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**Multipurpose  
Soft Starter  
Sizes 8 to 840 AMP**

**Installation & Operating Manual**

**9/06**

**MN894**



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# Section 1

## General Information

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### Introduction

Three phase multipurpose soft starter control provides reduced voltage, three phase motor starting. Ramp up and extended ramp down features provide an effective means to start and stop material handling equipment and pumping equipment to minimize spillage and water hammer problems. Adjustable current limit allows constant current starting of high inertia loads such as chippers, centrifuges and compressors. It also reduces the peak demand of power required from utility companies or generating equipment.

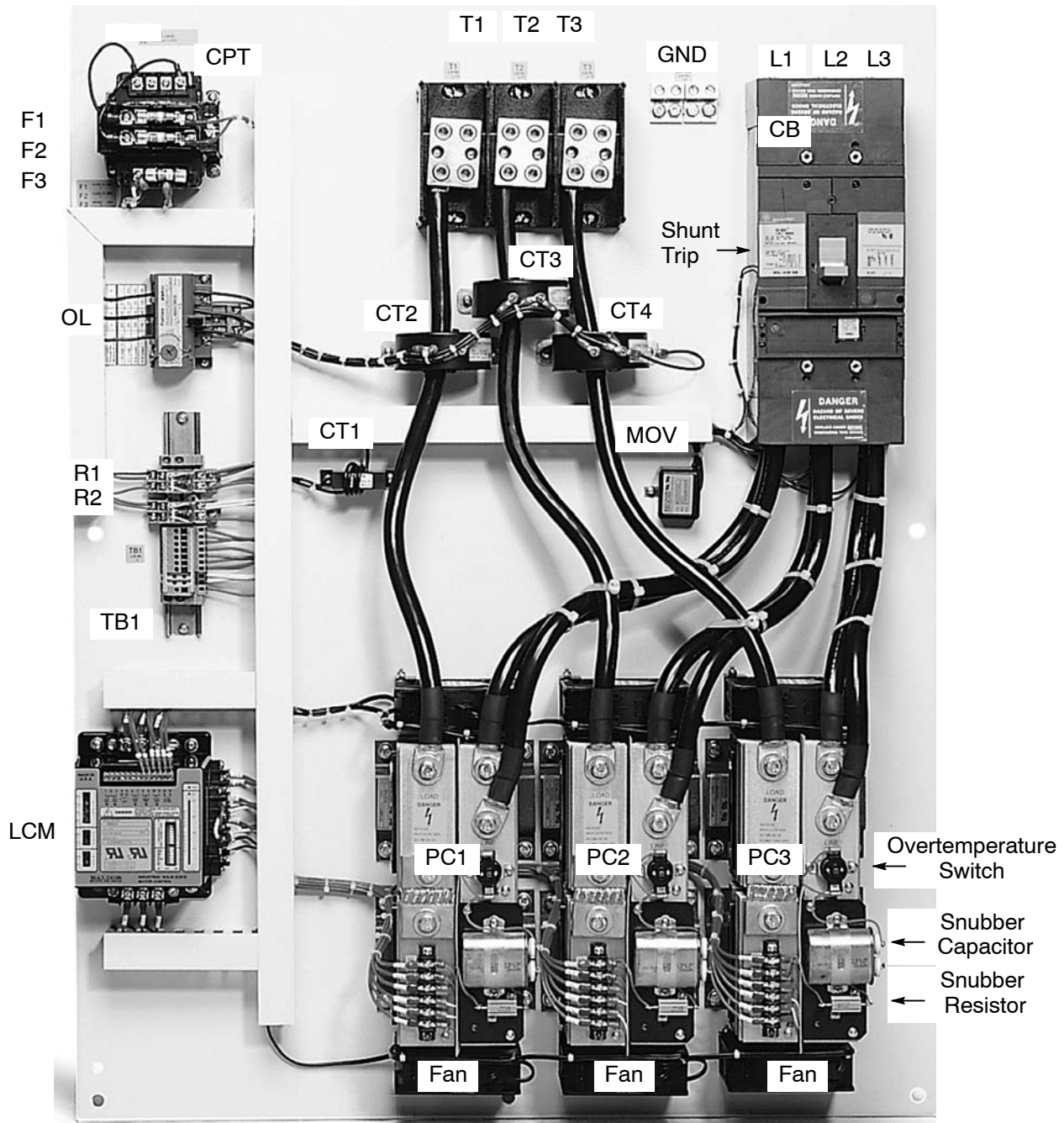
Tachometer feedback may be used to provide consistent starting and stopping times with linear acceleration and deceleration. This is especially important under varying load conditions like: textile, material handling and pumping equipment.

Six SCR (silicon controlled rectifier) devices are connected in three sets of inverse parallel configuration to provide full wave voltage and current control of the three phase AC motor. MOV (metal oxide varistors) provide surge voltage protection at the AC input to the starter.

Several product features make this soft start control easy to use:

- Two selectable starting methods.
- Individual ramp up and ramp down adjustments.
- Flexible yet simple setup with switch selections and potentiometer adjustments.
- Simple onboard current calibration.
- Indicator lights and status contacts providing information about the starting, running and stopping conditions.
- Bar graph display provides a visual representation of motor current to assist in set-up and troubleshooting. (0 to 400% FLA).
- Tachometer input.
- Five output relay contacts.
- Built-in protection features to reduce down time.

