digits of the catalog number -suffix. (Refer to Section 6 “Catalog Number Identification” for a description of each character of the catalog number.)

- ASD Keypad Control
- ASD/Bypass Keypad Control
- ASD 2 Wire Control
- ASD/Bypass 2 Wire Control
- ASD 3 Wire Control
- ASD/Bypass 3 Wire Control

Use size 20 - 16 AWG (0.5 - 1.5 mm^2) stranded, insulated copper conductors for all control connections. Torque control connections to 5 lb-in (0.56 Nm).

Figure 2-5 ASD Keypad Control Wiring – A A (Catalog No. Suffix)

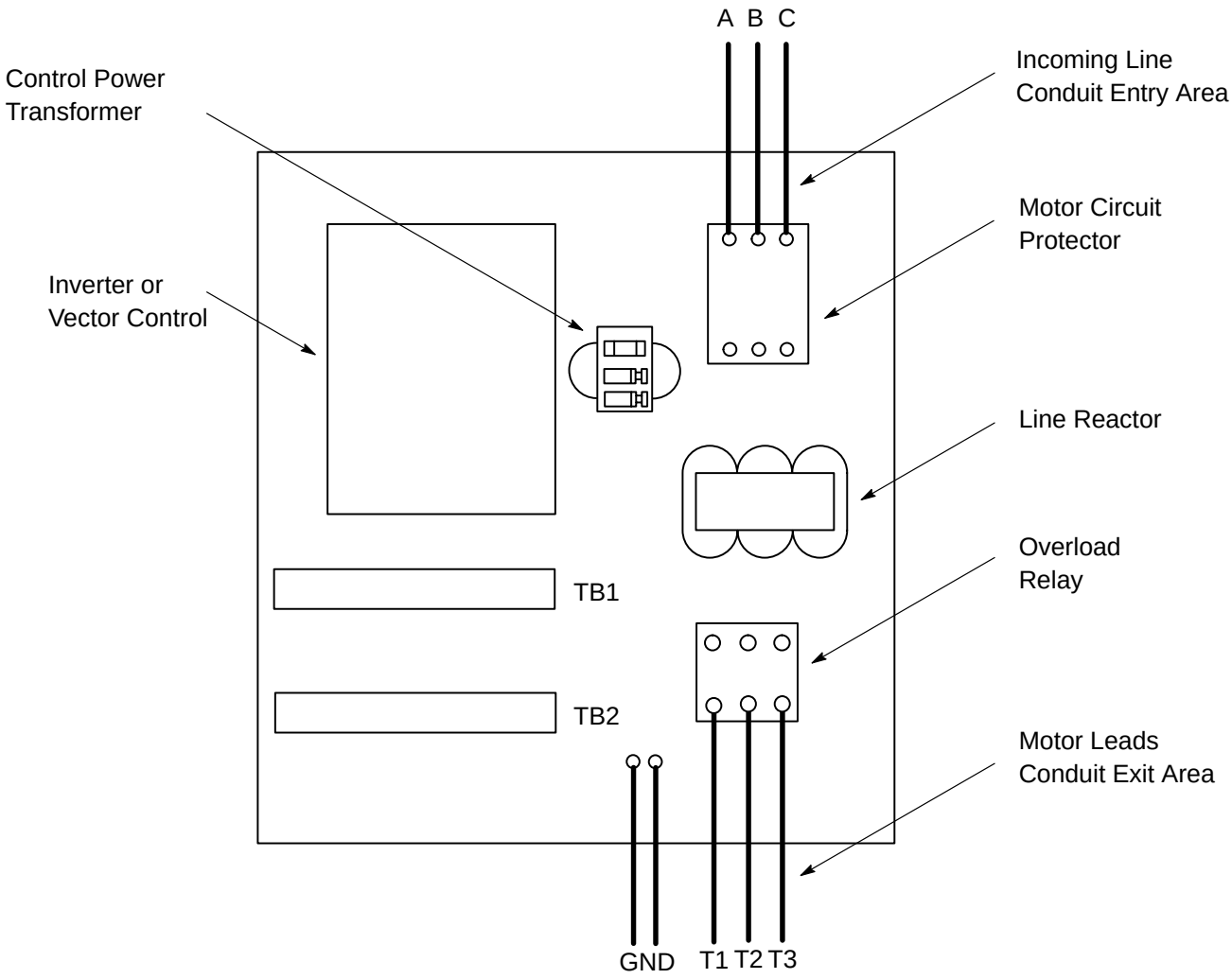


Figure 2-6 ASD/Bypass Keypad Control Wiring – B A (Catalog No. Suffix)

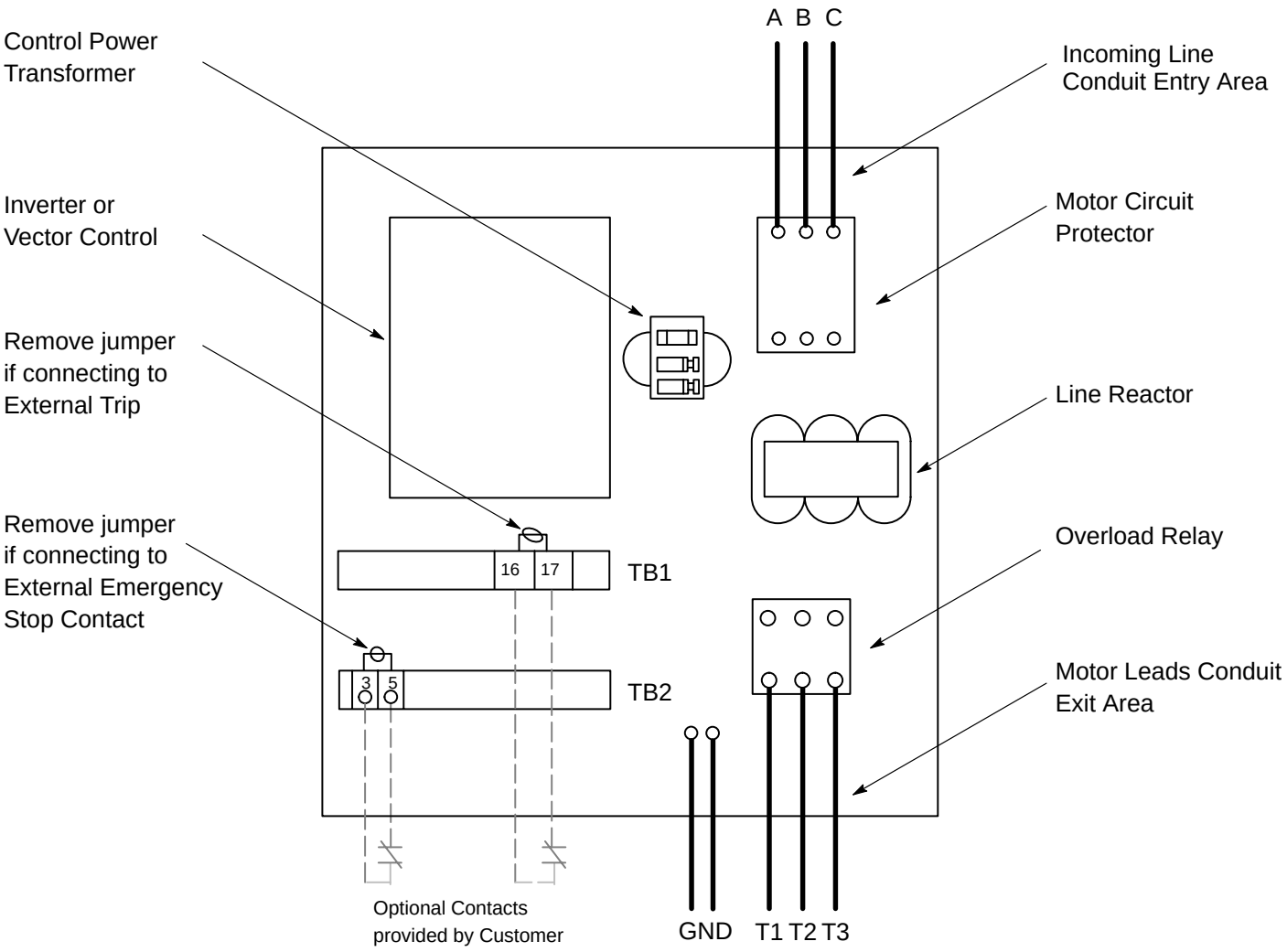


Figure 2-7 ASD 3 Wire Control Wiring – A B (Catalog No. Suffix)

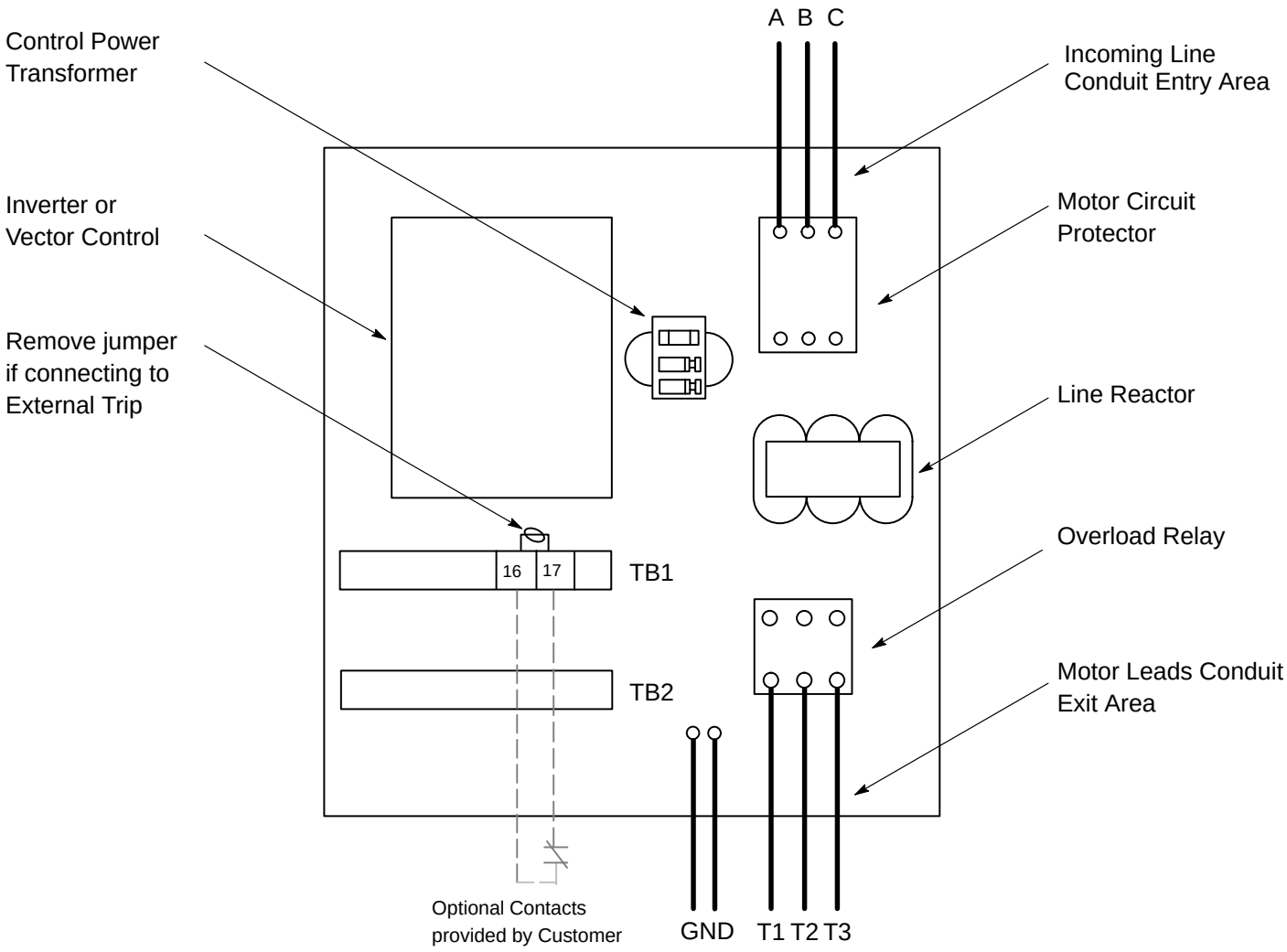


Figure 2-8 ASD/Bypass 3 Wire Control Wiring – B B (Catalog No. Suffix)

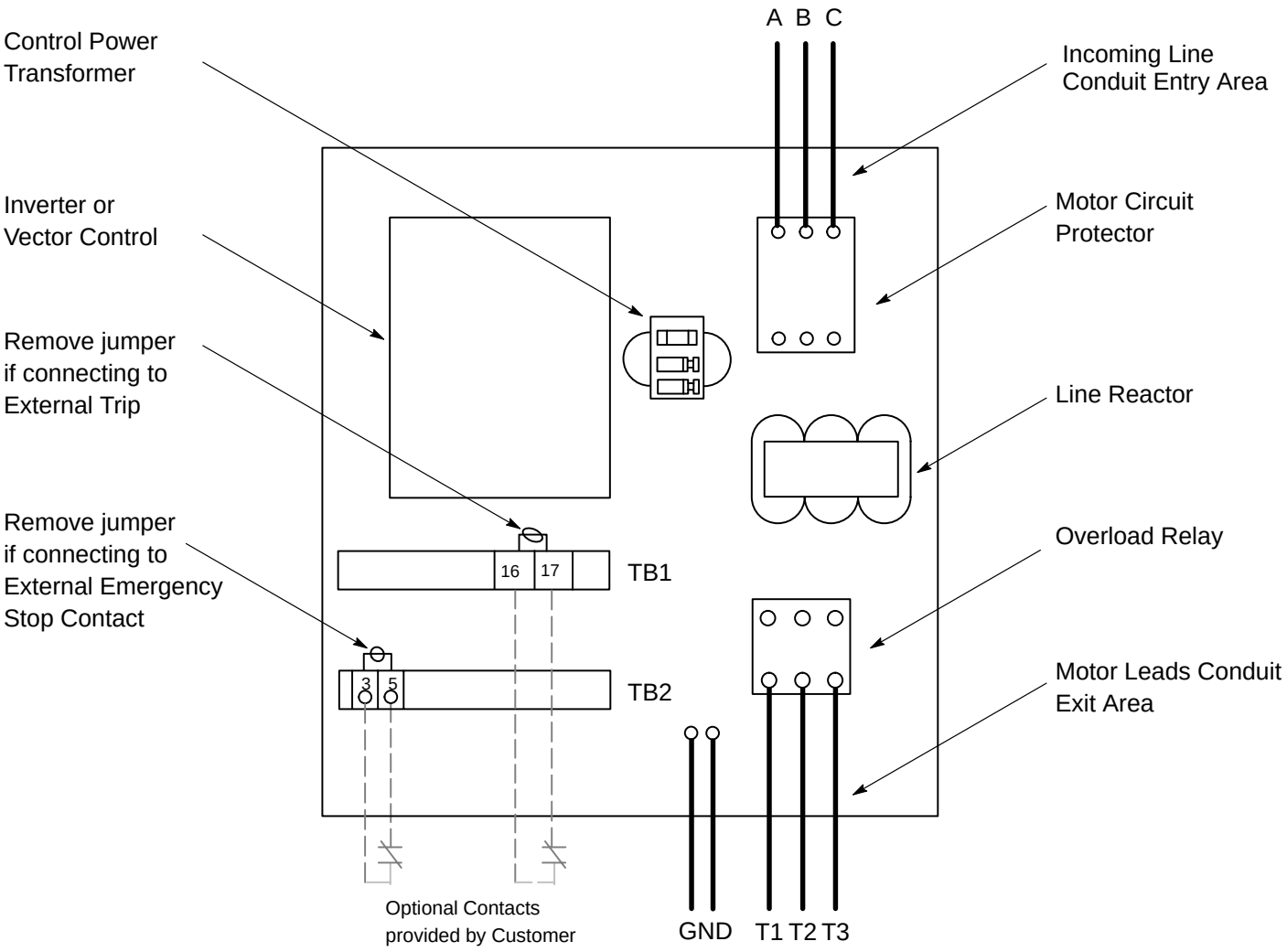


Figure 2-9 ASD 2 Wire Control Wiring – A C (Catalog No. Suffix)