**Figure 1-1 Layout and Identification**

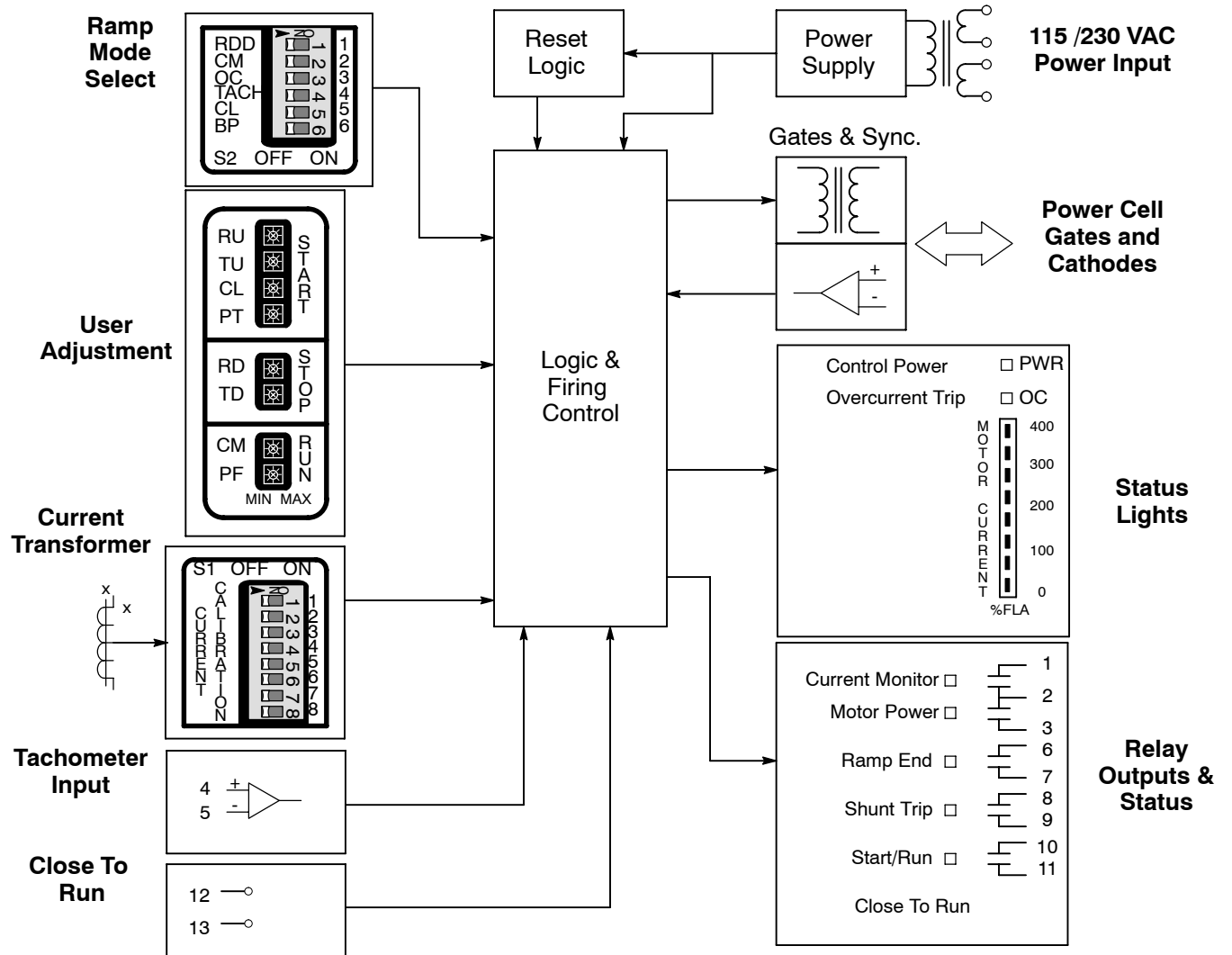


**Legend:**

- CB - Motor Circuit Protector or fusible disconnect
- CPT - Control transformer (control voltage)
- CT1, 2, 3, 4 - Current Transformer
- F1, F2, F3 - Control transformer fuses
- GND - Ground connection
- LCM - Logic control module
- MOV - Metal oxide varistors
- OL - Overload relay (electronic)
- PC1, 2, 3 - Power Cell
- R1, R2 - Control Relays
- TB1, 2 - Terminal block



Figure 1-2 Logic Control Module Block Diagram



**Legend:**

- BP - Bypass
- CL - Current Limit
- CM - Current Monitor
- OC - Overcurrent
- PF - Power Factor
- PT - Pulse Time
- RD - Ramp Down
- RDD - Ramp Down Disable
- RU - Ramp Up
- S1 - Calibration Switch
- TACH - Tachometer
- TD - Torque Down
- TU - Torque Up

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## Major Components

(Refer to Figures 1-1 and 1-2).

### **Logic Control Module (LCM)**

The LCM (Logic Control Module) operates in the voltage ramp mode or current limit mode during ramp up and ramp down (if ramp down is selected). The LCM controls the amount of current that the power cells deliver to the motor during ramp up and ramp down. It uses gates and synchronous timing circuits to control the firing times of the SCR's in the power cells. The current transformer provides the LCM with motor current information. The on board current calibration switches (S1-1 thru S1-8), place burden resistors in parallel with the current transformer to calibrate the LCM to the correct FLA (full load amperes) of the motor being used.

### **Current Transformer**

(CT1) provides starting, stopping and running current information to the LCM. This information is used to control starting and stopping current, current limit, current monitor and over current shutdown, power factor effect and motor current bar graph indicator.

(CT2) is required only for sizes 160 through 840 amps. It steps down current to match primary rating of CT1 transformer.

**8, 16 and 30 amp models** - CT1 is mounted inside the LCM housing.

**55 and 80 amp models** - CT1 is mounted externally on the panel.

**160 to 840 amp models** - CT1 and CT2 are mounted externally on the panel.

CT1 ratio is 6000:1

CT2 ratio is 500:5 for 160, 250 and 420 Amp models.

CT2 ratio is 1000:5 for 600 and 840 Amp models.

### **Power Cells (PC)**

Power cells control the voltage delivered to the motor during ramp up and ramp down (if ramp down is enabled). The LCM controls the duty cycle of the SCR's in the power cells ("on" time versus "off" time of each SCR). A power cell contains two silicon controlled rectifiers (SCR's). The SCR's are solid state switches that are able to control large amounts of current with a small amount of gate current supplied by the LCM.

**8, 16 and 30 amp models** - six SCR's are mounted inside the LCM housing.

**55 and 80 amp models** - SCR's are mounted in an isolated package containing two SCR's for each power cell. With this type of package, three power cells are mounted to a single heat sink at ground potential. A temperature switch is provided in each cell to protect the power cell from overheating.

**160 to 840 amp models** - Each SCR is a disk type package containing one SCR. Two SCR's are clamped between two heat sinks. A temperature switch is provided to protect the SCR assembly from overheating. Heat sinks are mounted on an insulated base with a terminal block and snubber network. The snubber network is a capacitor resistor series circuit wired in parallel with the disk type SCR's. The snubber network enhances the electrical characteristics of the SCR's and provides transient voltage protection. This arrangement makes up one power cell. The power cell is at line potential for both line and load terminals when line voltage is applied.

## Protection Devices

### **Metal Oxide Varistors (MOV)**

An MOV provides voltage surge protection. Voltage surges also called high voltage spikes are caused by a number of sources. Short duration high voltage spikes caused by starting and stopping other motor loads or switching On and Off capacitor banks may appear on the incoming lines. Transients can occur from lightning storms or from other lightly loaded devices on the same line, such as motors, transformers, or solenoids. Electrical noise can be caused by lightning, arc welders and heat exchange equipment on the same transformer bus line.

An MOVs provide protection by absorbing or clamping these transient energy levels. High energy transients that exceed the MOV rating may damage the MOV and the multipurpose starter.

**Snubber Network**

**160 through 840 amp models only.** A resistor and capacitor series circuit (snubber) is wired in parallel with each disk type SCR. The RC network enhances the electrical characteristics of the SCR and provides high voltage transient protection.

**Shorted SCR Detection:**

If a shorted SCR condition is detected while starting, running or stopping, the SHUNT TRIP contact will close and the SHUNT TRIP light will indicate the condition.

The SHUNT TRIP contact is used to open the circuit breaker via a shunt trip device. Also, the shunt trip contact from the LCM module can be used to activate other circuit interrupting device to remove the motor and control from the AC power line.

When a bypass contactor is used, the shunt trip circuit is disabled when the bypass contactor is closed. This is accomplished by switching switch BP S2-6 On.

**Over Current Shut Down:**

The control module has an over current detection circuit to trip and shut down the control if motor current exceeds 450% FLA. To restart, open the Close To Run circuit, then close it.

**Current Monitor:**

When the motor is at speed (End of Ramp light is "ON"), the current monitor can detect over current or overload motor conditions. This warning can alert an operator or be used to stop a motor. It can also be used for indications of jams or blockages.

**Motor Overload Protection:**

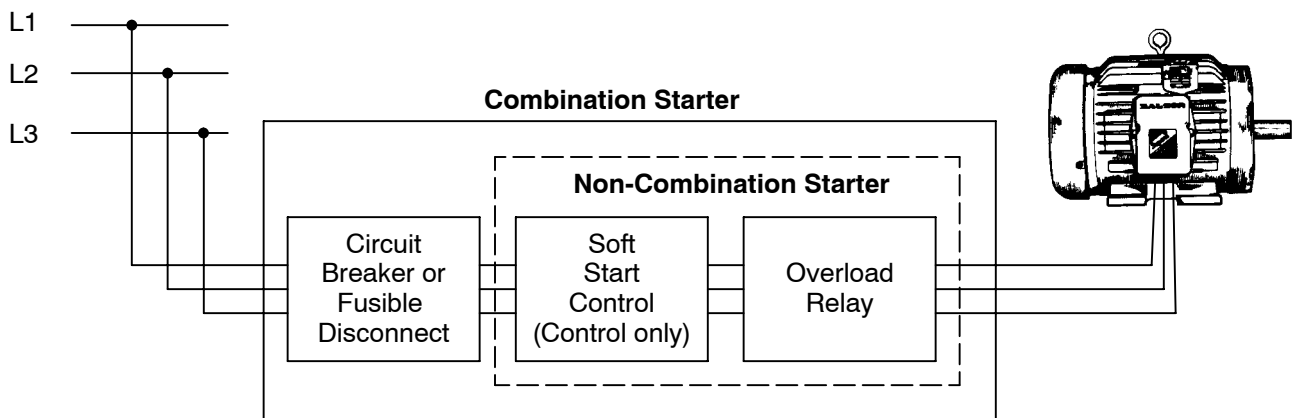
Class 30 motor overload protection is required to protect the control and the motor from repetitive or extended starting conditions, as well as running during an overload condition. Class 10 or 20 overloads may trip when starting high inertia loads or when operating in current limit starting mode.