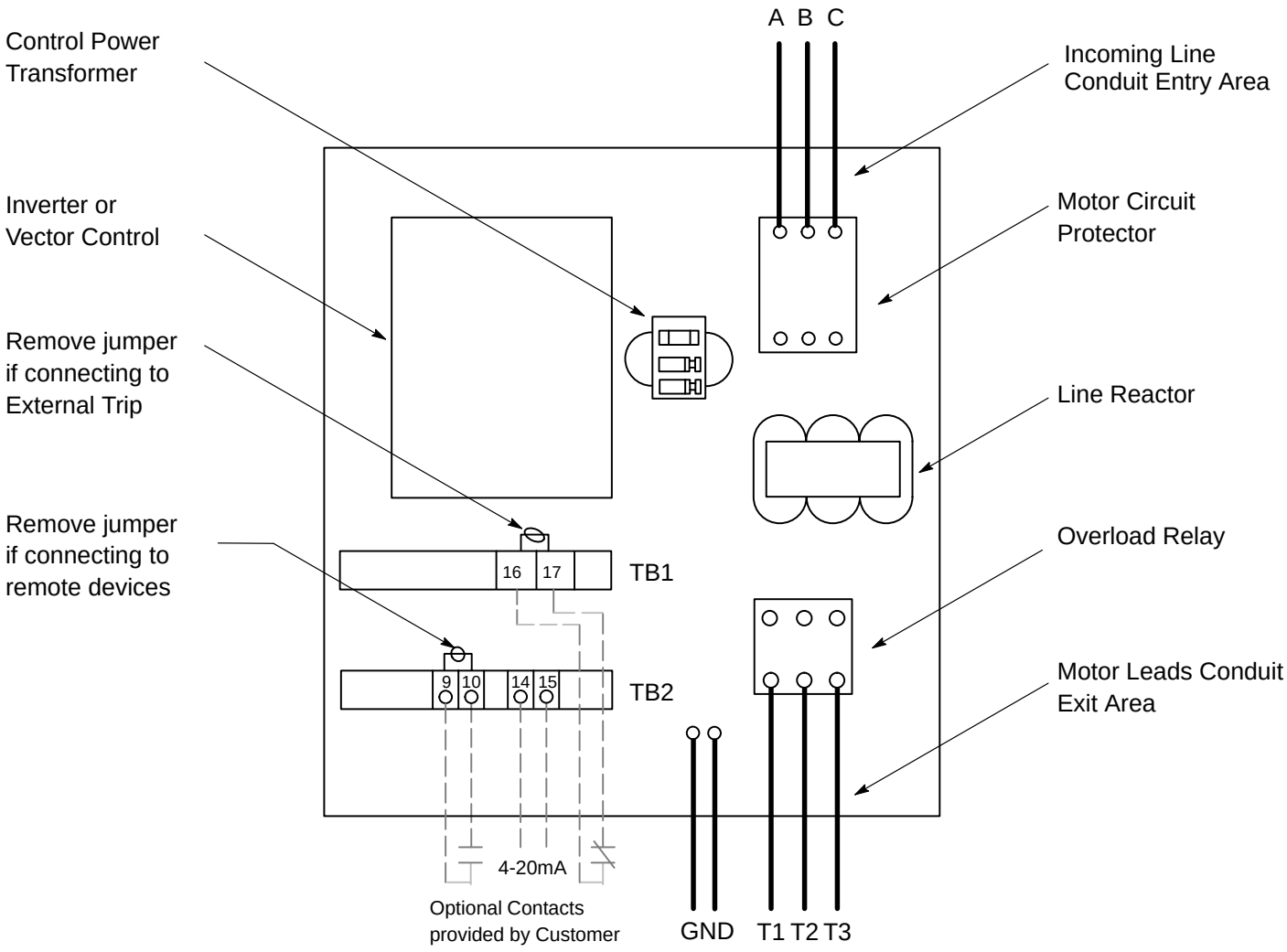
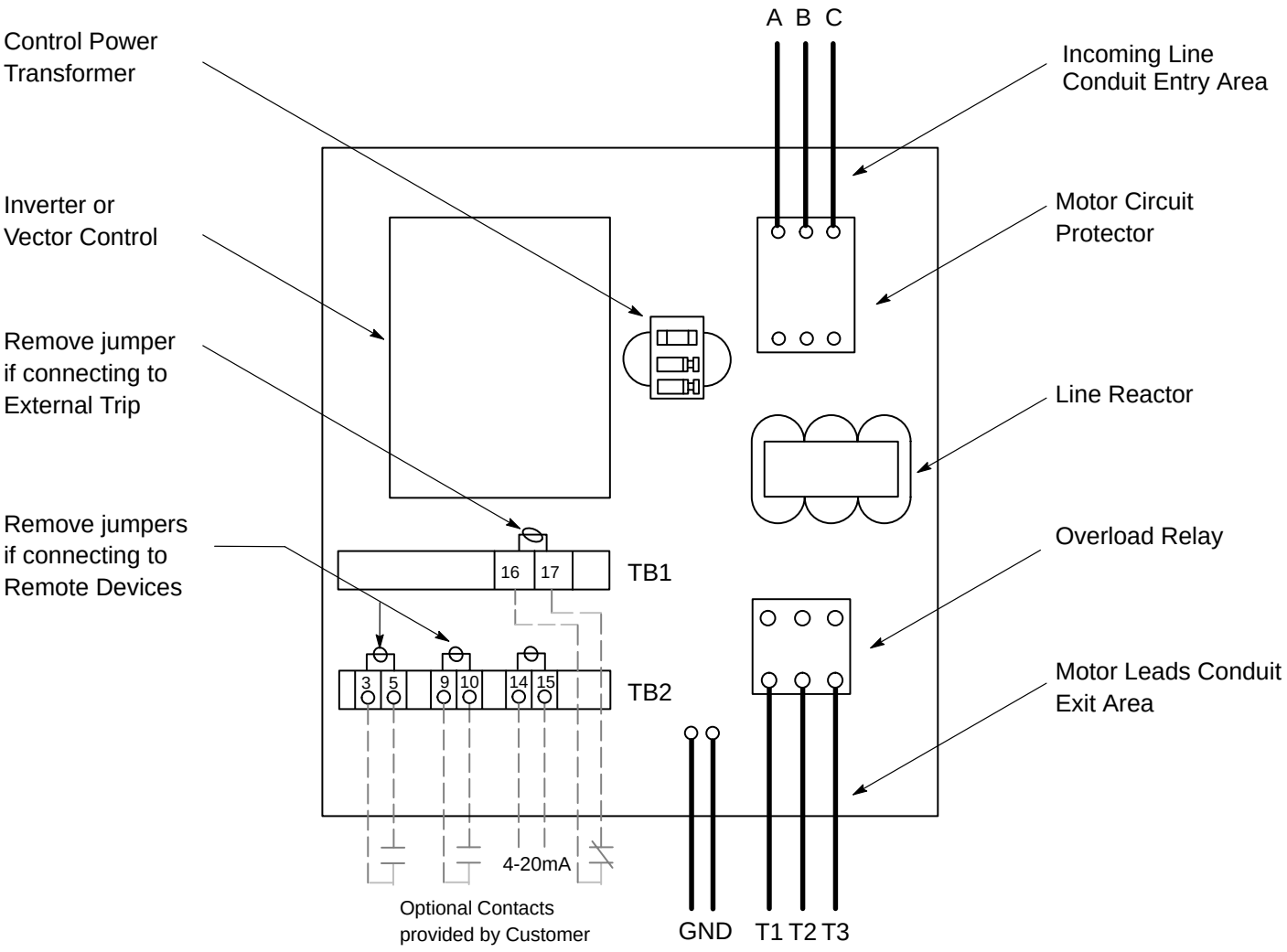


Figure 2-10 ASD/Bypass 3 Wire Control Wiring – B C (Catalog No. Suffix)



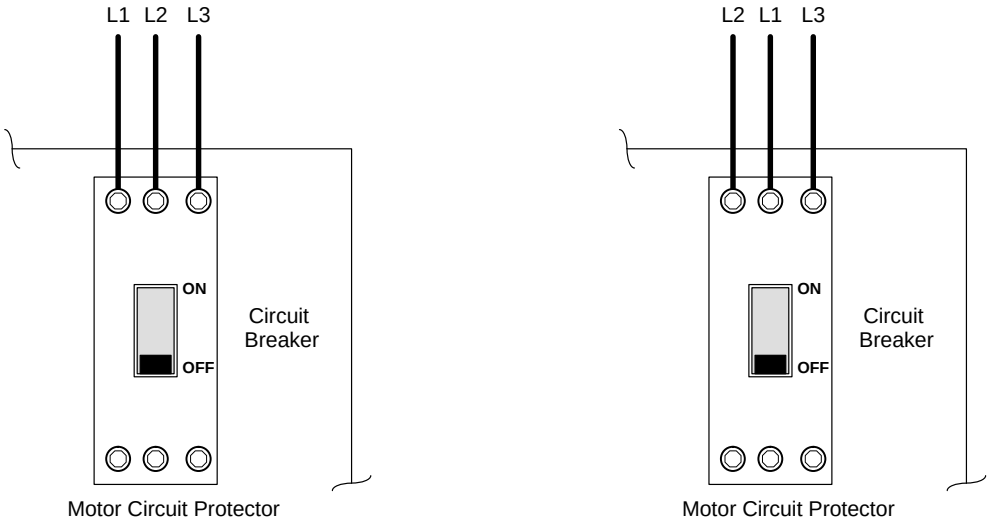
Phase Sequence Verification

⚠ WARNING: Bypass Control Panels are equipped with "across-the-line" combination starters. Verify that the direction of motor rotation in "Adjustable Speed mode" and "Bypass Mode" is the same. If rotation is opposite in these modes, safely disconnect the AC power and reverse the L1 and L2 connections.

The control is not sensitive to the phase sequence of the input power. However, the ASD Bypass mode is phase sequence sensitive. If in the ASD Bypass mode motor rotation direction is opposite of the desired rotation, perform the following procedure: (refer to Figure 2-11)

1. Turn power on and observe direction of motor rotation. If rotation direction is correct, do not perform the following steps. If rotation direction is wrong, proceed to step 2.
2. Disconnect all power to the control panel.
3. Reverse the phase sequence (and motor rotation direction) by changing the L1 and L2 connections to the Motor Circuit Protector.
   a. Remove and label the L1 and L2 wires at the Motor Circuit Protection breaker (see Figure 2-11 normal connection).
   b. Connect the wire labeled L1 to the L2 input of the Motor Circuit Protection breaker (see Figure 2-11 reversed connection).
   c. Connect the wire labeled L2 to the L1 input of the Motor Circuit Protection breaker (see Figure 2-11 reversed connection).
   d. Remove temporary labeling from L1 and L2.
4. Apply power and verify correct motor rotation direction.

Figure 2-11 Reverse Phase Sequence



(Normal Connection) **(Reversed Connection)**

Section 3
Programming and Operation

Pre-Operation Checklist

Check of Electrical Items

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

1. Verify AC line voltage at source matches control rating.
2. Inspect all power connections for accuracy, workmanship and tightness and compliance to codes.
3. Verify control and motor are grounded to each other and the control is connected to earth ground.
4. Check all signal wiring for accuracy.
5. Check the following items to be sure that they are tight and/or there are no loose connections:
   All control wiring connections, door mounted devices such as keypad, lights and switches and that relays and timers are properly seated in their sockets.

Check of Motors and Couplings

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

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

Application of Power

1. Verify that any enable inputs to J1-8 are open.
2. Apply power and observe that the keypad display is on. If the keypad display does not become active, disconnect all power, check all connections and verify input voltage. If fault indication occurs, refer to the troubleshooting section of the control manual.
3. At the keypad, press “PROG”.

⚠ **WARNING: As a safety precaution, the Level 2 MISCELLANEOUS block, RESTART AUTO/MAN parameter value is set to Manual. This does not allow automatic restart after a fault condition. Automatic restarts can cause unexpected operation of the motor shaft during the restart which can injury personnel or damage equipment.**

4. Set the Level 2 MISCELLANEOUS block, RESTART AUTO/MAN parameter to Automatic. This is required for true 2 wire or 3 wire control panel operation. If this is not required, it is recommended to leave the Level 2 MISCELLANEOUS block, RESTART AUTO/MAN parameter in the Manual setting. If a fault occurs, you must manually reset the control to resume operation.
5. Set the Level 2 MISCELLANEOUS block, RESTART FAULT/HR parameter as desired.
6. Set the Level 2 MISCELLANEOUS block, RESTART DELAY parameter as desired.
7. Press “RESET” to return to keypad operation.
8. Run the drive from the keypad using either the JOG mode. Use keypad entered speed commands or speed commands using the arrow keys.
9. While the motor is running in the JOG mode, notice the direction of shaft rotation. If the motor shaft is rotating in the opposite direction, refer to the troubleshooting section of the control manual.

The system is now ready for normal operation.

As-Built Control Adjustments

The following tables define the “As-Built” control parameter adjustments. You will need these values if the control is replaced for any reason or if the Level 2 Miscellaneous block, Factory Settings are restored (this will erase all values and restore general purpose control parameter values). Two tables are provided, one for an inverter control and one for a vector control.

Parameter Values

Table 3-1 Inverter Parameter Values

Level 1 Blocks		
Block Title	**Parameter**	**As-Built Setting**
PRESET SPEEDS	PRESET SPEED #1	
	PRESET SPEED #2	
	PRESET SPEED #3	
	PRESET SPEED #4	
	PRESET SPEED #5	
	PRESET SPEED #6	
	PRESET SPEED #7	
	PRESET SPEED #8	
	PRESET SPEED #9	
	PRESET SPEED #10	
	PRESET SPEED #11	
	PRESET SPEED #12	
	PRESET SPEED #13	
	PRESET SPEED #14	
	PRESET SPEED #15	
ACCEL/DECEL RATE	ACCEL TIME #1	
	DECEL TIME #1	
	S-CURVE #1	
	ACCEL TIME #2	
	DECEL TIME #2	
	S-CURVE #2	
JOG SETTINGS	JOG SPEED	
	JOG ACCEL TIME	
	JOG DECEL TIME	
	JOG S-CURVE	
KEYPAD SETUP	KEYPAD STOP KEY	
	KEYPAD STOP MODE	
	KEYPAD RUN FWD	
	KEYPAD RUN REV	
	KEYPAD JOG FWD	
	KEYPAD JOG REV	
	3 SPEED RAMP	
	SWITCH ON FLY	
	LOC. HOT START	

Level 1 Blocks - Continued		
Block Title	**Parameter**	**As-Built Setting**
INPUT	OPERATING MODE	
	COMMAND SELECT	
	ANA CMD INVERSE	
	ANA CMD OFFSET	
	ANA CMD GAIN	
	CMD SEL FILTER	
	PWR UP MODE OP	
OUTPUT	DIGITAL OUT #1	
	DIGITAL OUT #2	
	DIGITAL OUT #3	
	DIGITAL OUT #4	
	ZERO SPD SET PT	
	AT SPEED BAND	
	SET SPEED POINT	
	ANALOG OUT #1	
	ANALOG OUT #2	
	ANALOG #1 SCALE	
	ANALOG #2 SCALE	
V/HZ AND BOOST	CTRL BASE FREQUENCY	
	TORQUE BOOST	
	DYNAMIC BOOST	
	SLIP COMP ADJ	
	V/HZ PROFILE	
	V/HZ 3–PT VOLTS	
	V/HZ 3–PT FREQUENCY	
	MAX OUTPUT VOLTS	

Factory Set by: _____ **Date:** _____
Spec. No.: _____ **Serial No.:** _____

Table 3-1 Inverter Parameter Values Continued

Level 2 Blocks		
Block Title	**Parameter**	**As-Built Setting**
OUTPUT LIMITS	OPERATING ZONE	
	MIN OUTPUT FREQ	
	MAX OUTPUT FREQ	
	PK CURRENT LIMIT	
	PWM FREQUENCY	
	REGEN LIMIT	
	REGEN LIMIT ADJ	
CUSTOM UNITS	MAX DECIMAL PLACES	
	VALUE AT SPEED	
	VALUE DEC PLACES	
	VALUE SPEED REF	
	UNITS OF MEASURE	
	UNITS OF MEASURE 2	
PROTECTION	EXTERNAL TRIP	
	LOCAL ENABLE INP	
MISCELLA-NEOUS	RESTART AUTO/MAN	
	RESTART FAULT/HR	
	RESTART DELAY	
	LANGUAGE SELECT	
	FACTORY SETTINGS	
	STABIL ADJ LIMIT	
	STABILITY GAIN	
SECURITY CONTROL	SECURITY STATE	
	ACCESS TIMEOUT	
	ACCESS CODE	
MOTOR DATA	MOTOR VOLTAGE	
	MOTOR RATED AMPS	
	MOTOR RATED SPD	
	MOTOR RATED FREQ	
	MOTOR MAG AMPS	

Level 2 Blocks Continued		
Block Title	**Parameter**	**As-Built Setting**
BRAKE ADJUST	RESISTOR OHMS	
	RESISTOR WATTS	
	DC BRAKE VOLTAGE	
	DC BRAKE FREQ	
	BRAKE ON STOP	
	BRAKE ON REVERSE	
	STOP BRAKE TIME	
	BRAKE ON START	
	START BRAKE TIME	
PROCESS CONTROL	PROCESS FEEDBACK	
	PROCESS INVERSE	
	SETPOINT SOURCE	
	SETPOINT COMMAND	
	SET PT ADJ LIMIT	
	AT SETPOINT BAND	
	PROCESS PROP GAIN	
	PROCESS INT GAIN	
	PROCSS DIFF GAIN	
	FOLLOW I:O RATIO	
	FOLLOW I:O OUT	
	ENCODER LINES	
	INTEGRATOR CLAMP	
	MINIMUM SPEED	
SKIP FREQUENCY	SKIP FREQ #1	
	SKIP BAND #1	
	SKIP FREQ #2	
	SKIP BAND #2	
	SKIP FREQ #3	
	SKIP BAND #3	
SYNCHRO–START	SYNCHRO-STARTS	
	SYNC START FREQUENCY	
	SYNC SCAN V/F	
	SYNC SETUP TIME	
	SYNC SCAN TIME	
	SYNC V/F RECOVER	
	SYNC DIRECTION	
COMMUNICA-TIONS	PROTOCOL	
	BAUD RATE	
	DRIVE ADDRESS	