**Over Temperature Switch:**

Power cells have over temperature switches to detect an overheating condition. The switch is an isolated bimetallic, normally closed contact. If loss of cooling causes a power cell to overheat, the temperature switch contact will open and shut down the control circuit.

Note: When a temperature switch opens, the control shuts down. It must be reset manually to restart the control.

**Figure 1-3 Starter Diagram**



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## Configurations

**Control Only:** Soft start control, without motor overload protection or branch circuit protection circuit breaker or fusible disconnect switch. Suitable for installation with a series contactor or as a retrofit for an existing motor starter.

**Non-combination Starter:** Soft start control with motor overload protection, less branch circuit protection circuit breaker or fusible disconnect switch. Installation with existing branch circuit protection would use this configuration.

**Combination Starter:** Soft start control with motor overload protection and branch circuit protection and branch circuit protection circuit breaker or fusible disconnect switch. Only push buttons are required to complete the system. New installations with no existing control equipment would use this configuration.

**Bypass System, Control Only:** Soft start control without overload protection and branch protection. Includes a bypass contactor to shunt the power cells after the control is in the full run mode to eliminate heat generation across the power cells. Allows installation in a NEMA 4 or NEMA 12 enclosure.

**Bypass System, Non-combination:** Soft start control noncombination system with motor overload protection, less branch circuit protection. Includes a bypass contactor to shunt the power cells after the starter is in the full run mode to eliminate heat generation across the power cells. Allows installation in a NEMA 4 or NEMA 12 enclosure.

**Bypass System, Combination:** Soft start control combination system with motor overload protection and branch circuit protection circuit breaker or fusible disconnect switch. Includes a bypass contactor to shunt the power cells after the starter is in the full run mode to eliminate heat generation across the power cells. Allows installation in a NEMA 4 or NEMA 12 enclosure.

**Enclosures and Ventilation:** Soft start controls are available in panel mount or in NEMA type 1, 12, 3R enclosures. The control will generate approximately 3.3 watts of heat per running ampere during operation. All factory supplied enclosures are designed to dissipate this heat under maximum specified operating conditions. If the multipurpose control is mounted in an enclosure not supplied by the factory, this heat dissipation must be considered. Adequate ventilation or convection cooling should be provided unless a bypass contactor is used.

**Panel Mount:** Soft start control mounted on a panel with provisions for wall or enclosure installation.

**NEMA Type 1 (IP23):** Soft start control mounted in a ventilated NEMA type 1 panel enclosure. Intended for indoor use primarily to provide a degree of protection against contact with enclosed electrical components. Available for all sizes and configurations.

**NEMA 12/3R (IP65/IP32):** NEMA 12 enclosure provides protection from dust, dirt, oil and water. NEMA 3R outdoor installation protects from rain, sleet and snow. A NEMA 12/3R is shipped as a NEMA 12 and to convert to NEMA 3R, remove the drain screw at the bottom of the enclosure.

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### **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.

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## **Safety Notice**

This equipment contains voltages that may be as high as 600 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

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

### **PRECAUTIONS**

- ⚠ WARNING:** Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury.
- ⚠ 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:** 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.
- ⚠ 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 the control rating.
- ⚠ Caution:** Do not “Megger” test the motor while it is connected to the control. Failure to disconnect motor 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. Do not megger any part of the control.
- ⚠ Caution:** Do not connect power factor correction capacitors to motor terminals. If power factor correction capacitors are necessary, contact Baldor.
- ⚠ Caution:** If a brake motor is used, the initial starting voltage may not be sufficient to release the brake. It may be necessary to provide separate power for the brake and soft start control.
- ⚠ Caution:** Do not connect AC incoming line power to the Motor terminals T1, T2 and T3. Connecting AC power to these terminals may result in damage to the control.
- ⚠ Caution:** Do not supply any power to the “Close To Run” terminals. Power on these leads can damage the control. Use a dry contact type that requires no external power to operate.
- ⚠ Caution:** Do not change the position of any switch while power is applied. Changing the position of a switch during operation can damage the control and cause erratic behavior of the load.
- ⚠ 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 rating.
- ⚠ Caution:** This equipment is shipped as a multipurpose apparatus. Before power is applied, the line voltage selection and the full load current calibration must be correctly set. Failure to select the proper line voltage or to calibrate the full load current may cause damage.

## Section 2 Installation

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### Receiving, Inspection and Storage

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 carton. Inspect for shipping damage and report any damage immediately to your commercial carrier.
3. Verify that the part number of the control you received is the same as the part number listed on your purchase order.
4. If the control is to be stored for several weeks before use, be sure that it is stored in a location that is clean, dry and free from corrosives and contaminants. Storage temperatures must not exceed 140°F (60°C).

Be sure to read and become familiar with the safety notices in Section 1 of this manual. Failure to observe the product safety notices can result in injury or equipment damage. If you have questions, please contact your Baldor distributor. Do not proceed unless you understand the installation and operation requirements and safety notices.

### Physical Location

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

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

1. For effective cooling and maintenance, the control should be mounted vertically on a flat, smooth, non-flammable vertical surface. Heat dissipation of 3.3 watts per running FLA of the motor must be provided. All factory supplied enclosures provided adequate heat dissipation.
2. If the control is mounted in an enclosure, sufficient air flow must be provided. The fan or blower must be rated for at least 0.8 cubic feet per minute for each ampere of motor FLA rating.
3. Keep high voltage and low voltage wiring separated. If the conduits must cross, be sure that they cross at 90° angles only.
1. Motor overload protection is required for starters that do not have an overload protection device.
2. The multipurpose soft starter is suitable for use on a circuit capable of delivering no more than the short circuit  $A_{RMS}$  listed in Table 2-1.
3. A short circuit current and overcurrent devices are required for soft start controls that do not have a circuit breaker or fusible disconnect switch.

### AC Main Circuit **Protection Devices**

Be sure a suitable input power protection device is installed. Use the recommended circuit breaker or fuses listed in Table 2-1. Wire sizes and protective device specifications are based on the maximum output power rating of the control.

### **Power Disconnect**

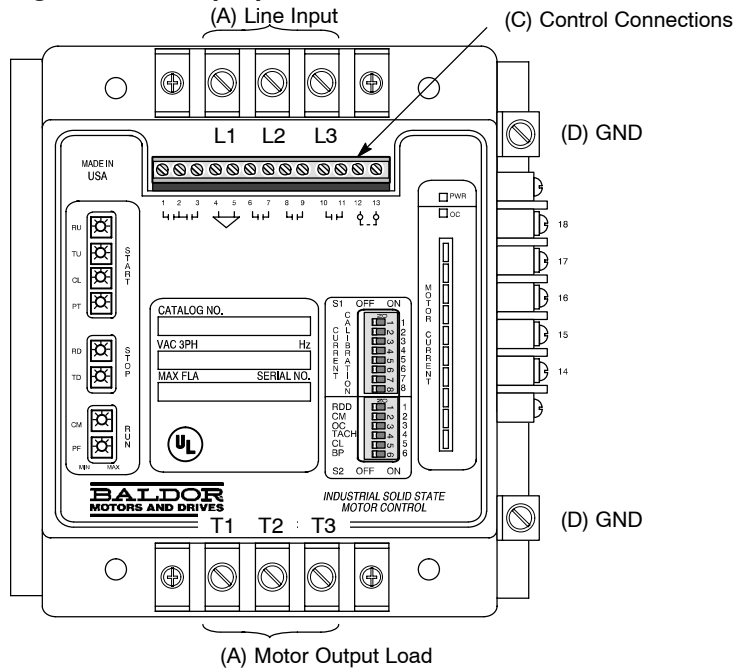
A power disconnect should be installed between the input power service and the control for a fail safe method to disconnect power. The control will remain in a powered-up condition until all input power is removed from the control and internal voltages are depleted.