Factory Set by: _____ **Date:** _____

Spec. No.: _____ **Serial No.:** _____

Table 3-2 Vector Parameter Values

Level 1 Blocks		
Block Title	**Parameter**	**As-Built Setting**
PRESET SPEEDS	PRESET SPEED #1	
	PRESET SPEED #2	
	PRESET SPEED #3	
	PRESET SPEED #4	
	PRESET SPEED #5	
	PRESET SPEED #6	
	PRESET SPEED #7	
	PRESET SPEED #8	
	PRESET SPEED #9	
	PRESET SPEED #10	
	PRESET SPEED #11	
	PRESET SPEED #12	
	PRESET SPEED #13	
	PRESET SPEED #14	
	PRESET SPEED #15	
ACCEL/DECEL RATE	ACCEL TIME #1	
	DECEL TIME #1	
	S-CURVE #1	
	ACCEL TIME #2	
	DECEL TIME #2	
	S-CURVE #2	
JOG SET-TINGS	JOG SPEED	
	JOG ACCEL TIME	
	JOG DECEL TIME	
	JOG S-CURVE TIME	
KEYPAD SETUP	KEYPAD STOP KEY	
	KEYPAD STOP MODE	
	KEYPAD RUN FWD [1]	
	KEYPAD RUN REV [1]	
	KEYPAD JOG FWD	
	KEYPAD JOG REV	
	LOC. HOT START	

Level 1 Blocks Continued		
Block Title	**Parameter**	**As-Built Setting**
INPUT	OPERATING MODE	
	COMMAND SELECT	
	ANA CMD INVERSE	
	ANA CMD OFFSET	
	ANA 2 DEADBAND	
	ANA 1 CUR LIMIT	
OUTPUT	OPTO OUTPUT #1	
	OPTO OUTPUT #2	
	OPTO OUTPUT #3	
	OPTO OUTPUT #4	
	ZERO SPD SET PT	
	AT SPEED BAND	
	SET SPEED	
	ANALOG OUT #1	
	ANALOG OUT #2	
	ANALOG #1 SCALE	
	ANALOG #2 SCALE	
	POSITION BAND	
VECTOR CONTROL	CTRL BASE SPEED	
	FEEDBACK FILTER	
	FEEDBACK ALIGN	
	CURRENT PROP GAIN	
	CURRENT INT GAIN	
	SPEED PROP GAIN	
	SPEED INT GAIN	
	SPEED DIFF GAIN	
	POSITION GAIN	
	SLIP FREQUENCY	
	STATOR R1	
	STATOR X1	

[1] Note: Factory setting is “Off” for By–Pass 2 wire panels.

Factory Set by: _____ **Date:** _____

Spec. No.: _____ **Serial No.:** _____

Table 3-3 Vector Parameter Values Continued

Level 2 Blocks		
Block Title	**Parameter**	**As-Built Setting**
OUTPUT LIMITS	OPERATING ZONE	
	MIN OUTPUT SPEED	
	MAX OUTPUT SPEED	
	PK CURRENT LIMIT	
	PWM FREQUENCY	
	CUR RATE LIMIT	
CUSTOM UNITS	MAX DECIMAL PLACES	
	VALUE AT SPEED	
	VALUE DEC PLACES	
	VALUE SPEED REF	
	UNITS OF MEASURE	
	UNITS OF MEASURE 2	
PROTECTION	OVERLOAD	
	EXTERNAL TRIP	
	LOCAL ENABLE INP	
	FOLLOWING ERROR	
	TORQUE PROVING	
MISCELLANEOUS	RESTART AUTO/MAN	
	RESTART FAULT/HR	
	RESTART DELAY	
	FACTORY SETTINGS	
	HOMING SPEED	
	HOMING OFFSET	
SECURITY CONTROL	SECURITY STATE	
	ACCESS TIMEOUT	
	ACCESS CODE	
MOTOR DATA	MOTOR VOLTAGE	
	MOTOR RATED AMPS	
	MOTOR RATED SPD	
	MOTOR RATED FREQ	
	MOTOR MAG AMPS	
	ENCODER COUNTS	
	RESOLVER SPEEDS	
	CALC PRESETS	

Level 2 Blocks Continued		
Block Title	**Parameter**	**As-Built Setting**
BRAKE ADJUST	RESISTOR OHMS	
	RESISTOR WATTS	
	DC BRAKE CURRENT	
PROCESS CONTROL	PROCESS FEEDBACK	
	PROCESS INVERSE	
	SETPOINT SOURCE	
	SETPOINT COMMAND	
	SET PT ADJ LIMIT	
	PROCESS ERR TOL	
	PROCESS PROP GAIN	
	PROCESS INT GAIN	
	PROCESS DIFF GAIN	
	FOLLOW I:O RATIO	
	FOLLOW I:O OUT	
	MASTER ENCODER	
COMMUNICATIONS	PROTOCOL	
	BAUD RATE	
	DRIVE ADDRESS	
AUTO-TUNING	CALC PRESETS	
	CMD OFFSET TRM	
	CUR LOOP COMP	
	STATOR R1	
	FLUX CUR SETTING	
	FEEDBACK TESTS	
	SLIP FREQ TEST	
	SPD CNTRLR CALC	

Factory Set by: _____ **Date:** _____

Spec. No.: _____ **Serial No.:** _____

Circuit Breaker Adjustment (Inrush current estimation)

Mechanical adjustment of the trip setting may be necessary if the circuit breaker is replaced. The first step of this adjustment procedure is to determine the motor inrush current (in amperes). Inrush current is also called “Locked Rotor AMPS” or “LRA”.

In control panels with a bypass starter, when the AC motor is started with full voltage (across-the-line starting), the motor will draw line amperage that can be 300% to 800% greater than their full load running current. This inrush current is determined by motor horsepower and motor design characteristics. To define inrush characteristics, code letters are used. This code letter defines both the low voltage and high voltage inrush values for dual voltage motors. Table 4-1 shows these code letters.
(KVA = Kilovolt-Amperes; HP = Horsepower).

KVA/HP Calculation of motor

Table 4-1 Code Letter Definition

Code Letter	KVA/HP Range	KVA/HP Mid-Range Value
A	0.00 - 3.14	1.6
B	3.15 - 3.54	3.3
C	3.55 - 3.99	3.8
D	4.00 - 4.49	4.3
E	4.50 - 4.99	4.7
F	5.00 - 5.59	5.3
G	5.60 - 6.29	5.9
H	6.30 - 7.09	6.7
J	7.10 - 7.99	7.5
K	8.00 - 8.99	8.5
L	9.00 - 9.99	9.5
M	10.00 - 11.19	10.6
N	11.20 - 12.49	11.8
P	12.50 - 13.99	13.2
R	14.00 - 15.99	15.0

3 Phase Inrush Current Calculation (Use mid range value for KVA/HP)

$$\text{Inrush AMPS} = \frac{\left(\frac{\text{KVA}}{\text{HP}_{\text{mid range value}}}\right) \times \text{HP} \times 577}{\text{Rated Volts}}$$

Example: 3 phase Motor rated at 50 HP at 460VAC, 65 amps (continuous), code letter J.

$$I_{Inrush} = \left(\frac{7.5 \times 50 \times 577}{460}\right) = 470 \text{ Amperes}$$

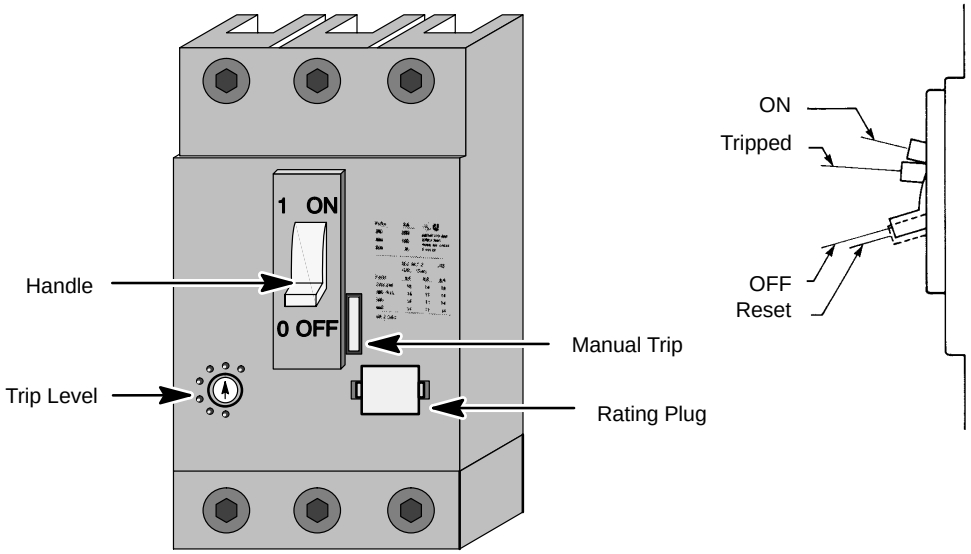
Circuit Breaker Adjustment

The calculated Inrush Amps value is used to initially set the breaker. If the circuit breaker trips during use, the trip level is increased. Refer to Figure 4-1.

⚠ **Caution: The trip level of the circuit breaker must remain as low as possible to avoid damage to equipment. If set too high, the circuit breaker may not trip during a high overcurrent condition.**

1. Refer to the manufacturers literature or the rating label on the circuit breaker. Determine the correct setting of the Trip Level adjustment based on the calculated Inrush Amps. Set the Trip Level adjustment to this initial level.
2. Turn on power and start the motor.
3. If the breaker trips, Turn power off and set the Trip Level to the next greater setting.
4. Turn on power and start the motor.
5. If the breaker trips, repeat steps 3 and 4. If the Trip Level adjustment is at the maximum setting and you have verified there is no phase to phase or phase to ground shorts, perform step 6. Otherwise, refer to Section 5 Troubleshooting.
6. If the breaker continues to trip due to inrush current (and not a short circuit) the Rating Plug may be replaced with one that has a greater current rating. Refer to the circuit breaker manufacturers information and ratings.

Figure 4-1 Magnetic Circuit Breaker



Section 5
Troubleshooting

The control panel is intended to provide years of trouble free service with appropriate cooling and protection from the elements. Should trouble occur, refer to the appropriate control manual for control and motor troubleshooting information.

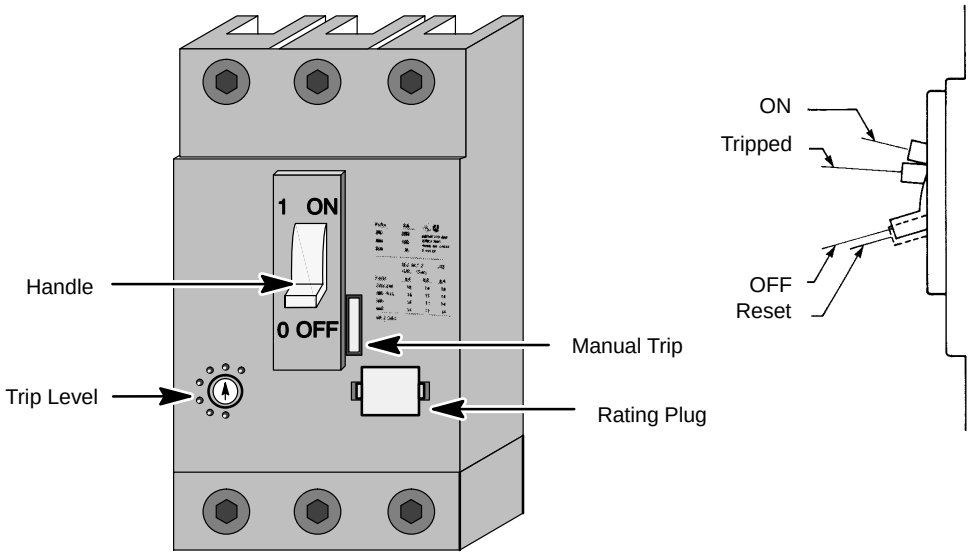
Reset the Circuit Breaker

If the circuit breaker is tripped, it must be reset to restore power. The breaker is tripped if the handle is in the “Tripped” position as indicated in Figure 5-1.

Before the breaker is reset, locate the source of electrical trouble.

1. Check for phase-to-phase and phase-to-ground shorts.
2. Check for loose connections at power connectors (L1, L2, L3 and Earth as well as T1, T2, T3 and Motor Ground).
3. If all checks in steps 1 and 2 are OK, move the breaker handle all the way down to the “Reset” position then move the handle to the “ON” position to restore power. (In the “Reset” position, a click sound will be heard.)
4. Verify that the inrush current in the “Bypass” mode does not trip the breaker. If the breaker continues to trip and the Trip Level has been adjusted as described in Section 4, the breaker is defective and must be replaced. When the new breaker is installed, be sure to refer to Section 4 and perform the Circuit Breaker Adjustment procedure.

Figure 5-1 Magnetic Circuit Breaker

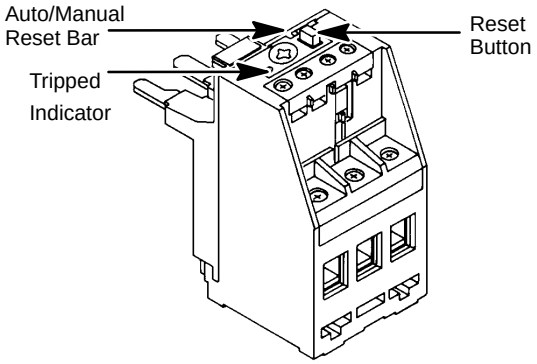


Reset an Overload Relay

If the Overload relay is tripped, the tripped indicator (Figure 5-2) will be in the “Tripped” position.

1. Verify that the overload condition has been cleared to allow restart.
2. Verify motor lead connections are tight.
3. Allow time for the overload bi-metallic elements to cool.
4. Press the “Reset Button” (Figure 5-2). If the “Auto/Manual Reset Bar” is in the AUTO position, the relay will automatically attempt to restart after an overload.

Figure 5-2 Overload Relay

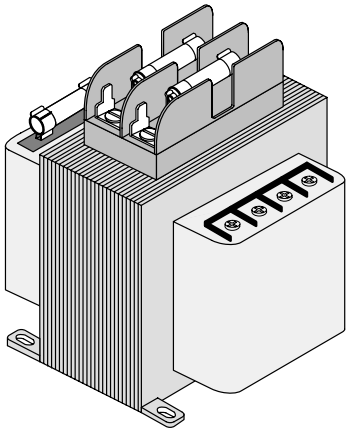


Fuse Replacement

If the control circuit voltage drops to zero volts, the control power transformer fuses (Figure 5-3) should be inspected. If a fuse is opened, perform the following steps:

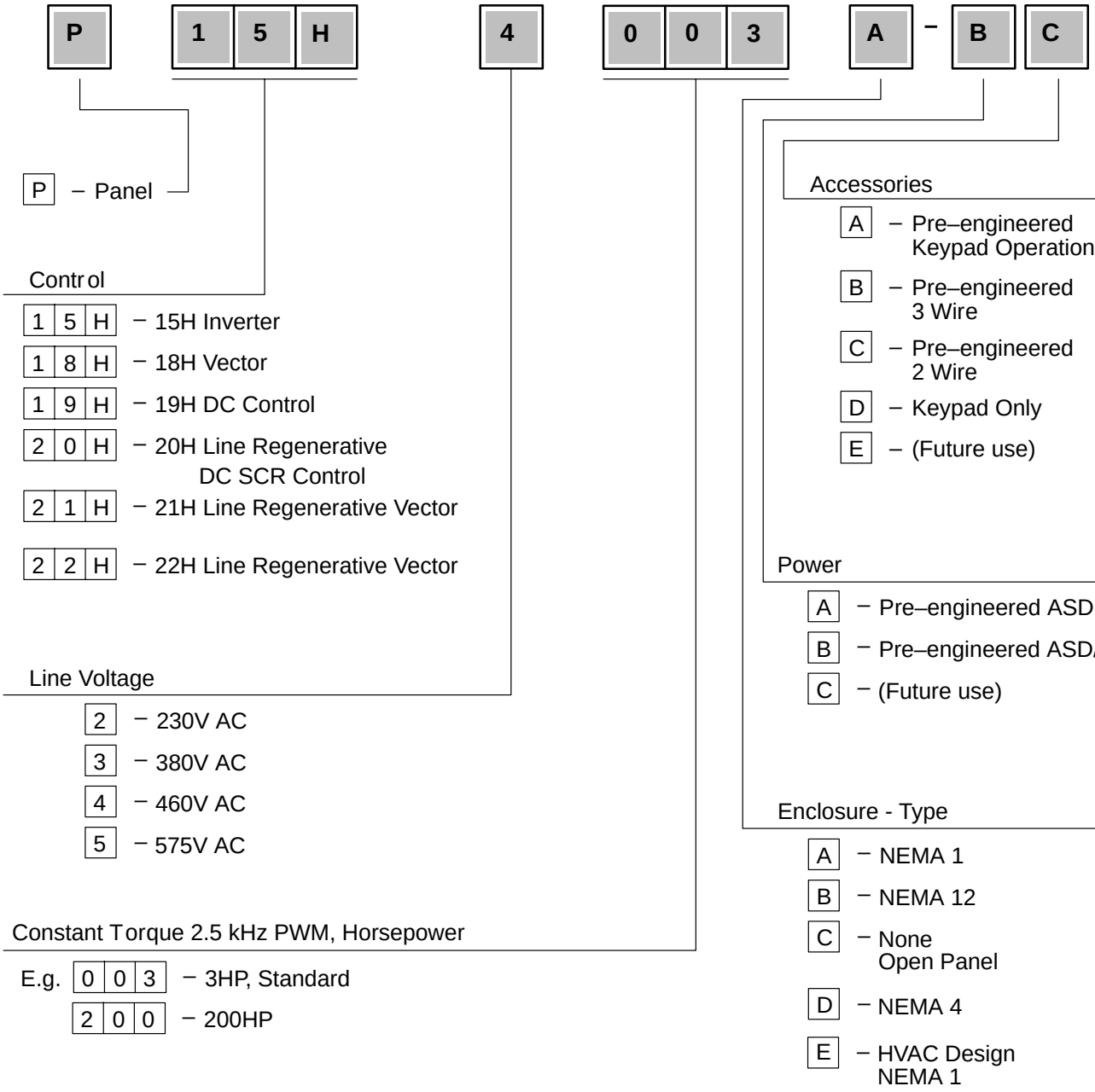
1. Check for line-to-ground short circuit condition and repair if necessary.
2. Check control wiring and control devices (timers, relays, terminal blocks, wire terminations, etc.) for signs of damage, overheating, or loose connections and repair if necessary.
3. Replace the fuse with the same fuse class, type and rating (interrupting capacity).

Figure 5-3 Control Transformer with Fuses



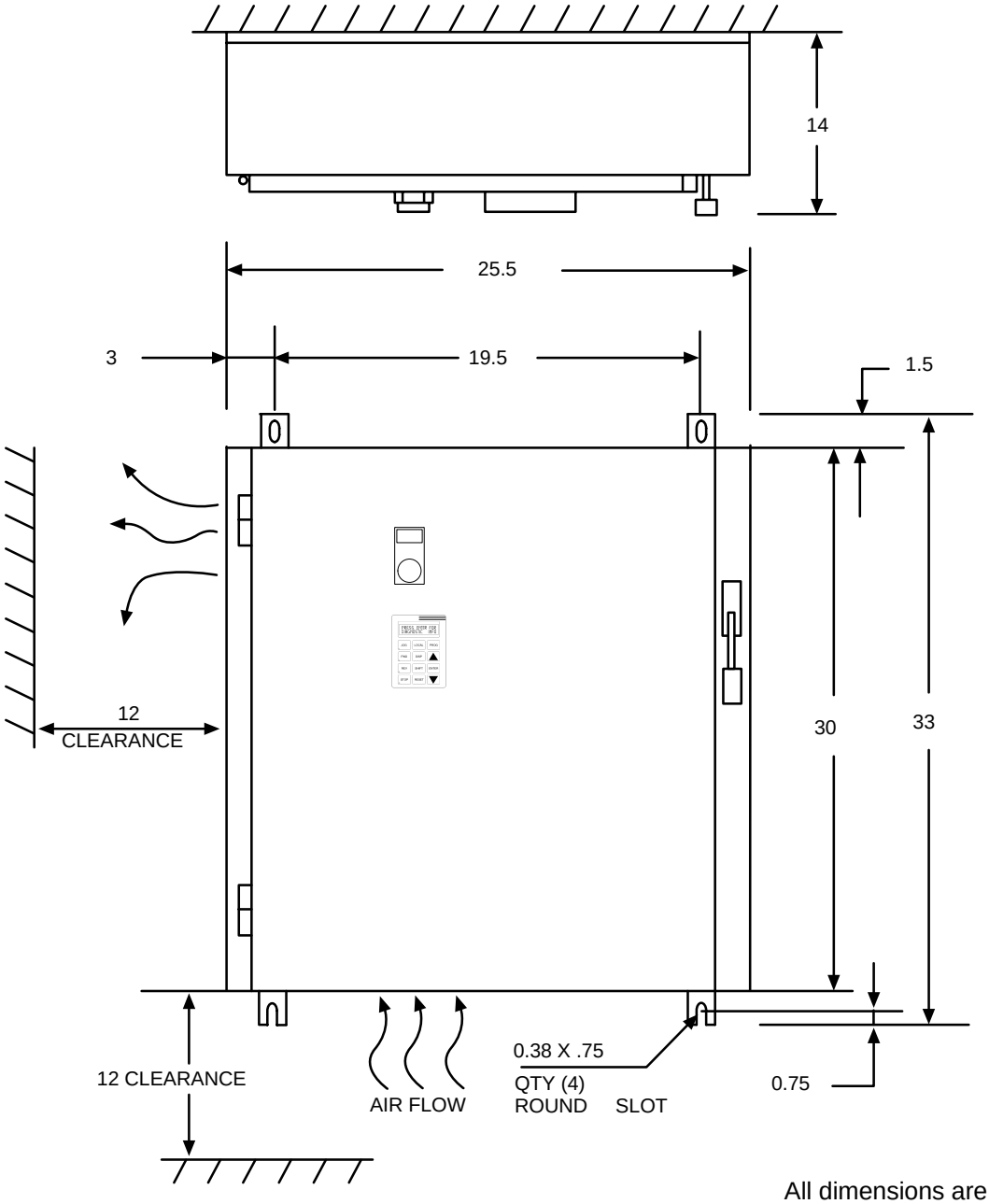
Note: Refer to component technical data sheets for operation, adjustment, service and specifications information for power circuit and control devices.

Catalog Number Identification



Mounting Dimensions

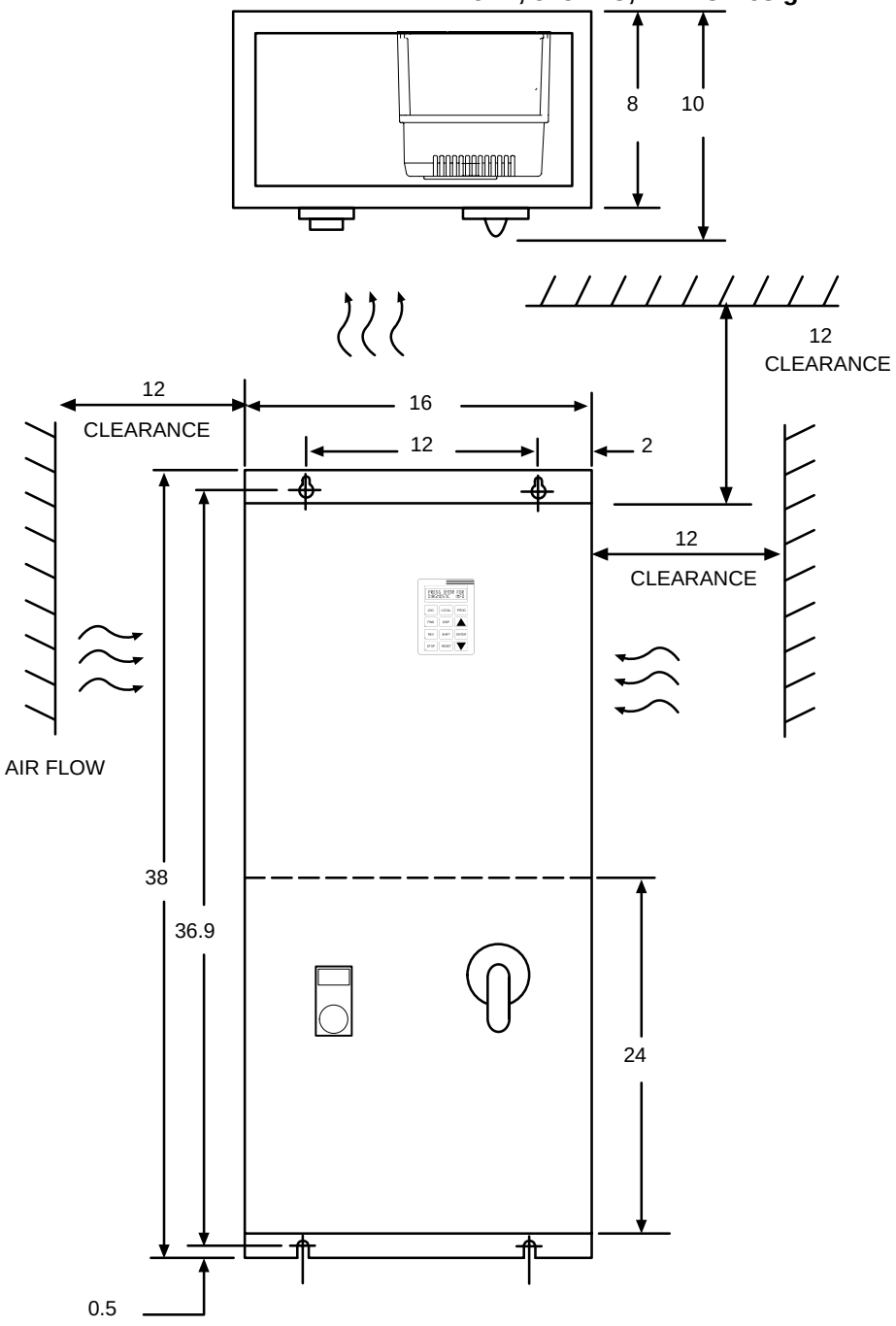
Size A & B Controls **NEMA 1 1-10HP, 230VAC**
1-10HP, 460VAC
1-15HP, 575VAC



All dimensions are in inches.

Mounting Dimensions Continued

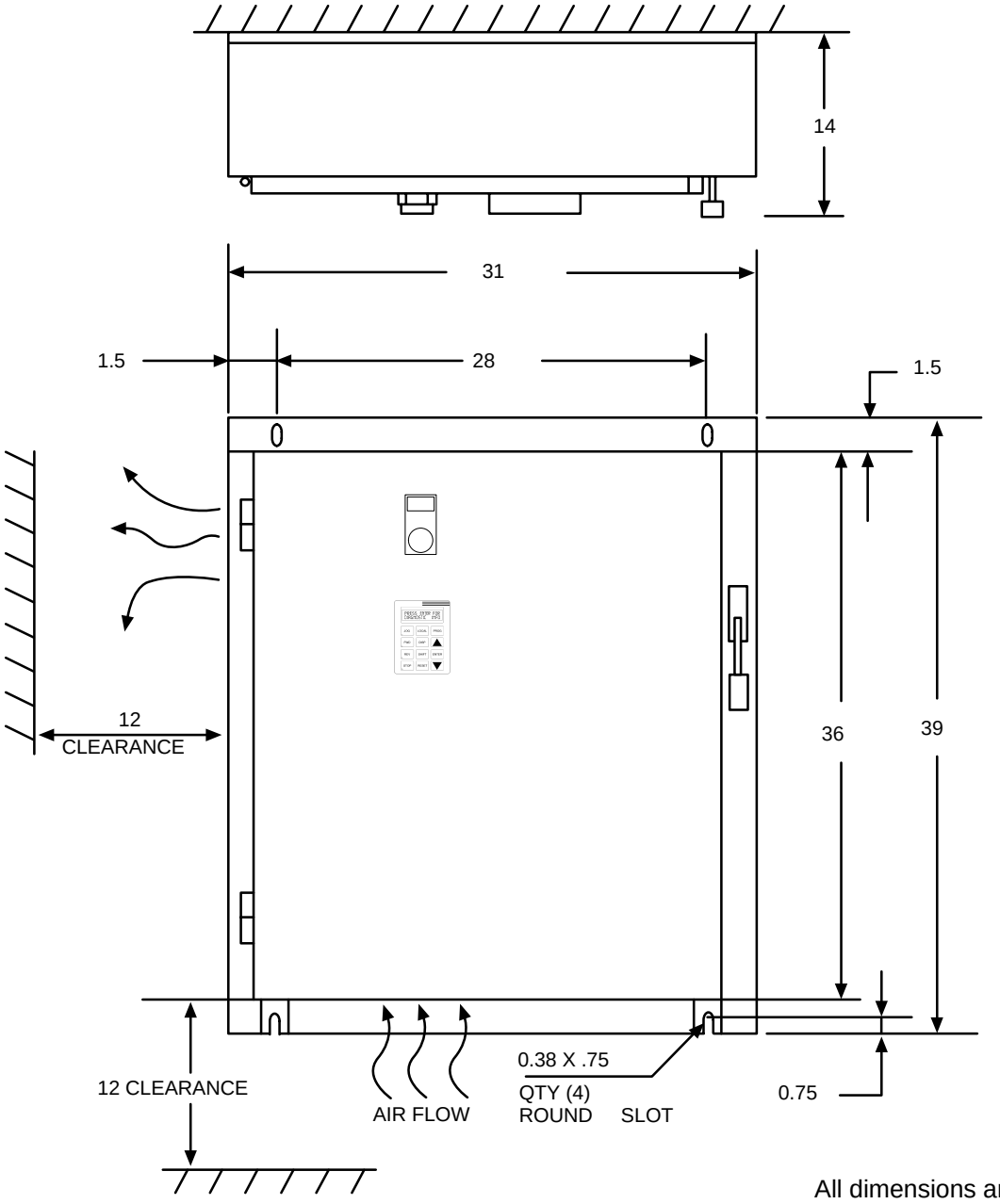
Size A & B Controls **NEMA 1** **1-10HP, 230VAC, HVAC Design**
1-10HP, 460VAC, HVAC Design
1-15HP, 575VAC, HVAC Design



All dimensions are in inches.

Mounting Dimensions

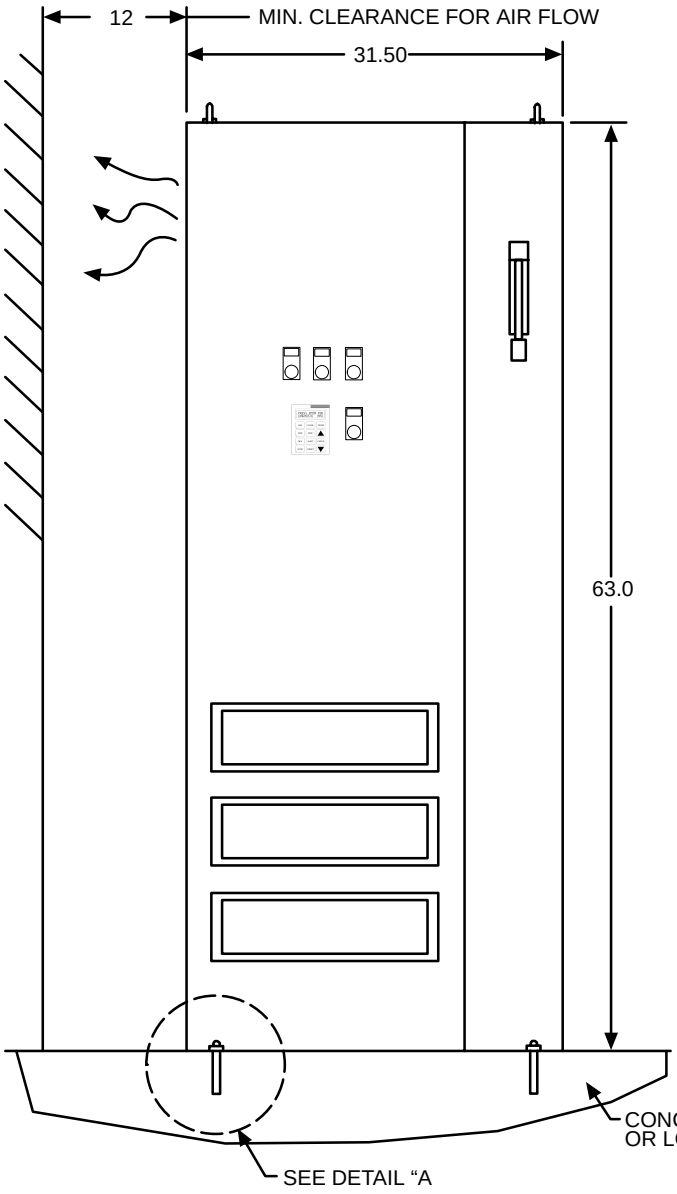
Size A, B & C Controls **NEMA 1 1-30HP, 230VAC**
1-30HP, 460VAC
1-30HP, 575VAC

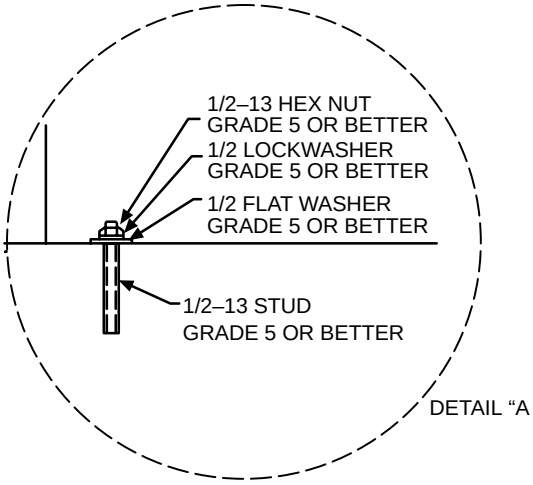


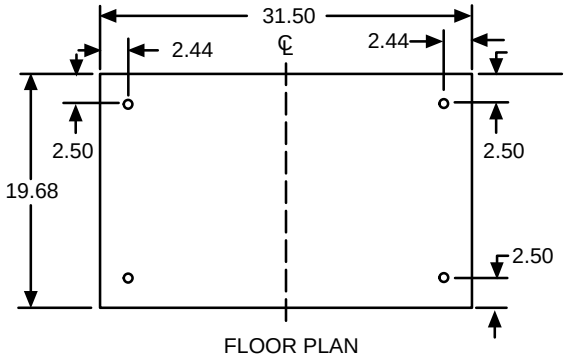
All dimensions are in inches.