**Table 2-1 Three Phase**

Rating (AMPS)	Fuse			MCP (GE)		
	Amps	Class	Short Circuit $A_{RMS}$	Amps	Type	Short Circuit $A_{RMS}$
8	100	J	5,000	20	SELA SFLA SGLA SKLA	5,000
16	100	J	5,000	20		5,000
30	200	J	5,000	50		5,000
	100	RK1	5,000	50		
55	175	J	42,000	100		10,000
80	175	J	42,000	100		10,000
160	400	RK5	100,000	300		42,000
250	400	RK5	100,000	300		42,000
420	800	L	100,000	600		42,000
600	800	L	100,000	600		42,000
840	1200	L	100,000	600	42,000	

Note: Maximum recommended fuses/breakers are based on 25°C ambient, maximum continuous current.

**Figure 2-4 Multipurpose Control Terminal Locations**





## Installation

1. Mount the panel or enclosure to the mounting surface. The panel or enclosure must be securely fastened to the mounting surface. Refer to the mounting dimensions in Section 6 of this manual.
2. Ground the panel and control per NEC article 250 as well as state and local codes.
3. Use copper wire rated for at least 75°C. Refer to Figure 2-4 and Table 2-2 for wire size recommendations.
4. Connect the incoming AC power wires from the power disconnect and/or protection devices to L1, L2 and L3 terminals. Tighten each terminal as specified in Figure 2-4 and Table 2-2.
5. \* Connect earth ground to the “GND” of the control. Be sure to comply with local codes.
6. Verify the input line voltage is correct.
7. For MA#-XX models, verify the line voltage selection jumpers on the LCM module are properly set. For MB#-XX models, verify the control transformer primary taps are connected for the line voltage applied.
8. Connect the three phase power leads of the AC motor to terminals T1, T2, and T3 of the Main Circuit Terminals.
9. \* Connect motor ground wire to the “GND” of the control. Be sure to comply with all applicable codes.

**⚠ Caution:** Do not supply any power to the “Close To Run” terminals. Power on these leads can damage the control. Use a dry contact type that requires no external power to operate.

10. Connect the remaining control terminals as required for your installation. Refer to Figure 2-4 and Table 2-2 for wire size and terminal torque specifications.
- \* Grounding by using conduit or panel connection is not adequate. A separate conductor of the proper size must be used as a ground conductor.

**Table 2-2 Recommended Wire Size and Tightening Torque**

Starter Rating	Terminal	Torque		Wire Size	
		lb-in	Nm	AWG	mm <sup>2</sup>
8, 16 and 30 AMPS	A	20	2.5	10-16	6-1.5
	B	35	4	8	10
	C	12	1.4	12-22	4-0.34
	D	45	5.1	6-14	16-2.5
55 through 840 AMPS	A	<b>Note 1</b>	<b>Note 1</b>	<b>Note 2</b>	<b>Note 2</b>
	B	<b>Note 1</b>	<b>Note 1</b>	<b>Note 2</b>	<b>Note 2</b>
	C	12	1.4	12-22	4-0.34
	D	45	5.1	6-14	16-2.5

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.

**Note1:** Refer to the label on the equipment panel for line and load tightening torque values.

**Note2:** Line and Load wires sizes for 55 through 840 AMP models are as follows:

AMPS	Wire Size	
	AWG	mm <sup>2</sup>
55	4	25
80	3	30
160	3/0	95
250	350 mcm	185
420	2x 300 mcm	2x 150
600	2x 500 mcm	2x 240
840	3x 500 mcm	2x 240

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## **Non-Motor and Special Motor Applications**

- Non-motor load:** The multipurpose control is designed to provide reduced starting voltage for standard three phase induction motors. The control may also start non-motor loads for controlled inrush current applications with resistive or inductive loads. Consult Baldor if the control is to be used with a non-motor load.
- Wye-Delta or Part Winding Starter:** The multipurpose control can replace an existing wye-delta or part winding starter. Begin by removing the existing contactors. Wire the motor in its "RUN" delta configuration and connect the motor to the control. The control can be used as if it were controlling a standard design B motor.
- Wound Rotor Motors:** Consult Baldor if the control is to be used with a wound rotor or slip ring type motor. This type of load produces high starting torque with reduced starting current and speed. The multipurpose control provides low starting current and low starting torque. The multipurpose control can be used for applications that do not require high starting torque and a continuous speed reduction.
- High Slip Motors:** The multipurpose control can be used with high slip motors, such as design D. These motors are used with large inertial loads that require extended starting times. Reduced starting voltage will reduce the starting current and extend the starting time. Long starting times may require using slow trip overloads. However, the thermal capabilities of the motor and control must be evaluated before extending the overload trip times.
- Reversing Applications:** For reversing applications, two multipurpose controls can be used or a reversing contactor can be used. Consult Baldor for more information.
- Multispeed Motors:** **Consult Baldor if the control is to be used with a multispeed motor.** The control can be used with a multispeed motor if a multispeed starter is connected between the control and the motor. In this case, an additional MOV must be connected to the terminal side of the control. Switching is normally done by auxiliary contacts from the multispeed starter that are connected to the control circuit of the multipurpose control.
- Motors on Grounded and open delta systems:** A multipurpose starter should not be used with "Delta" or "Open" ground systems. Without a proper ground, the circuit to detect a shorted SCR condition may malfunction or may not be able to detect a shorted SCR condition.

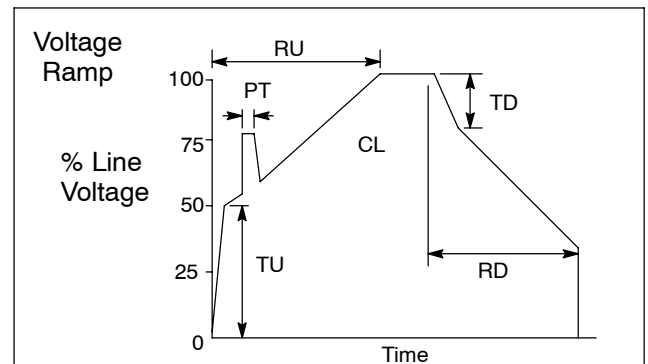
## Section 3 Operation

### Types of Starting

#### Voltage Starting (S2-4 = OFF)

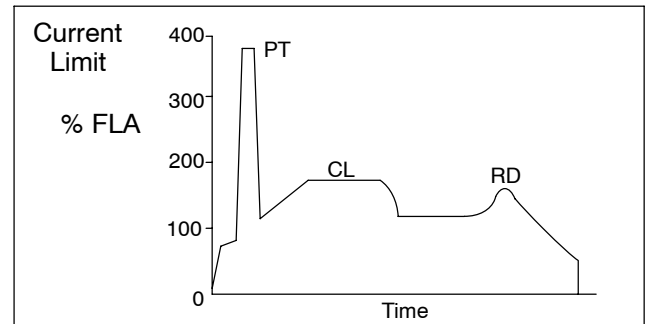
During start the initial voltage (TU) is set to a level where the motor will begin to turn when power is applied. The ramp time (RU) is adjustable to provide a smooth start. The pulse time (PT) is used for high friction loads to break loose "frozen" loads with up to 400% FLA.