Mounting Dimensions

Size D Controls **NEMA 1** **40-50HP, 230VAC**
40-60HP, 460VAC
40-60HP, 575VAC



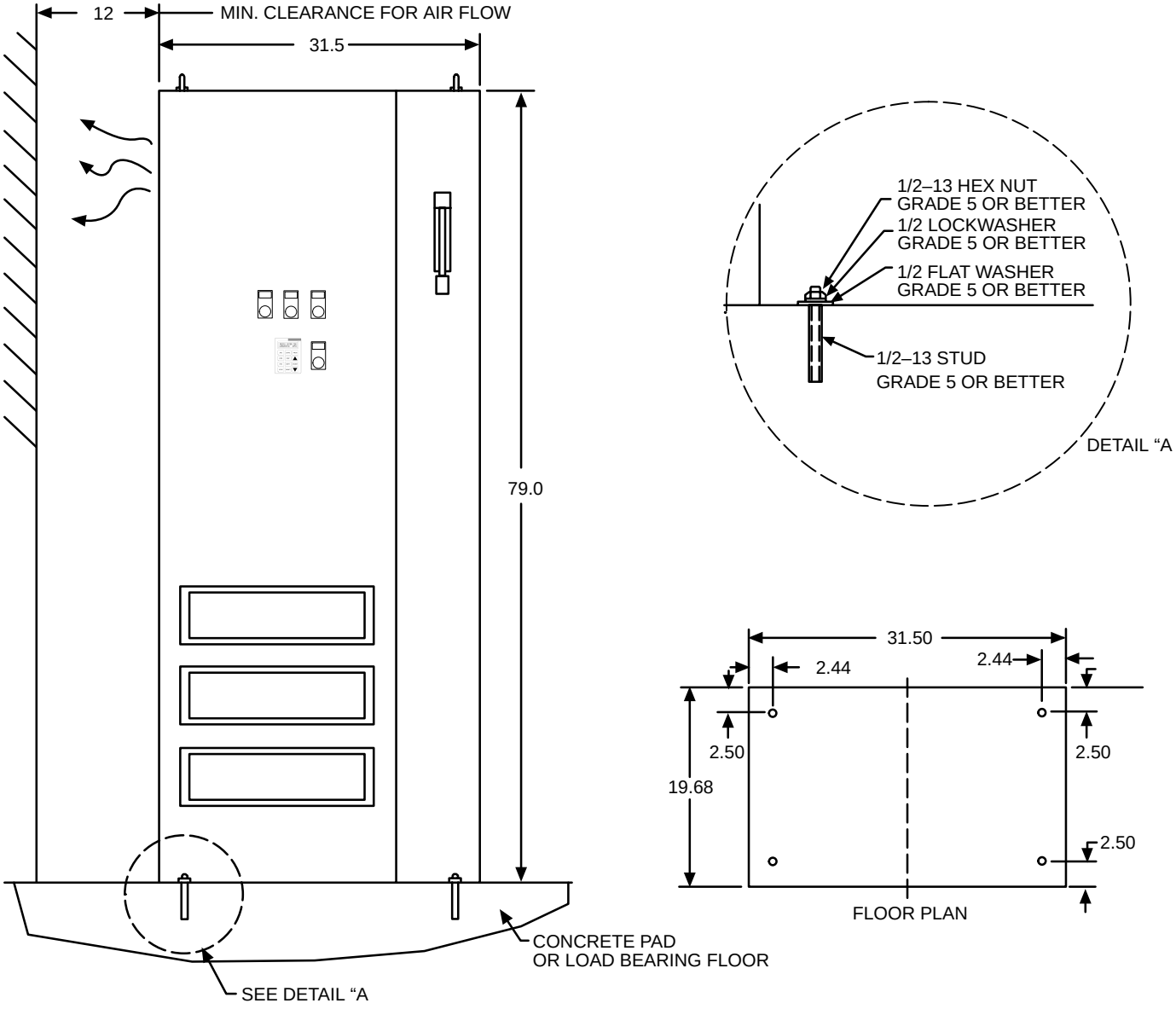




All dimensions are in inches.

Mounting Dimensions Continued

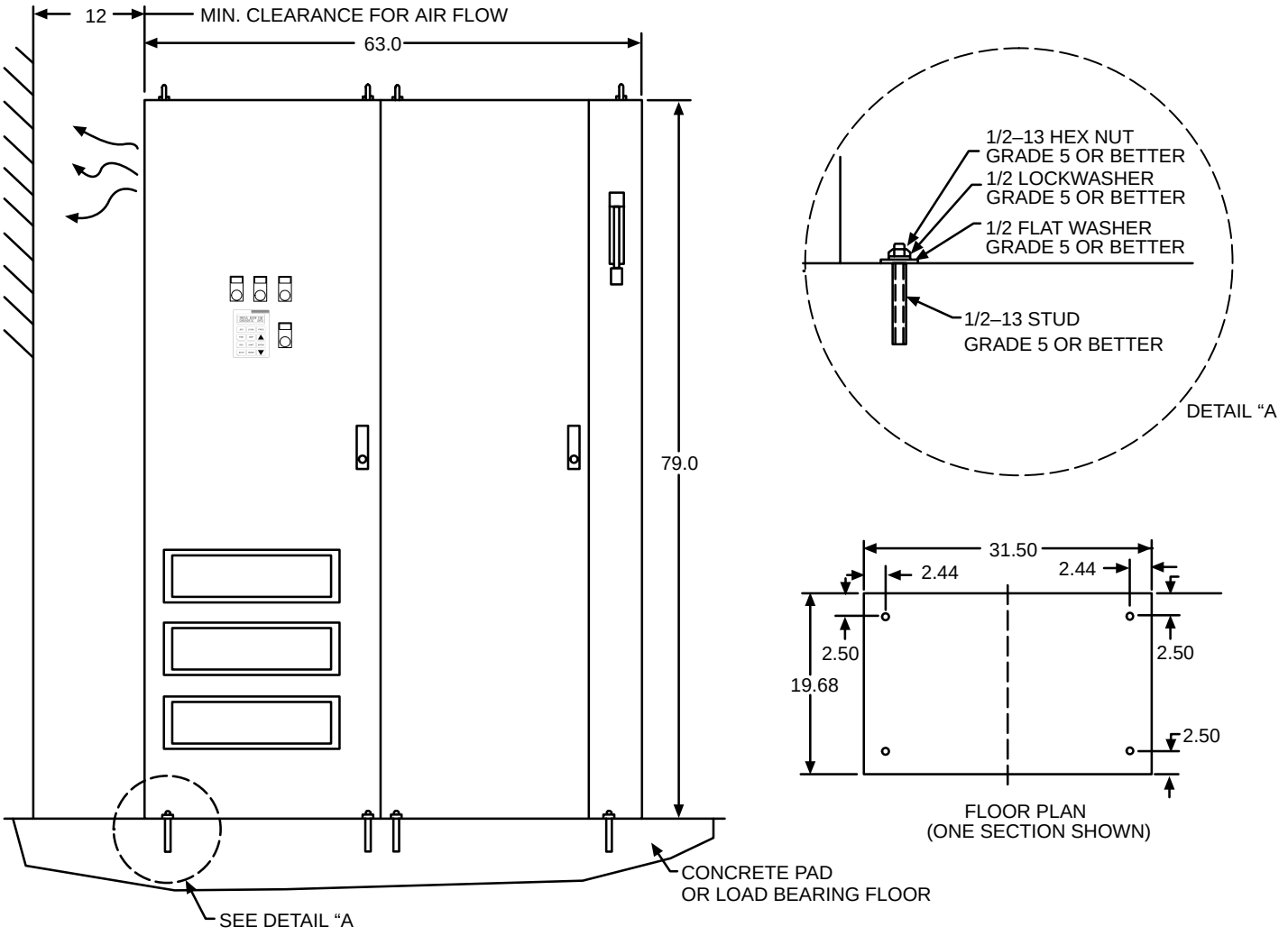
Size E Controls **NEMA 1** **75-150HP, 460VAC**
75-150HP, 575VAC



All dimensions are in inches.

Mounting Dimensions Continued

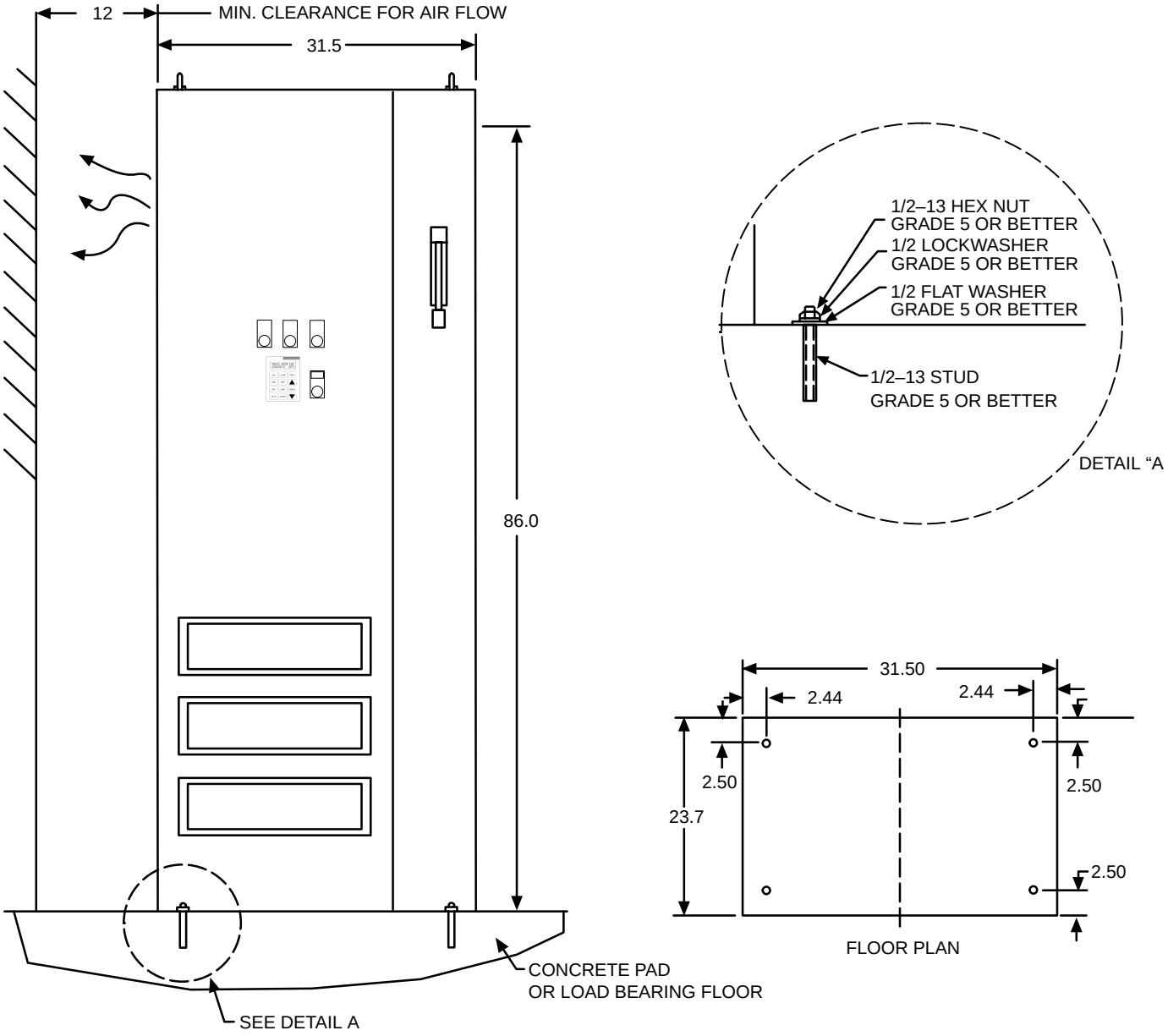
Size E Controls **NEMA 1** **75-150HP, 460VAC, with Soft Start Bypass**
75-150HP, 575VAC, with Soft Start Bypass



All dimensions are in inches.

Mounting Dimensions Continued

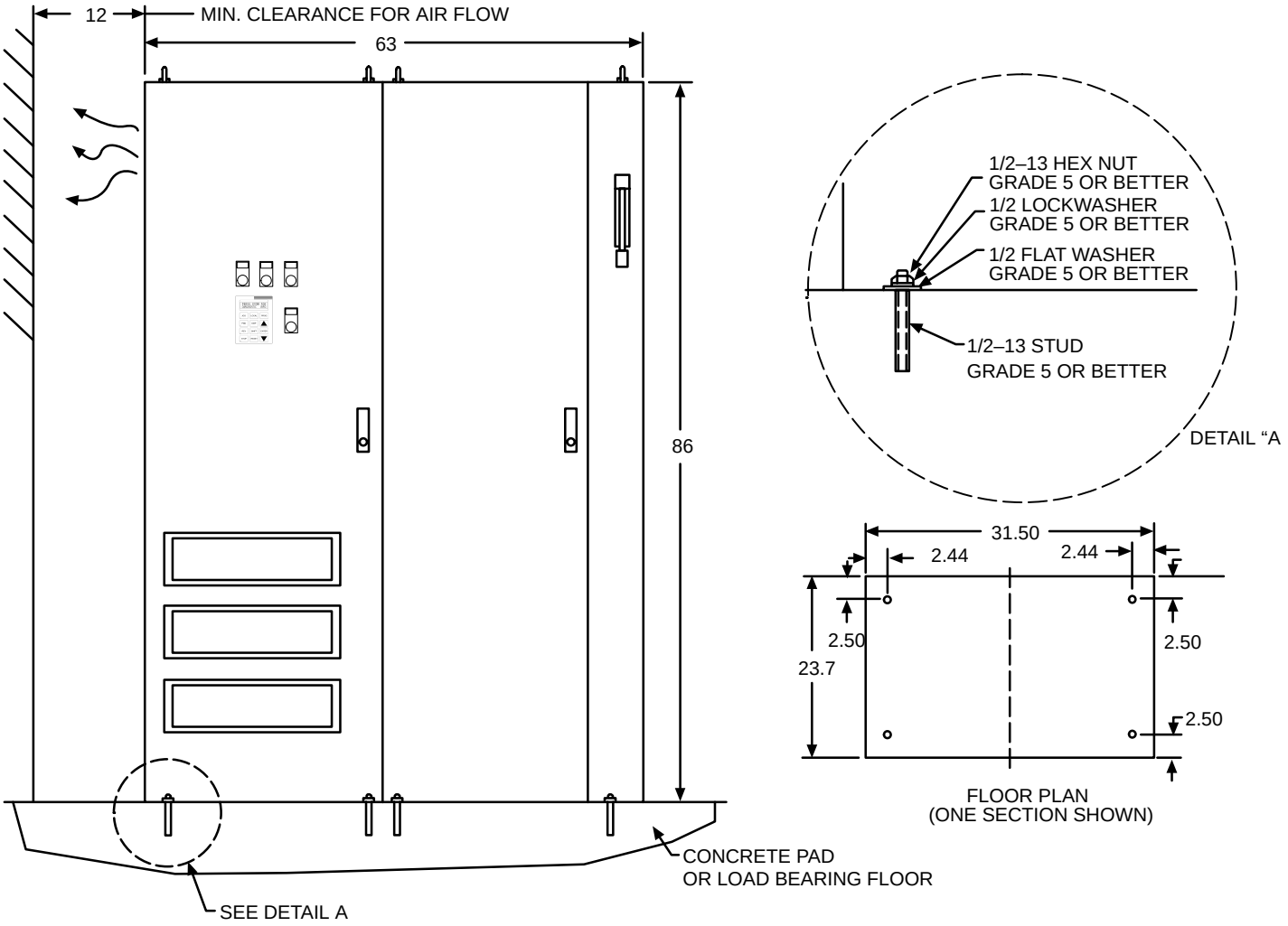
Size F Controls **NEMA 1** **150-250HP, 460VAC**



All dimensions are in inches.

Mounting Dimensions Continued

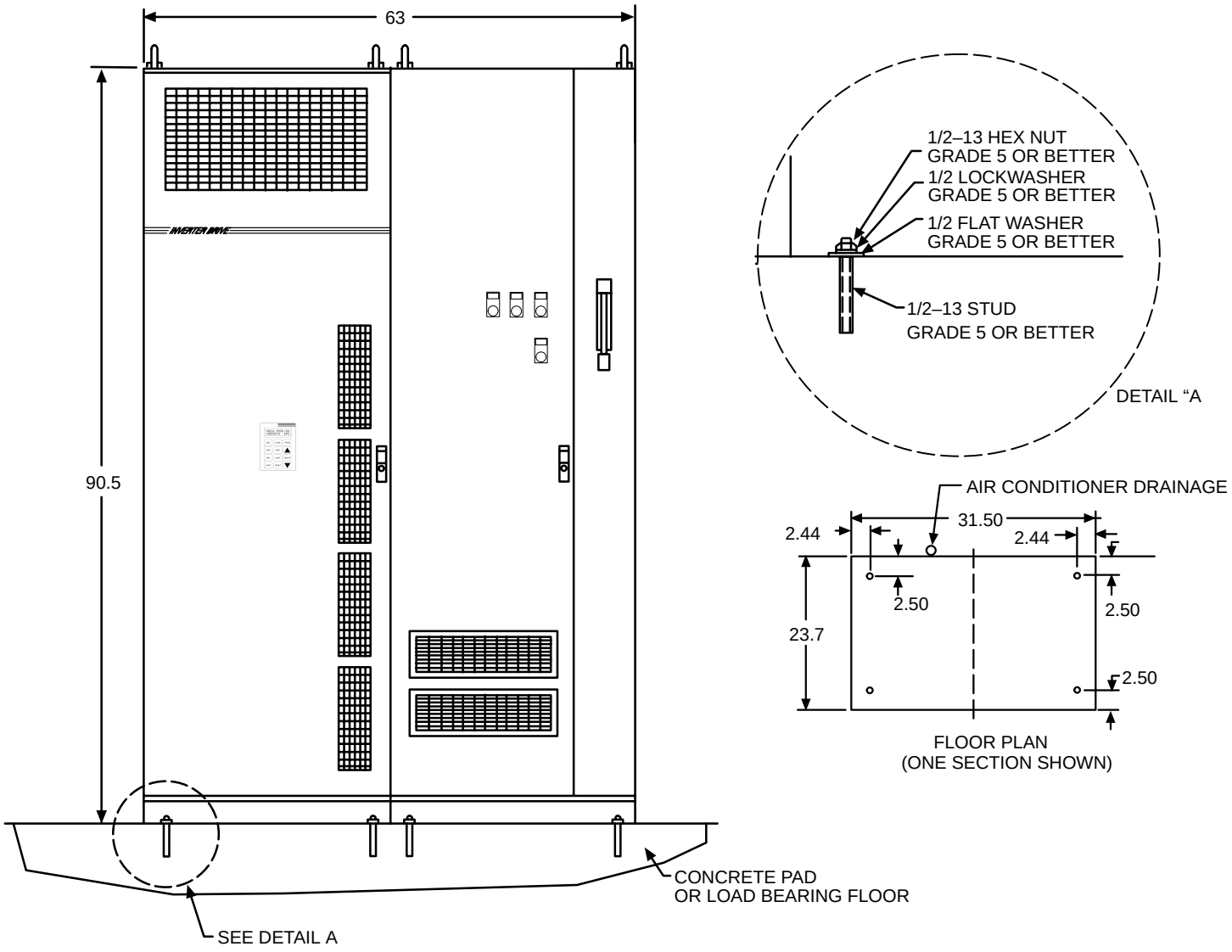
Size F Controls **NEMA 1** **150-250HP, 460VAC, with Soft Start Bypass**



All dimensions are in inches.

Mounting Dimensions Continued

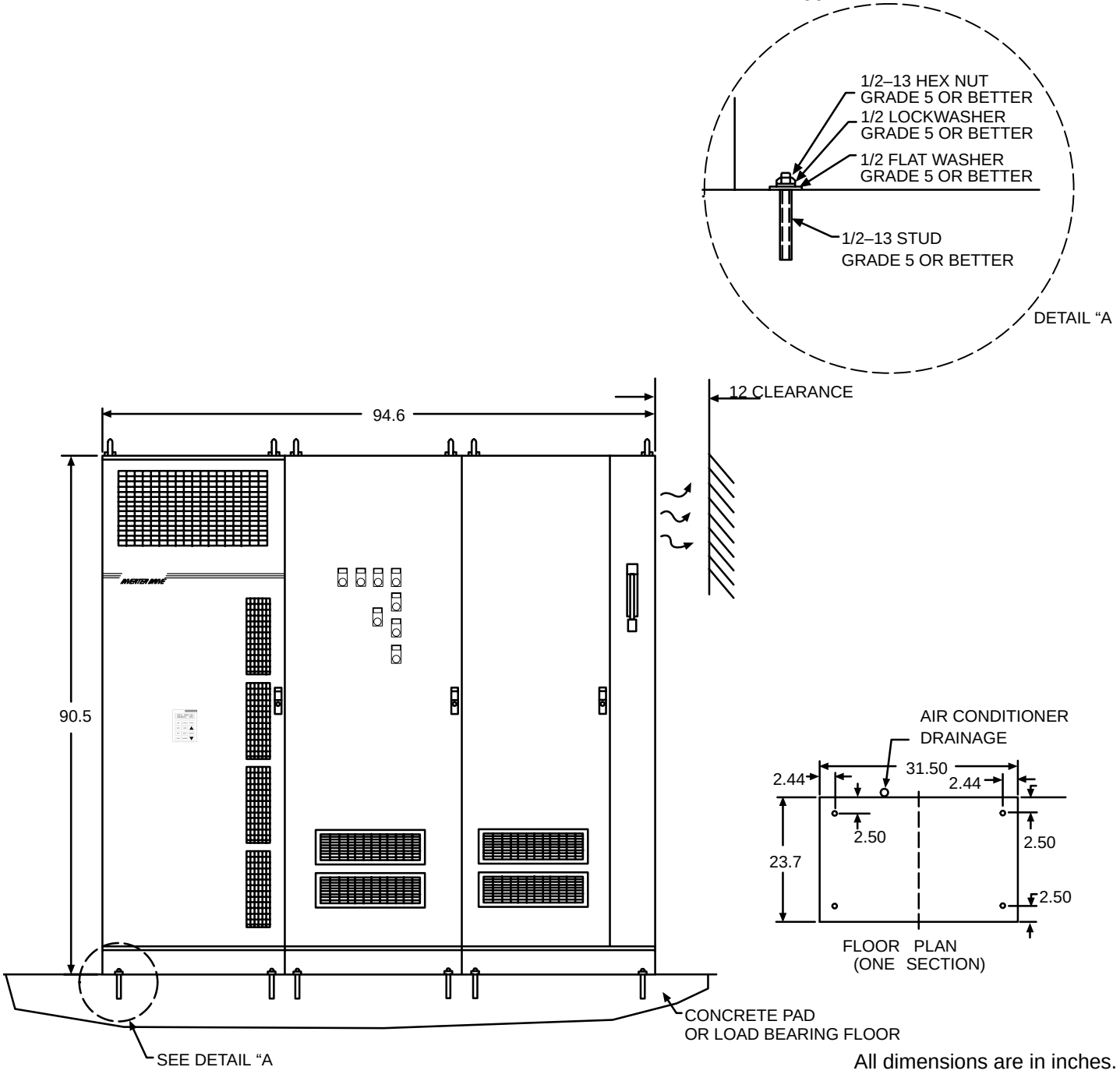
Size G Controls **NEMA 1** **300-500HP, 460VAC**



All dimensions are in inches.

Mounting Dimensions Continued

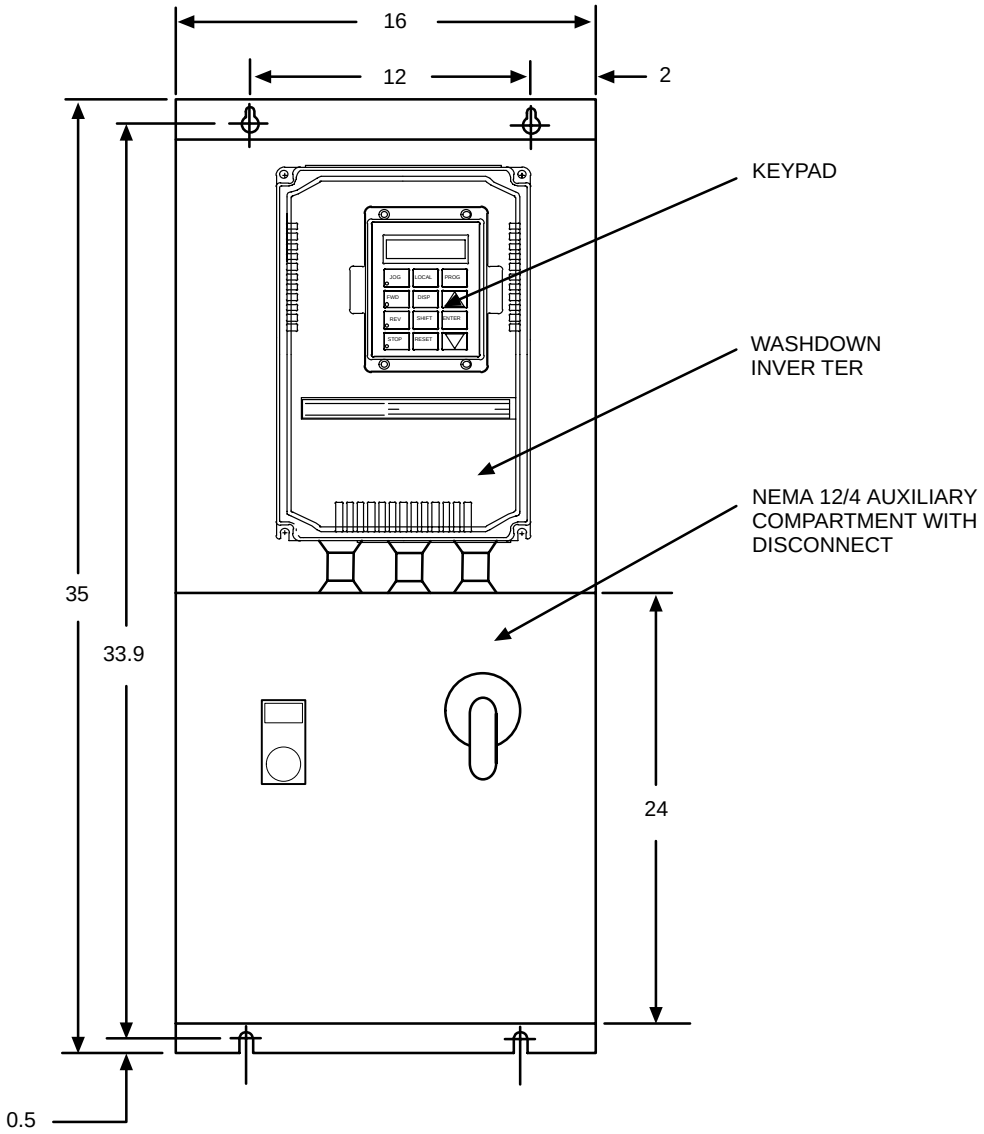
Size G Controls NEMA 1 300-500HP, 460VAC, with Soft Start Bypass



All dimensions are in inches.

Mounting Dimensions Continued

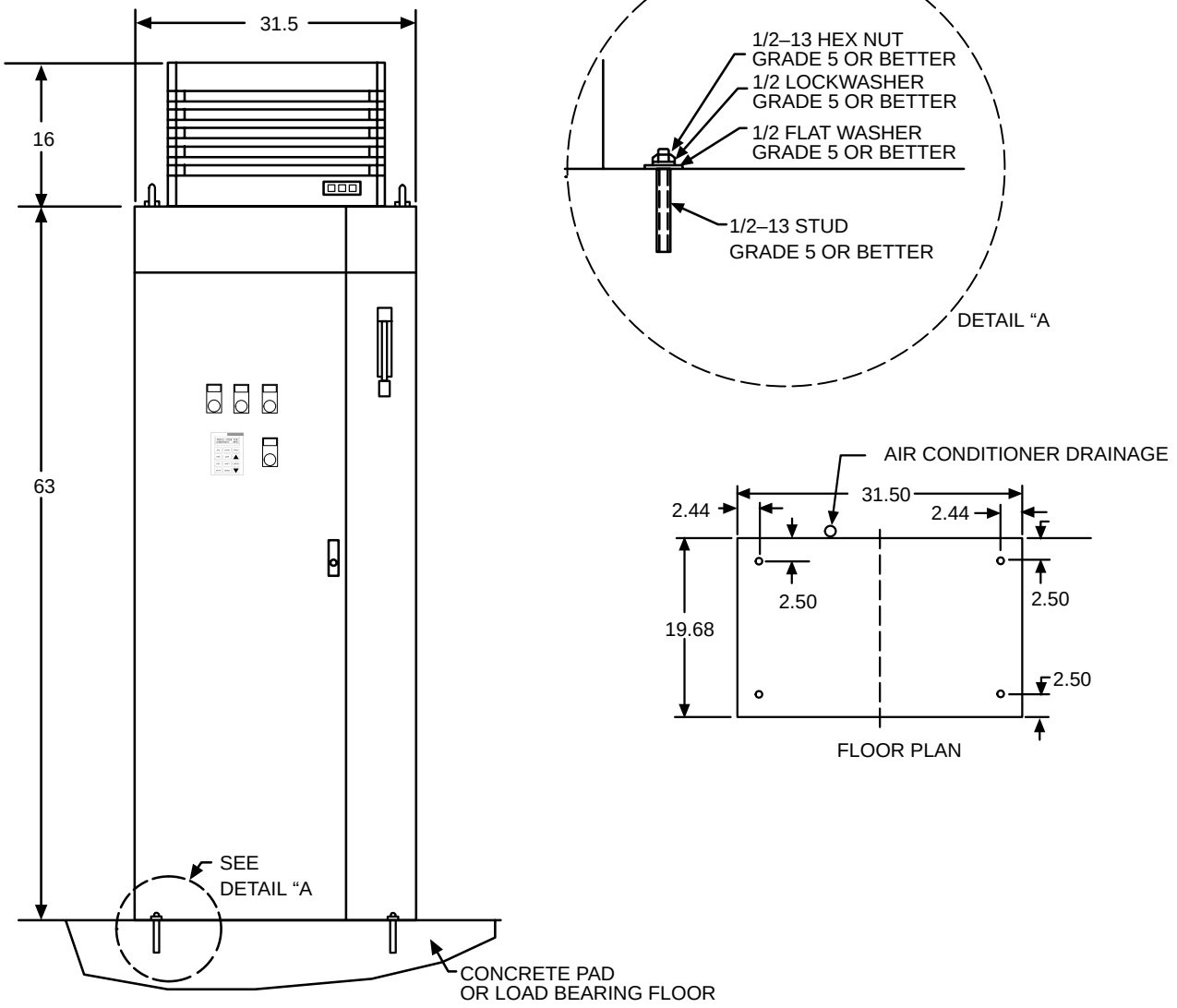
Size A & B Controls **NEMA 12 / 4** **1-7.5HP, 230VAC**
1-7.5HP, 460VAC



All dimensions are in inches.