If a ramp down function is needed, the initial voltage TD setting is used to lower voltage to a level where the motor will begin to slow down when the stop button is pushed. Ramp down (RD) can only extend motor stopping time preventing sudden stopping problems such as water hammer.



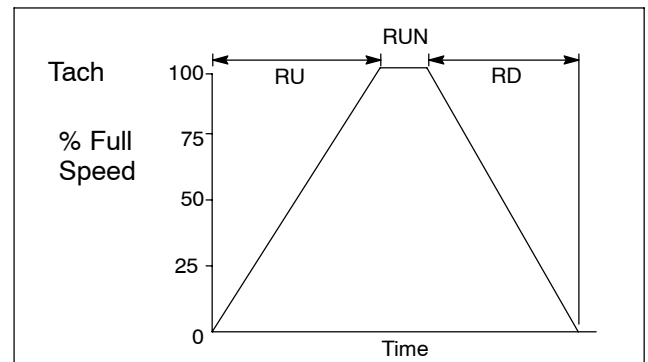
#### Current Limit Starting (S2-5 = ON)

If current limit starting is selected the starter will operate similar to voltage starting. On high inertia loads such as chippers and grinders the Current Limit (CL) setting is what determines the starting time. The starter will provide that current regardless of the ramp time setting. The CL setting must be high enough to provide enough starting current in all starting conditions. Ramp down (RD) can only extend motor stopping time preventing sudden stopping problems such as water hammer.



#### Tach Feedback Starting (S2-4 = ON)

Tach feedback starting/stopping uses a 0-10 VDC Tach signal. The control will provide voltage to the motor to generate a smooth linear starting even under cycling load conditions. Ramp down (RD) can only extend motor stopping time preventing sudden stopping problems such as water hammer.



---

## **Start Adjustments** (Refer to Figure 3-1).

### **Ramp Up**

Ramp up time (RU) is adjustable from 3 to 50 seconds. RU adjusts the voltage ramp or the tachometer starting ramp time. For voltage starting, RU adjusts the time it takes the motor to reach full voltage. Actual acceleration time to full speed depends upon the motor load and the setting of the additional start adjustments.

For Tach feedback starting, RU adjusts the motor starting time independent of the load when used with a 0 to 10 VDC tachometer feedback signal. Smooth linear speed ramp up with constant acceleration is achieved.

### **Torque Up**

The initial starting torque (TU) for ramp up is enabled only in the voltage ramp mode. Usually set high enough to start the motor slowly turning the instant the start button is pressed.

### **Pulse Time**

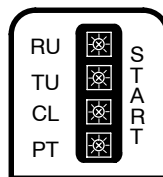
Starting pulse time (PT) is adjustable from 0 to 1.5 seconds in the voltage ramp mode. When the start button is pressed, the initial motor voltage depends on the setting of TU. One second after the start button is pressed, a pulse of approximately 400% FLA will occur; the duration will depend upon the setting of PT.

### **Current Limit**

Current limit (CL) is adjustable from 75 to 400% of FLA. It can be used in both the voltage and tachometer ramp modes of operation. When CL is enabled (S2-5=ON), motor starting and stopping current will not exceed the set point of CL, except during PT.

Note: CL must be set high enough to allow the motor to start under maximum load conditions. In the Tach feedback mode, CL will affect linearity and start and stop times. The current is held at the CL limit until the motor current decreases to less than the CL setting, regardless of the RU setting.

**Figure 3-1**



## **Stop Adjustments** (Refer to Figure 3-2).

### **Ramp Down**

Ramp downtime (RD) extends the stopping time from 5 to 50 seconds. RD can be used in both the voltage and tachometer modes.

In the tachometer mode, when used with a 0 to 10 VDC tachometer feedback signal, RD will adjust the actual stopping time independent of motor load condition. Smooth linear speed ramp down with constant deceleration is achieved.

In the voltage mode, RD adjusts the time it takes to reach minimum motor voltage and turn off. The actual stopping time will depend on the motor load condition.

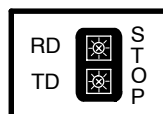
Note: Ramp down mode is not suitable for coasting or inertial loads that require braking. Ramp down will only extend the stopping time.

### **Torque Down**

Torque down advance (TD) is adjustable from 0 to 100% advance. TD sets the initial torque or voltage which ramp down starts and can be used in both voltage and tachometer modes.

In ramp down mode, when the stop button is pressed, voltage will immediately decrease to the set point of TD. Control will continue to ramp down to zero speed or voltage, depending upon RD setting, then the control will turn off.

**Figure 3-2**



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## **Run Adjustments** (Refer to Figure 3-3).

### **Current Monitor**

Current monitor set point (CM) is adjustable from 50 to 400% FLA to monitor the running current after the motor reaches the full run condition.

With CM enabled (S2-2=ON), if the running current exceeds the CM set point, the control will shut down, the CUR MON contact will close, and the light will illuminate.

With CM disabled (S2-2=OFF), if motor current exceeds CM set point, the control will not shut down, the CUR MON contact will close and the light will illuminate.

### **Power Factor**

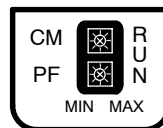
Power factor effect (PF) is adjustable from 0 to 100%. PF is used to adjust the maximum voltage applied to the motor under lightly loaded conditions to minimize motor current with minimum motor load.

PF is enabled after the motor reaches full on condition.

PF should be turned off (CCW) if more than one motor is used with one control or if a by-pass contactor is used.

Note: PF adjustment has no effect in bypass mode.

**Figure 3-3**



**Current Calibration Switch** Refer to the multipurpose control Current Calibration Chart in Appendix A. Set switches S1 to the motor FLA rating. Calibration is based on the motor nameplate full load amperes (FLA), not necessarily actual running current. Motors with more than 6 times locked rotor current may require a higher setting to start properly.

## **Operating Parameters Switch** (Refer to Figure 3-4).

Switches S2-1 thru S2-6 select the operating modes that best fit the application.

### S2-1 Ramp Down Disable (RDD).

In the “On” position: When the stop button is pressed, the control will immediately turn off. User stop adjustments RD (ramp down time) and TD (ramp down initial starting torque) are disabled.

In the “Off” position: When the stop button is pressed, the control will ramp down. In the voltage mode of operation, ramp down time depends on RD and TD settings and the load condition.

### S2-2 Current Monitor (CM)

“On” position: If the motor running current exceeds the Current Monitor (CM) setting, the control will shut down. The shut down condition is indicated by the current monitor light and the closure of the current monitor contact. The current monitor is typically used to shut the control down when a jam occurs. To restart the control, press stop, then start; or open the close to run circuit, then close it.

“Off” position: If motor running current exceeds the current monitor setting, the current monitor light and contact will indicate this condition but the control will not shut down. The current monitor can be used as an over and under current monitor.

### S2-3 Over Current Indicator (OC).

“On” position: If an over current trip occurs (current exceeds 450% FLA), the control will shut down and the condition will be indicated by the OC light and CM light and the closure of the current monitor contact. To restart the control, press stop then start; or open the close to run circuit, then close it.

“Off” position: An over current trip is indicated by the over current light and will not affect the current monitor. The control will shut down.

### S2-4 Tachometer and Voltage Ramp Select (TACH)

“On” position: The control is in the tachometer ramp mode during start and stop. Starting and stopping times are independent of the load conditions. Ramp up (RU) is dependent on the ramp up and current limit (CL) settings. RD is dependent on the RD and CL settings.

Note: Current limit is disabled if S2-5 is “Off”. Operation in the tachometer mode requires an isolated input tach signal of 0 to 10 volts DC with a 10 msec response time or better. Tachometers with other voltage ranges may be used with this control. Consult the factory for instructions.

If the tachometer full speed voltage is less than 10 volts DC, the starting and stopping times will be proportionally shorter. For example, if the starting and stopping times are adjusted to 20 seconds with a 0 to 10 volt DC tachometer signal; for a 0 to 5 Volt DC tachometer signal with the same setting, the time will be 10 seconds.

“Off” position: The control is operating in the voltage ramp mode during start and stop (if ramp down is selected using S2-1). All user settings for start, stop and run can be used to set up the control to meet the application requirements. Starting and stopping times are dependent on the actual load condition and control settings.

### S2-5 Current Limit Enable (CL)

“On” position: Starting and stopping current will not exceed the setting of the current limit setting, except during PT, if pulse start is being used. Current limit must be set high enough to allow the motor to start under maximum load conditions.

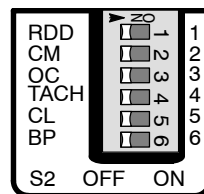
“Off” position: Current limit is disabled. Maximum motor current is then limited by the over current shutdown circuit to 450% FLA, preset at the factory.

### S2-6 By-Pass Select (BP)

“On” position: When the end of ramp contact closes, the circuit breaker shunt trip circuit (the Shunt Trip contact on the Multipurpose control module) is disabled after the starter is in the full run condition. This allows the use of a by-pass contactor without tripping the circuit breaker when the power cells are bypassed.

“Off” position: the Shunt Trip circuit is enabled at all times.

**Figure 3-4**



**Control Connections** (Refer to Figure 3-5).

**CLOSE TO RUN**

Close to Run terminals 12 and 13. Close to run contact must be closed to initiate ramp up and run. Close to Run contact must be opened to initiate ramp down to stop. Close to run contact must be dry and electrically isolated contact. If a voltage is applied to these terminals, the control may be damaged.

When the Close to Run circuit is closed, the Start/Run light will be on and the contact will close. This normally open contact is typically used to seal in the start button circuit.

**START/RUN**

Start/Run light and contact terminals 10 and 11. As long as the Closed to Run circuit remains closed, the Start/Run light and contact will remain activated. This condition also applies to an over current or a current monitor shutdown.

**SHUNT TRIP**

Shunt Trip light and contact terminals 8 and 9. If the control detects a shorted SCR condition, the shunt trip light will be on and the contact will close. The shunt trip contact is used to operate a Shunt Trip device in the circuit breaker or similar disconnection means to remove the motor and controller from the line should a shorted SCR condition occur.

The shunt trip circuit may also detect loss of phase or low voltage on a phase. The circuit may not work properly on grounded delta systems or open delta systems. The Shunt Trip circuit will trip when energized on single phase or an unbalanced line voltage.

**RAMP END**

Ramp End light and contact terminals 6 and 7. In the voltage or the tachometer modes, when the starting ramp is completed and the control is in the full run mode, the ramp end light will be on and the contact will close. The starting current limit is then disabled and CUR MON (running current monitor) is enabled.

Note: Since most loads do not require full voltage and torque to reach full speed, when control is in the voltage ramp mode, the motor will reach full speed before the ramp end contact and light are activated. Ramp end will only be activated after the motor and control reach full voltage.

The ramp end contact can be used to turn on other equipment. The ramp end contact can be used to close the bypass contactor to reduce heat dissipation of the SCRs.

**TACH**

Tachometer input terminals 4 and 5. The TACH input is used in the tachometer mode (S2-4=ON). The input required for TACH feedback is a 0 to 10 volt DC signal with a maximum 10 ms response time.

**MTR PWR**

Motor Power light and contact at terminals 2 and 3. Indicates that voltage and current are supplied to the motor. If a current monitor or an over current shut down condition occurs, the contact is deactivated and the light is turned off.

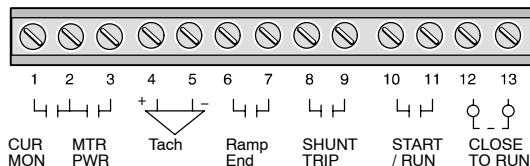
**CUR MON**

Current Monitor light and contact terminals 1 and 2. A user adjusted monitor. Maximum running current is adjustable from 50% to 400% FLA. Switch S2-2 controls the CM monitor.

S2-2 "On" position: If motor current exceeds the CUR MON setting, the light will be on and the contact will close. In addition, the motor power and ramp end LEDs will be off and their contacts will open. The control will shut down. The Start/Run light will stay on and the contact will remain closed. Typically used to shut down the control in case of a mechanical jam. To restart a CUR MON shutdown, press stop then start; or open the close to run circuit, then close it.

S2-2 "Off" position: If current exceeds the CUR MON setting, the light will be on and the contact will close for the duration of the over current. The control will not shut down. In this mode, the CUR MON monitor can be used as an over and under current monitor.

**Figure 3-5**



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## Indicators

### **Power On**

The PWR light indicates that power is supplied to the internal power supply of the control.

**⚠ WARNING: If the power light is not illuminated, it does not necessarily mean that the line voltage is off. Electrical shock hazard may exist. Measure the voltage at the line terminals before service.**

### **Over Current**

OC over current shutdown LED. If the control shuts down due to an over current condition (motor current is greater than 450% FLA), the OC light will be on. To restart the control, press stop, then start; or open the close to run circuit, then close it.

### **Motor Current**

The Motor Current display is a 10 segment bar graph representation of motor current from 0 to 400% FLA. Used to check ramp up, run and ramp down current conditions while the control is in operation.

## Summary of Start and Stop Sequences

**To Start the Motor:** Close 12 - 13 (Close to Run) and the following occurs:

1. 10 - 11 close to confirm start command.
2. 2 - 3 close when power is applied to motor. Ramp up cycle begins.
3. 6-7 close at the end of ramp up cycle.

**To Stop the Motor:** Open 12 - 13 (Close to Run) and the following occurs:

1. 10 - 11 open to confirm stop command.
2. 6-7 opens immediately.
3. 2 - 3 operation depend on ramp down mode selection:  
**With Ramp Down:** 2 - 3 opens when ramp down is complete.  
**Without Ramp Down:** 2 - 3 opens immediately.

**Shunt Trip:** During normal operation, detection of a shorted SCR, misfiring SCR will cause the following:

1. 8 - 9 close immediately.
2. Shunt Trip light turns ON.
3. The shunt trip breaker is immediately tripped and all power is removed from the control and motor.

Note: The shunt trip breaker will only trip if it is connected to the shunt trip contact at terminals 8 & 9.



## Section 4 Start-up

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### Safety Notice

Be sure to read and understand all notices, warning and caution statements in Section 1 of this manual. If you have any questions about the safe operation of this equipment, please contact your Baldor representative before you proceed.

### Start-up Checklist

#### Recommended Equipment

Volt meter (20k $\Omega$  per volt or better, true RMS meter).  
Clamp on ammeter (5 times FLA full scale).  
Adjustment wand (provided with multipurpose soft start control).

#### Overview

The following adjustment procedures are examples and are intended to be used as a guideline to match motor starting characteristics to the load. Actual loads may be characterized by one or more of the examples. These procedures are intended to help you design your own procedure for your specific application.

Keep in mind that reducing the starting current by one half will reduce the starting torque by one fourth. This will cause the motor to take four times longer to reach full speed. In situations where overloads tend to trip because of long starting times, increase the starting current and decrease the ramp up time (RU) to help eliminate nuisance trips.

The potentiometer adjustments have a maximum span of 270°. Use the adjustment wand (provided) to adjust these devices and do not force the adjustments beyond their mechanical stops.



**Caution:**

**This equipment is shipped as a multipurpose apparatus. Before power is applied, the line voltage selection and the full load current calibration must be correctly set. Failure to select the proper line voltage or to calibrate the full load current may cause damage.**

Switches S1 and S2 as well as all potentiometer adjustments are not factory preset. These will be set during the example procedures given in this section.