Mounting Dimensions Continued

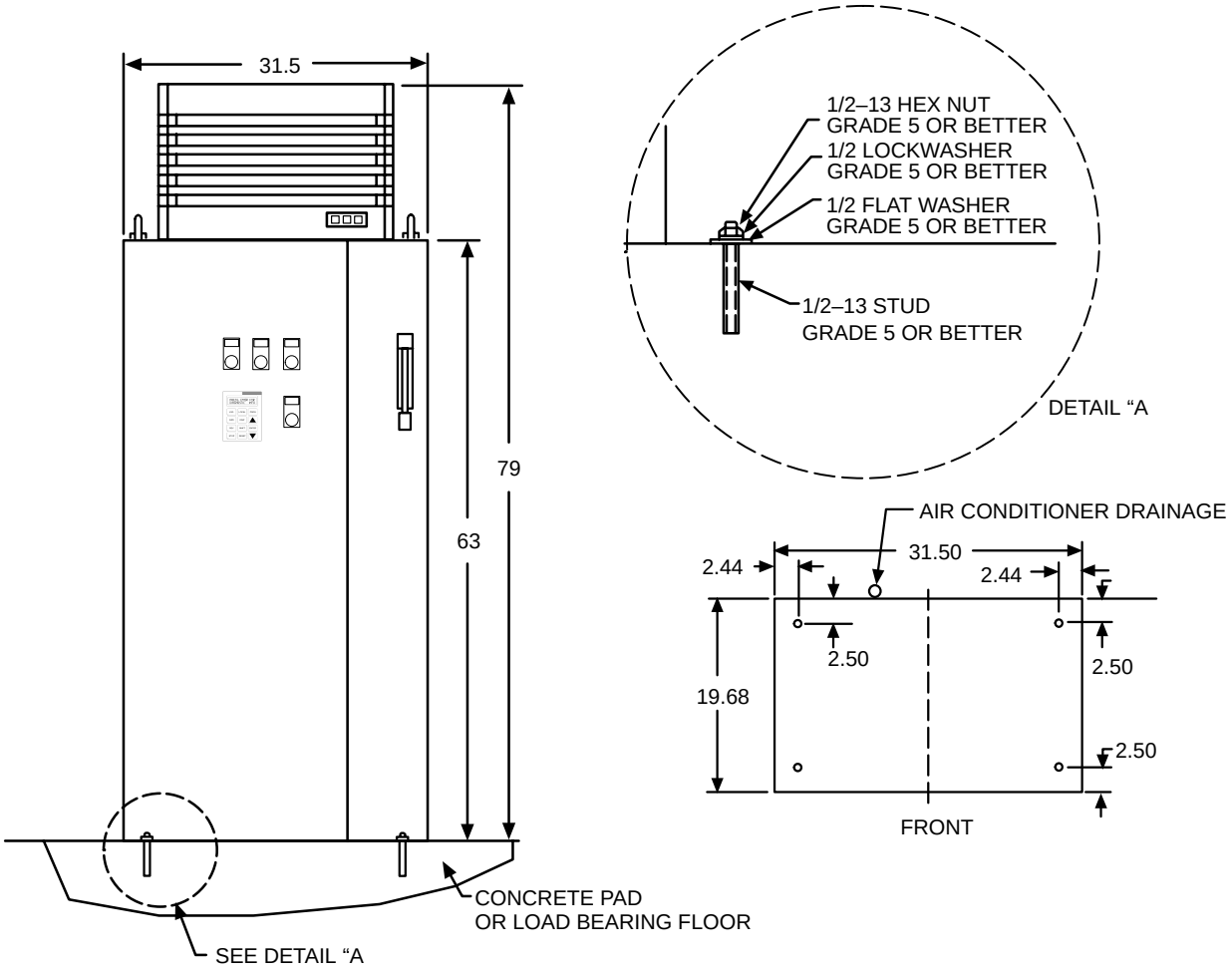
Size B, C & D Controls **NEMA 12** **10-50HP, 230VAC**
10-60HP, 460VAC
10-60HP, 575VAC



All dimensions are in inches.

Mounting Dimensions Continued

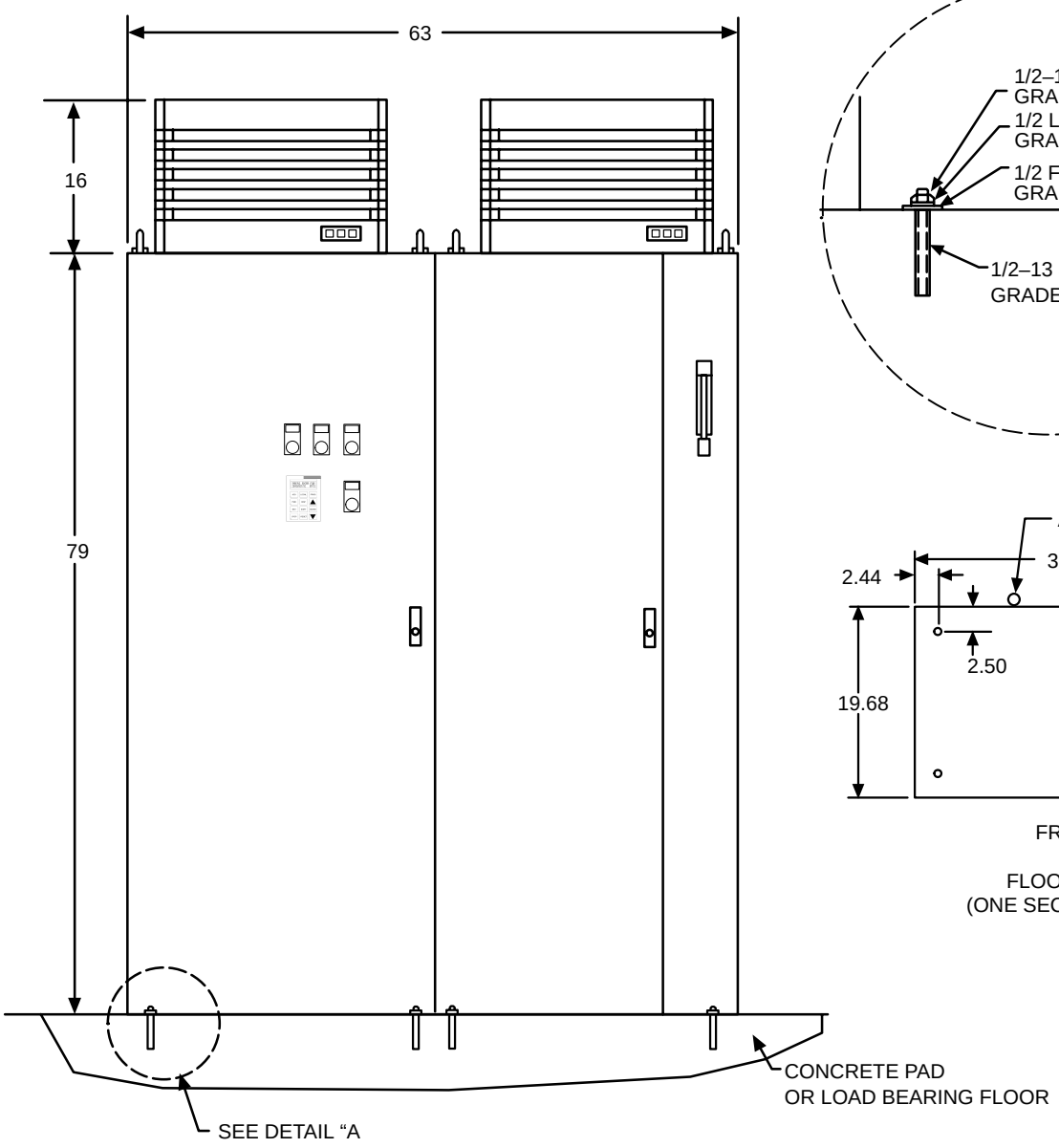
Size E Controls **NEMA 12** **75-150HP, 460VAC**
75-150HP, 575VAC

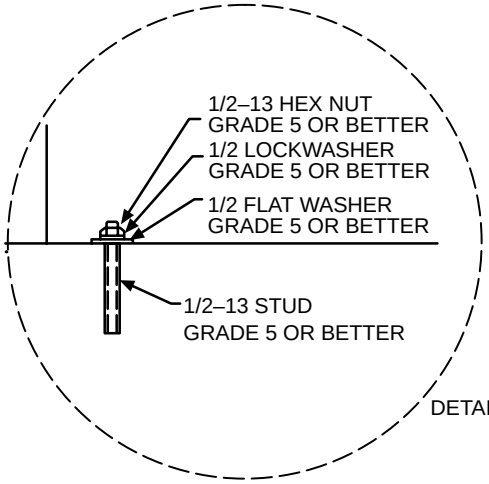


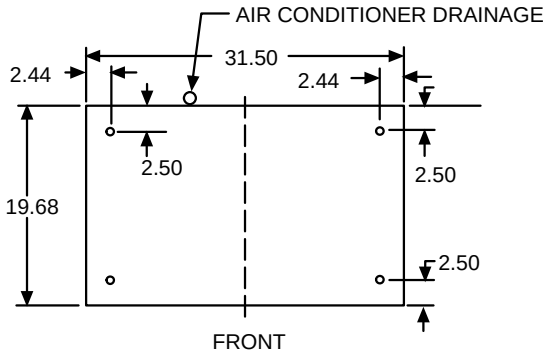
All dimensions are in inches.

Mounting Dimensions Continued

Size E Controls **NEMA 12** **75-150HP, 460VAC, with Bypass**
75-150HP, 575VAC, with Bypass





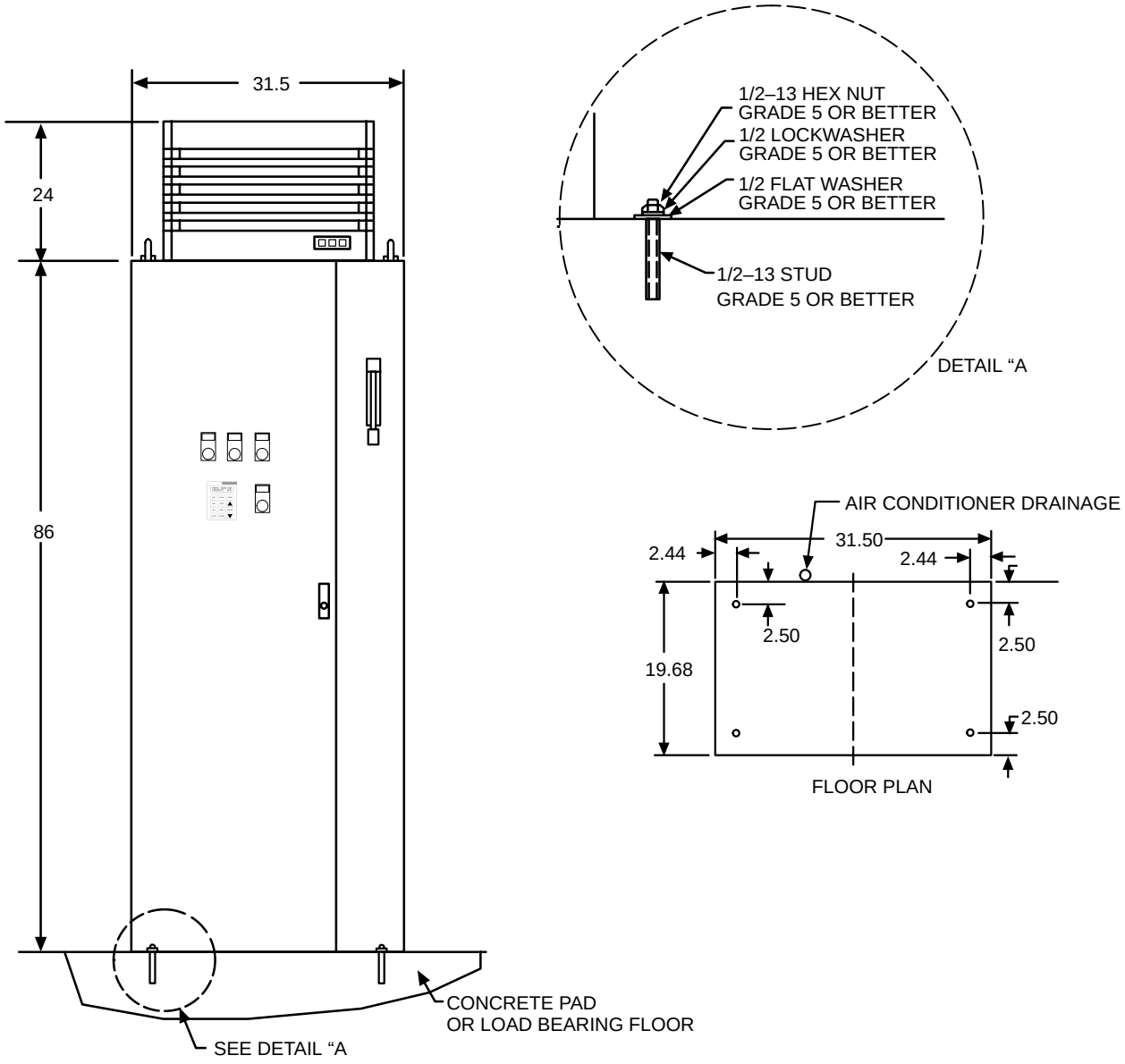


FLOOR PLAN
(ONE SECTION SHOWN)

All dimensions are in inches.

Mounting Dimensions Continued

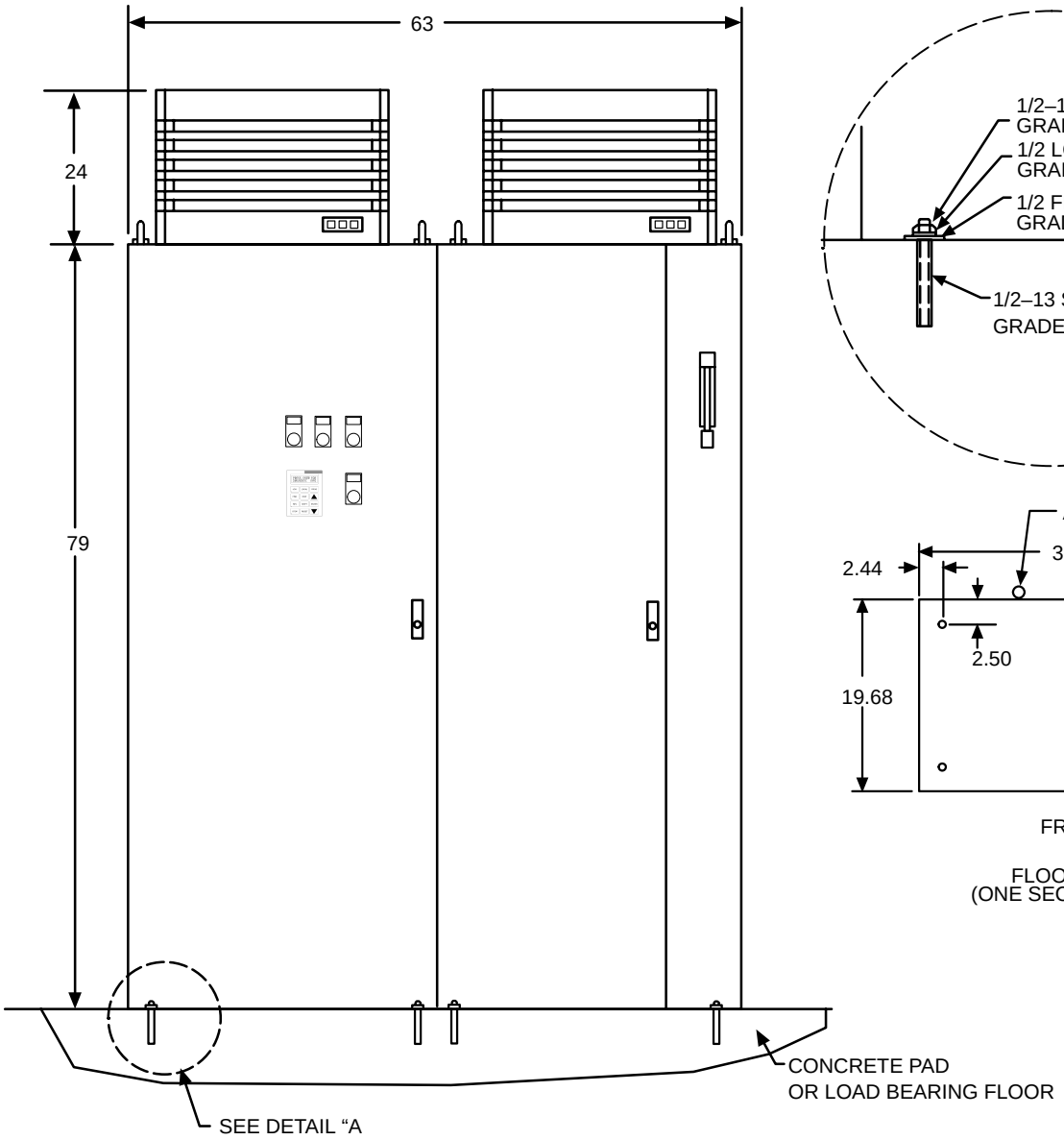
Size F Controls **NEMA 12** **150-250HP, 460VAC**

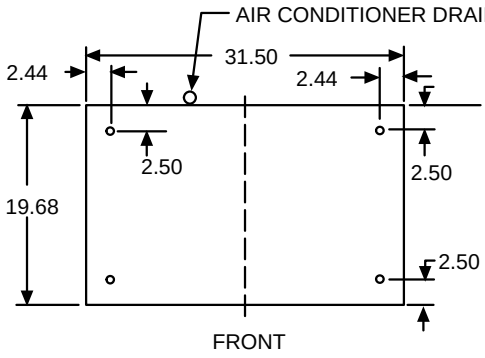


All dimensions are in inches.

Mounting Dimensions Continued

Size F Controls **NEMA 12** **150-250HP, 460VAC, with Bypass**



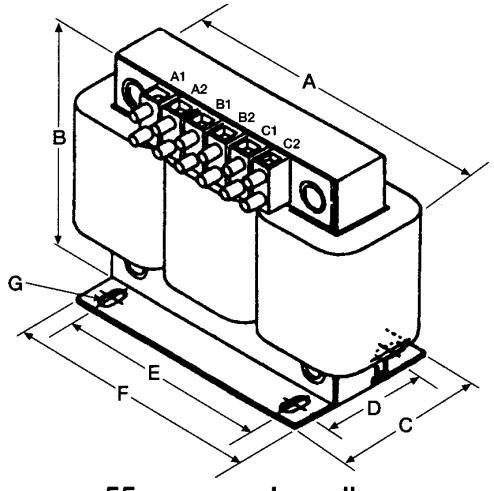


FLOOR PLAN
(ONE SECTION SHOWN)

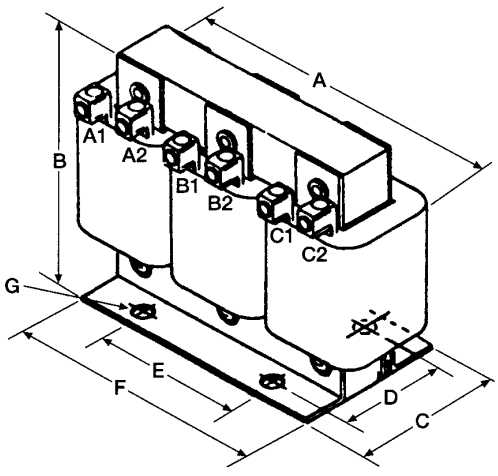
All dimensions are in inches.