#### Before you apply Power

- Verify the installation procedure has been performed correctly.
- Know if your application is one of the “Non-motor and Special Motor Applications” described in Section 2.
- Verify the wiring to the motor does not have any short circuits.
- Verify the motor is properly connected. Verify the voltage and full load amp rating on the motor nameplate.

Note: A load must be connected to the control for testing. If the actual load cannot be connected, connect any small motor temporarily for testing.

- Verify that the control transformer is properly jumpered for the line voltage at your location. (MB#–XXX models).
- Verify that the control module jumper is correctly set for the line voltage. (MA#–XXX models).
- Set S1 to the motor nameplate FLA value.
- Set S2 for the type of application.
- Set potentiometers as suggested.
- Verify the overload setting corresponds to the full load current range on the calibration label.

#### After you apply Power

- Verify the input voltage to the starter and the 115VAC from the control transformer (if a control transformer is installed).
- Verify the PWR light is on. (If not, refer to troubleshooting).
- Verify the shunt trip light is OFF. If it is ON, verify the motor is connected and all three motor phases are present. If the motor is connected and the shunt trip light is on, do not attempt to start the control. A short in the motor or wiring may exist.
- Perform the starting procedure for your application.

---

## **Quick Set-Up**

1. Check continuity of the motor wiring and check for phase to phase and phase to ground short circuits.
2. Connect the control wiring for your application.  
(Refer to section 2 for wire size and torque specifications).
3. For MB#-XXX models, verify the control transformer is set for the line voltage.  
For MA#-XXX models, verify proper voltage jumper selection on LCM models.
4. Calibrate S1. Refer to Appendix A for switch settings.

### **Voltage Ramp Starting - (Fans or lightly loaded motors)**

5. Set for ramp up **with** ramp down as follows:  
S2-1 = OFF Ramp down disable  
S2-2 = OFF Current monitor  
S2-3 = OFF Over current shut down  
S2-4 = OFF Tachometer enable  
S2-5 = OFF Current limit enable  
S2-6 = OFF Bypass contactor  
Set RU, TU, PT and PF fully CCW.  
Set RD and RT at mid point.
6. Set for ramp up **with no** ramp down as follows:  
S2-1 = ON Ramp down disable  
S2-2 = OFF Current monitor  
S2-3 = OFF Over current shut down  
S2-4 = OFF Tachometer enable  
S2-5 = OFF Current limit enable  
S2-6 = OFF Bypass contactor  
Set RU, TU, PT and PF fully CCW.

Note: If the control OC trips, use Current Ramp Starting.

7. Continue with step 14.

### **Current Ramp Starting - (High inertial loads)**

8. Set for ramp up **with** ramp down as follows:  
S2-1 = OFF Ramp down disable  
S2-2 = OFF Current monitor  
S2-3 = OFF Over current shut down  
S2-4 = OFF Tachometer enable  
S2-5 = ON Current limit enable  
S2-6 = OFF Bypass contactor  
Set RU, TU, PT and PF fully CCW.  
Set RD and RT at mid point.
9. Set for ramp up **with no** ramp down as follows:  
S2-1 = ON Ramp down disable  
S2-2 = OFF Current monitor  
S2-3 = OFF Over current shut down  
S2-4 = OFF Tachometer enable  
S2-5 = ON Current limit enable  
S2-6 = OFF Bypass contactor  
Set TU, PT, RD, TD and PF fully CCW.  
Set RU fully CW.  
Set CL to midpoint.
10. Continue with step 14.

### Tach Feedback Starting

11. Set for ramp up **with** ramp down as follows:  
 S2-1 = OFF Ramp down disable  
 S2-2 = OFF Current monitor  
 S2-3 = OFF Over current shut down  
 S2-4 = ON Tachometer enable  
 S2-5 = OFF Current limit enable  
 S2-6 = OFF Bypass contactor  
 Set RU, TU, PT and PF fully CCW.  
 Set RD and RT at mid point.
12. Set for ramp up **with no** ramp down as follows:  
 S2-1 = ON Ramp down disable  
 S2-2 = OFF Current monitor  
 S2-3 = OFF Over current shut down  
 S2-4 = ON Tachometer enable  
 S2-5 = OFF Current limit enable  
 S2-6 = OFF Bypass contactor  
 Set RU, TU, PT and PF fully CCW.
13. Continue with step 14.

**⚠ 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: 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.**

14. Confirm the Close to Run contact is open.
15. Turn Power ON.
16. Close the Run contact.
17. The motor should just begin to rotate when power is applied and reach Ramp End in a minimum starting time. The control is properly set if the motor starts smoothly when power is applied and comes to speed as quickly as possible. Be sure CL is set high enough so the motor can start with a full load. The control is finished starting when the Ramp End light is ON.
18. If motor operation is not correct, perform one or more of the following adjustments:

If the motor	Remedy
Starts abruptly (jerks)	Decrease TU by turning it CCW.
Starts too slowly	Increase CL by turning it CW. Then decrease ramp time RU by turning it CW.
Starts too quickly	Decrease CL by turning it CCW. Then increase ramp time RU by turning it CCW.
Is connected to a high inertial load or a high slip motor is used	It may be necessary to increase S1 setting to allow more motor current for faster starting.
Is not starting properly	Refer to detailed starting instructions for your application for more information on starting adjustments. Also, refer to start-up troubleshooting.

---

## **Starting Instructions**

Choose one of the following examples that best matches your application. Read the procedure and set the control according to the procedure or use the steps to develop your own procedure.

### **Variable Load with Voltage Ramp (S2-2=OFF, S2-4=OFF)**

Typically used for non-inertial loads, loads that increase with speed and changing loads, such as axial fans and pumps.

1. Set RU, TU, PT, RD, TD and PF fully counterclockwise CCW).
2. Set CL and CM fully clockwise (CW).
3. Adjust TU clockwise sufficiently to start load slowly moving at moment of switching.
4. Adjust RU clockwise to achieve desired starting time with normal load conditions.

Note: Proceed to "Running Adjustment Procedure" if ramp down is not used.

5. Adjust TD clockwise sufficiently to cause the load to slow down soon after the stop button is pressed, with normal load conditions.
6. Adjust RD clockwise to achieve desired stopping time with normal load conditions.

### **Running Adjustment Procedure:**

After adjusting the starting and stopping characteristics, current monitor/trip (CM) and power factor adjustments can be made. If the power factor circuit is not used, turn the PF adjustment fully counterclockwise.

### **Power Factor Correction Adjustment (PF):**

1. Use an ammeter to measure motor running current.
2. With the motor at full speed, minimum load and the "Ramp End" light ON, adjust PF clockwise to minimize running current without oscillation. If there is no noticeable drop in current, repeat this step while measuring motor voltage.

### **Current Monitor/Trip (CM):**

1. Set S2-2=OFF.
2. Press start and allow the motor to reach full speed and the "Ramp End" light to turn ON.
3. Adjust CM to desired threshold by observing the "CUR MON" light.
4. The "CUR MON" contact can be used to indicate this threshold, or by setting the S2-2=ON, the starter will shut down. Press stop to reset the shutdown and trip condition.

### **Post Adjustment Check List:**

1. Check fans for proper operation.
2. If bypass contactor is used, check that the contactor is closing at Ramp End.
3. Using a current probe, measure current on all three motor phases. Be sure the current is balanced during ramp on, run and ramp down.
4. With the motor in run mode (Ramp End light "ON"), check phase current of all three phases. Currents should be balanced and within nameplate FLA.
5. Measure the line voltage at the control during ramp up to ensure voltage does not drop below minimum operating voltage.

---

## High Friction Load with Voltage Ramp (S2-2=OFF, S2-4=OFF)

Typically used for loads that require high breakaway torque and low acceleration torque; i.e., conveyors in icy environment, equipment that resists starting due to lack of use, traction loads, etc.