BALDOR® MOTORS AND DRIVES Line Reactors

CATALOG NUMBER	INPUT VOLTS	CONT CUR	INDUCT (mH)	WATTS LOSS	A	B	C	D	E	F	G	WGT. (LBS)
LRAC00401	208/230	4	3.0 mh	8	4.40	4.00	2.90	1.98	1.44	3.44	0.31x0.56	4
LRAC00801	208/230	8	1.5 mh	18	6.00	4.80	3.10	2.10	2.00	4.81	0.31x0.62	6
LRAC01201	208/230	12	1.25 mh	22	6.00	4.80	3.10	2.10	2.00	4.81	0.31x0.62	8
LRAC01801	208/230	18	0.8 mh	31	6.00	4.80	3.10	2.10	2.00	4.81	0.31x0.62	9
LRAC02501	208/230	25	0.5 mh	35	7.50	5.60	3.50	2.34	3.00	6.00	0.38x0.75	11
LRAC03501	208/230	35	0.4 mh	55	7.20	5.60	3.80	2.60	3.00	6.00	0.38x0.75	14
LRAC04501	208/230	45	0.3 mh	63	9.00	7.00	4.80	3.16	3.00	7.50	0.38x0.75	23
LRAC05501	208/230	55	0.25 mh	104	9.00	7.00	4.80	3.16	3.00	7.50	0.38x0.75	24
LRAC08001	208/230	80	0.2 mh	86	10.80	8.20	5.60	3.47	3.62	9.00	0.38x0.75	43
LRAC10001	208/230	100	0.15 mh	82	10.80	8.30	5.60	3.47	3.62	9.00	0.38x0.75	45
LRAC13001	208/230	130	0.1 mh	109	9.00	7.00	4.80	3.16	3.00	7.50	0.38x0.75	30
LRAC16001	208/230	160	0.075 mh	136	10.80	8.40	5.60	3.47	3.62	9.00	0.38x0.75	55
LRAC00201	460	2	12.0 mh	9	4.40	4.00	2.90	1.98	1.44	3.44	0.31x0.56	4
LRAC00402	460	4	6.5 mh	14	4.40	4.00	2.90	1.98	1.44	3.44	0.31x0.56	4
LRAC00802	460	8	3.0 mh	30	6.00	4.80	3.10	2.10	2.00	4.81	0.31x0.62	7
LRAC01202	460	12	2.5 mh	40	6.00	4.80	3.10	2.10	2.00	4.81	0.31x0.62	10
LRAC01802	460	18	1.5 mh	52	6.00	4.80	3.10	2.10	2.00	4.81	0.31x0.62	12
LRAC02502	460	25	1.2 mh	82	7.50	5.60	3.50	2.34	3.00	6.00	0.38x0.75	13
LRAC03502	460	35	0.8 mh	104	7.70	5.70	3.80	2.60	3.00	6.00	0.38x0.75	16
LRAC04502	460	45	0.7 mh	98	9.00	7.00	4.80	3.16	3.00	7.50	0.38x0.75	28
LRAC05502	460	55	0.5 mh	121	9.00	7.00	4.80	3.16	3.00	7.50	0.38x0.75	27
LRAC08002	460	80	0.4 mh	138	10.80	8.30	5.60	3.47	3.62	9.00	0.38x0.75	51
LRAC10002	460	100	0.3 mh	146	10.80	8.20	5.80	3.66	3.62	9.00	0.38x0.75	56
LRAC13002	460	130	0.2 mh	168	10.80	8.40	5.80	3.66	3.62	9.00	0.38x0.75	58
LRAC16002	460	160	0.15 mh	194	10.80	8.40	5.60	3.47	3.62	9.00	0.38x0.75	52
LRAC20002	460	200	0.11 mh	194	10.80	8.40	6.30	4.16	3.62	9.00	0.38x0.75	67
LRAC25002	460	250	0.09 mh	205	14.40	11.20	6.70	5.06	4.60	12.00	0.56 DIA	77
LRAC32002	460	320	0.075 mh	209	14.40	11.20	6.70	5.06	4.60	12.00	0.56 DIA	140
LRAC40002	460	400	0.06 mh	244	14.40	11.20	6.70	5.06	4.60	12.00	0.56 DIA	140
LRAC50002	460	500	0.05 mh	303	14.40	11.30	7.80	6.16	4.60	12.00	0.56 DIA	180
LRAC60002	460	600	0.04 mh	333	14.40	11.20	8.30	6.66	4.60	12.00	0.56 DIA	210

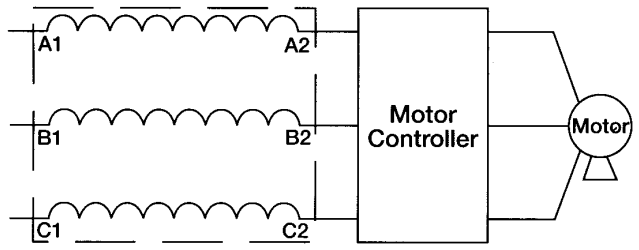


55 amps and smaller



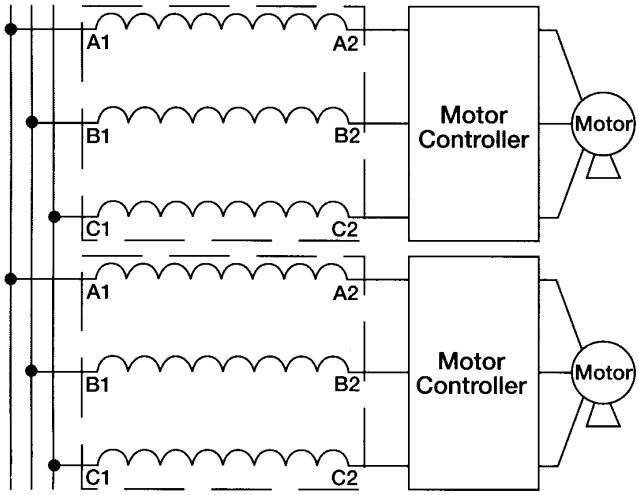
80 amps and larger

APPLYING LINE REACTORS



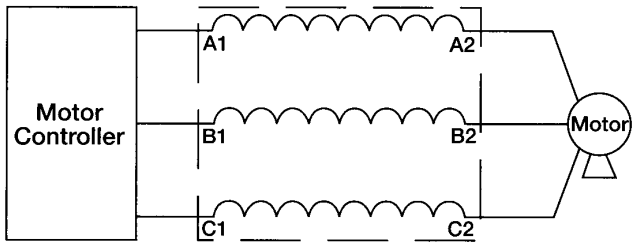
INPUT OF MOTOR CONTROL

Line reactors protect the motor control from voltage surges (spikes) and noise from the incoming power source. Some motor controls may require a minimum amount of power line impedance to protect the motor control from short circuit currents and to provide smoothing of the power waveform if the short circuit capability of the power line is many times greater than the continuous current rating of the motor control. The reactors also protect other electronic equipment from electrical noise (harmonics) that may be created by the motor control. In most cases the line reactor should be placed as close to the motor control as possible.



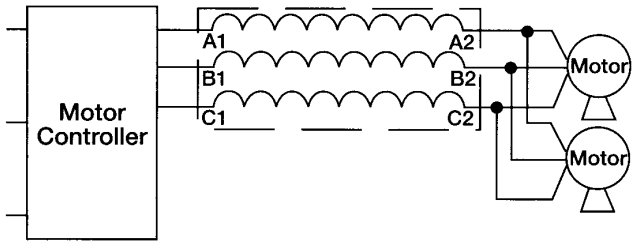
MULTIPLE MOTOR CONTROLS

When connecting several motor controls to a common power source one line reactor per motor control should be considered. The reactors should be connected between the power source and each motor control for optimum protection of the motor controls and minimal noise to the power source. The separate line reactors will also provide filtering between the motor controls and help eliminate crosstalk.



OUTPUT OF MOTOR CONTROL

When used between a motor and motor control, line reactors serve several useful functions such as protecting the motor control from a short circuit at the motor and limits the rate of rise of motor surge currents. More importantly on newer motor controls utilizing fast turn on power devices, line reactors slow down the rate of rise of the power supplied to the motor and improves the continuity of the waveform supplied to the motor. By improving the continuity or smoothness of the power waveform supplied to the motor, the motor has extra insurance against premature failure due to turn to turn winding failures. In most cases the line reactor should be placed as close to the motor control as possible.



MULTIPLE MOTORS

When one motor control is operating multiple motors, a single line reactor can typically be used between the motors and the motor control. The single reactor should be sized to provide the total current draw of all the motors connected to the motor control. For maximum protection of the motor windings, one reactor per motor should be considered in shared controller applications. The use of individual reactors will more closely match the motor load and minimize motor operating temperature and noise.

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Fort Smith, AR 72902-2400 U.S.A.
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Appendix B
Control Power Transformer Control Circuit Fuses

Time delay fuses are recommended due to inrush currents of inductors. Refer to National Electrical Code NEC430-72(c) exception #2, 450-3 (b) 1 & 2. Reference Underwriter Laboratories documents UL508 32.7, UL845 11.16 and 11.17.

Figure B-1 Maximum rating of primary fuses

Primary Volts	VA Rating										
	25	50	75	100	150	200	250	300	350	500	750
115	6/10 (1)	1-1/4 (2)	1-8/10 (3-2/10)	2-1/2 (4)	3-1/2 (6-1/4)	5 (8)	5	6-1/4	7-1/2	10	15
120	6/10 (1)	1-1/4 (2)	1-8/10 (3)	2-1/4 (4)	3-1/2 (6-1/4)	5 (8)	5	6-1/4	7	10	15
200	3/10 (6/10)	3/4 (1-1/4)	1-1/8 (1-8/10)	1-1/2 (2-1/2)	2-1/4 (3-1/2)	3 (5)	3-1/2 (6-1/4)	4-1/2 (7-1/2)	5 (8)	6-1/4	9
208	3/10 (6/10)	6/10 (1-18)	1 (1-8/10)	1-4/10 (2-1/4)	2 (3-1/2)	2-8/10 (4-1/2)	3-1/2 (6)	4 (7)	5 (8)	6	9
220	3/10 (1/2)	6/10 (1-1/8)	1 (1-6/10)	1-1/4 (2-1/4)	2 (3-2/10)	2-1/2 (4-1/2)	3-2/10 (5-6/10)	4 (6-1/4)	4-1/2 (7-1/2)	5-6/10	8
230	3/10 (1/2)	6/10 (1)	8/10 (1-6/10)	1-1/4 (2)	1-8/10 (3-2/10)	2-1/2 (4)	3-2/10 (5)	3-1/2 (6-1/4)	4-1/2 (7-1/2)	5	8
240	3/10 (1/2)	6/10 (1)	8/10 (1-1/2)	1-1/4 (2)	1-8/10 (3)	2-1/4 (4)	3 (5)	3-1/2 (6-1/4)	4 (7)	5	7-1/2
277	1/4 (4/10)	1/2 (8/10)	8/10 (1-1/4)	1 (1-8/10)	1-6/10 (2-1/2)	2 (3-1/2)	2-1/2 (4-1/2)	3-2/10 (5)	3-1/2 (6-1/4)	5 (9)	6-1/4
380	3/16 (3/10)	3/10 (6/10)	1/2 (8/10)	3/4 (1-1/4)	1-1/8 (1-8/10)	1-1/2 (2-1/2)	1-8/10 (3-2/10)	2-1/4 (3-1/2)	2-1/2 (4-1/2)	3-1/2 (6-1/4)	5-6/10 (9)
400	3/16 (3/10)	3/10 (6/10)	1/2 (8/10)	3/4 (1-1/4)	1-1/8 (1-8/10)	1-1/2 (2-1/2)	1-8/10 (3)	2-1/4 (3-1/2)	2-1/2 (4)	3-1/2 (6-1/4)	5-6/10 (9)
415	15/100 (3/10)	3/10 (6/10)	1/2 (8/10)	6/10 (1-1/8)	1 (1-8/10)	1-4/10 (2-1/4)	1-8/10 (3)	2 (3-1/2)	2-1/2 (4)	3-1/2 (6)	5 (9)
440	15/100 (1/4)	3/10 (1/2)	1/2 (8/10)	6/10 (1-1/8)	1 (1-6/10)	1-1/4 (2-1/4)	1-6/10 (2-8/10)	2 (3-2/10)	2-1/4 (3-1/2)	3-2/10 (5-6/10)	5 (9)
460	15/100 (1/4)	3/10 (1/2)	4/10 (8/10)	6/10 (1)	8/10 (1-6/10)	1-1/4 (2)	1-6/10 (2-1/2)	1-8/10 (3-2/10)	2-1/4 (3-1/2)	3-2/10 (5)	4-1/2 (8)
480	15/100 (1/4)	3/10 (1/2)	4/10 (3/4)	6/10 (1)	8/10 (1-1/2)	1-1/4 (2)	1-1/2 (2-1/2)	1-8/10 (3)	2 (3-1/2)	3 (5)	4-1/2 (7-1/2)
550	1/8 (2/10)	1/4 (4/10)	4/10 (6/10)	1/2 (8/10)	8/10 (1-1/4)	1 (1-8/10)	1-1/4 (2-1/4)	1-6/10 (2-1/2)	1-8/10 (3)	2-1/2 (4-1/2)	4 (6-1/4)
575	1/8 (2/10)	1/4 (4/10)	3/10 (6/10)	1/2 (8/10)	3/4 (1-1/4)	1 (1-6/10)	1-1/4 (2)	1-1/2 (2-1/2)	1-8/10 (3)	2-1/2 (4)	3-1/2 (6-1/4)
600	1/8 (2/10)	2/10 (4/10)	3/10 (6/10)	1/2 (8/10)	3/4 (1-1/4)	8/10 (1-6/10)	1-1/4 (2)	1-1/2 (2-1/2)	1-6/10 (2-8/10)	2-1/4 (4)	3-1/2 (6-1/4)

Figure B-2 Maximum rating of secondary fuses

Secondary Volts	VA Rating										
	25	**50**	**75**	**100**	**150**	**200**	**250**	**300**	**350**	**500**	**750**
23	1–8/10	3–1/2	5	7	10	12	15	20	20	30	45
24	1–6/10	3–2/10	5	6–1/4	10	12	15	20	20	30	40
25	1–6/10	3–2/10	5	6–1/4	10	12	15	15	20	25	40
90	4/10	8/10	1–1/4	1–8/10	2–1/2	3–1/2	4–1/2	5	6–1/4	9	12
95	4/10	8/10	1–1/4	1–6/10	2–1/2	3–1/2	4	5	6	8	12
100	4/10	8/10	1–1/4	1–6/10	2–1/2	3–2/10	4	5	5–6/10	8	12
110	3/10	3/4	1–1/8	1–1/2	2–1/4	3	3–1/2	4–1/2	5	7–1/2	10
115	3/10	6/10	1	1–4/10	2	2–8/10	3–1/2	4	5	7	10
120	3/10	6/10	1	1–1/4	2	2–1/2	3–2/10	4	4–1/2	6–1/4	10
220	15/100	3/10	1/2	3/4	1–1/8	1–1/2	1–8/10	2–1/4	2–1/2	3–1/2	5–6/10
230	15/100	3/10	1/2	6/10	1	1–4/10	1–8/10	2	2–1/2	3–1/2	5
240	15/100	3/10	1/2	6/10	1	1–1/4	1–6/10	2	2–1/4	3–2/10	5

Appendix C
Manual Bypass Circuit Description

Manual bypass circuit

1. The bypass circuit allows the user to manually bypass the drive and transfer control, to the motor across the line mode, running the motor at full speed. While in the bypass operation, the motor is protected by a circuit breaker and a class 10 bi-metallic overload relay. Door interlocked circuit breaker (65k A.I.C.) will disconnect all input power from the drive and all internally mounted devices. The disconnect handle is a through-the-door type, and is padlockable in the Off position. A three position selector switch to control the bypass contactor and the drive output contactor is mounted on the enclosure door. When in the ASD (adjustable speed drive) mode, the bypass contactor is open and the drive input and output contactors are closed. In the Off position, power will be removed from both the adjustable speed and the bypass circuits. In the Bypass position, the drive input and output contactors are open and the bypass contactor is closed. All safety interlocks operate in both the drive and bypass modes. The contactors auxiliary contacts are connected to indicating lights to provide indication of operating mode.

2. Input contactor may be energized by optional “Normal-Test” selector. This optional switch when specified, is mounted on the drive enclosure.

3. A motor overload relay provides protection for the motor in the bypass and adjustable speed modes.