1. Set RU, TU, PT, RD, TD and PF fully counterclockwise (CCW).
2. Adjust PT clockwise sufficiently to start load slowly moving at moment of switching.
3. Adjust TU clockwise sufficiently to keep load moving after starting pulse.
4. Adjust RU clockwise to achieve desired starting time with normal load conditions.

Note: Proceed to "Running Adjustment Procedure" if ramp down is not used.

5. Adjust TD clockwise sufficiently to cause the load to slow down soon after stop button is pressed, with normal load conditions.
6. Adjust RD clockwise to achieve desired stopping time with normal load conditions.

### Running Adjustment Procedure:

After adjusting the starting and stopping characteristics, current monitor/trip (CM) and power factor adjustment can be made. If the power factor circuit is not used, turn the PF adjustment fully counterclockwise.

1. Use an ammeter to measure motor running current.
2. With the motor at full speed, minimum load and "Ramp End" light on, adjust PF clockwise to minimize running current without oscillation. If there is no noticeable drop in current, repeat this step while measuring motor voltage.

### Current Monitor/Trip (CM):

1. Press start and allow the motor to reach full speed and the "Ramp End" light to turn on.
2. Adjust CM to desired threshold by observing the "CUR MON" light.
3. The "CUR MON" contact can be used to signal this threshold, or by setting the S2-2=ON, the starter will shut down. Press stop to reset the shutdown and trip condition.

### Post Adjustment Check List

1. Check fans for proper operation.
2. If bypass contactor is used, check to ensure that the contactor is closing at Ramp End.
3. Using a current probe, measure current on all three motor phases. Be sure the current is balanced during ramp up, run and ramp down.
4. With the motor in run mode (Ramp End light "ON"), check phase current of all three phases. Currents should be balanced and within nameplate FLA.
5. Measure the line voltage at the control during ramp up to ensure voltage does not drop below minimum operating voltage.

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## **Inertial Load** (S2-1=ON, S2-4=OFF, S2-5=ON)

Typically used on coasting and/or flywheel loads; i.e., chippers, centrifuges, compressors, crushers, chillers, band saws, centrifugal fans and blowers.

Note: Ramp down and pulse start are not normally used with inertial loads.

1. Set TU, PT, RD, TD and PF fully counterclockwise (CCW).
2. Set RU approximately 90% clockwise.
3. Set CL to midpoint.
4. Set CM fully clockwise (CW).
5. Adjust CL sufficiently to allow motor to reach full speed in desired time with maximum normal load.

### **Running Adjustment Procedure:**

After adjusting the starting and stopping characteristics, current monitor/trip (CM) and power factor adjustment can be made. If the power factor circuit is not used, turn the PF adjustment fully counterclockwise.

### **Power Factor Correction Adjustment (PF):**

1. Use an ammeter to measure motor running current.
2. With the motor at full speed, minimum load and the "Ramp End" light ON, adjust PF clockwise to minimize running current without oscillation. If there is no noticeable drop in current, repeat this step while measuring motor voltage.

### **Current Monitor/Trip (CM):**

1. Set S2-2=OFF.
2. Press start and allow the motor to reach full speed and the "Ramp End" light to turn ON.
3. Adjust CM to the desired threshold by observing the "CUR MON" light.
4. The "CUR MON" contact can be used to signal this threshold, or by setting S2-2=ON, the starter will shut down. Press stop to reset the shutdown and trip condition.

### **Post Adjustment Check List:**

1. Check fans for proper operation.
2. If a bypass contactor is used, check that the contactor closes at ramp end.
3. Using a current probe, measure current on all three motor phases. Be sure the current is balanced during ramp up, run and ramp down.
4. With the motor in run mode (ramp end light "ON"), check phase current of all three phases. Currents should be balanced and within nameplate FLA.
5. Measure the line voltage at the control during ramp up to ensure voltage does not drop below minimum operating voltage.

---

### **Tachometer Mode** (S2-4=ON, S2-5=OFF)

Typically used for changing loads that require consistent starting and stopping times, independent of load condition, and pumping applications with severe head pressure to reduce water hammer; i.e., pumps, conveyors, stackers and other material handling equipment.

1. Set RU, TU, PT, RD, TD and PF fully counterclockwise (CCW).
2. Set CL and CM fully clockwise (CW).
3. Adjust RU and RD for desired ramp up and ramp down time. RD is only effective with S2-1=OFF.

#### **Running Adjustment Procedure:**

After adjusting the starting and stopping characteristics, the current monitor/trip (CM) and power factor correction circuit (PF) can be adjusted. If the power factor circuit is not used, turn the PF adjustment fully counterclockwise.

#### **Power Factor Correction Adjustment (PF):**

1. Use an ammeter to measure motor running current.
2. With the motor at full speed, minimum load and SSC "Ramp End" light ON, adjust PF clockwise to minimize running current without oscillation. If there is no noticeable drop in current, repeat this step while measuring motor voltage.

#### **Current Monitor/Trip (CM):**

1. Set S2-2=OFF.
2. Press start and allow motor to reach full speed and the "Ramp End" light to turn ON.
3. Adjust CM to the desired threshold by observing the "CUR MON" light.
4. The "CUR MON" contact can be used to signal this threshold, or by setting the S2-2=ON, the starter will shut down. Press stop to reset the shutdown and trip condition.

#### **Post Adjustment Check List:**

1. Check fans for proper operation
2. If a bypass contactor is used, check to ensure that the contactor closes at ramp end.
3. Using a current probe, measure current on all three motor phases. Be sure the current is balanced during ramp up, run and ramp down.
4. With the motor in run mode (ramp end light "ON"), check phase current of all three phases. Currents should be balanced and within nameplate FLA.
5. Measure the line voltage at the control during ramp up to ensure voltage does not drop below minimum operating voltage.

---

**Start-up Troubleshooting** The Multipurpose Control module has 7 LEDs to help diagnose problems. There is a summary of the functions and indications on pages 2-8 and 2-9. The Multipurpose starter was tested under load with all SCR and electronic functions checked before shipping.

Note: To test the output of a soft starter a motor must be connected, even if it is a 1/2 HP motor on a 700 HP starter. Be careful not to start large motors repeatedly without a cooling-down period.

#### **No Power To The Motor**

1. Verify the PWR light is "ON".
2. Verify the Start/Run light is "OFF" and confirm terminals 12-13 on the control module are open.

3. Give the starter a start command by closing the start contact connected to terminals 12 and 13 (verify the Start/Run light is "ON").

If the Start/Run light is not ON, turn off power and connect terminals 12 and 13 together with a small piece of wire as the jumper. Turn power ON. The Start/Run light should come "ON" then the MTR PWR light should come "ON" with power going to the motor.

If this sequence occurs using the jumper, check the start circuit as to why it did not close the terminals 12-13. If this sequence did not occur, check the voltage going to the logic control module.

#### **Motor Does Not Start or Motor Does Not Come Up To Speed or The Motor Overload Overload Trips**

Adjust the "CL" to the max. If the motor is still not starting, set the S1 switch for current calibration to the max. for that control size. Setting the S1 switch to a higher setting only effects the calibration of light bar current indicator.

##### **Test:**

Try restarting the motor while adjusting the "CL" pot during starting. During starting, check that the incoming voltage is not dropping. If it fails to start at the max. S1 setting, record the line voltage during starting, the motor data including the lock rotor amps and contact your local Baldor office.

#### **Circuit Breaker is Tripping – On Power Up**

The circuit breaker supplied by Baldor is a motor circuit protector (MCP). It is also called an adjustable magnetic only breaker. This means it will only trip during a short circuit or instantaneous overcurrent condition. Baldor also adds a shunt trip module to the breaker. Isolate the problem by disconnecting the shunt trip circuit. Test for short circuit before re-energizing.

##### **Test:**

After the shunt trip circuit has been disabled, apply power. Check the shunt trip light, if it is "ON" it is detecting a shorted SCR, a loss of phase, a lack of a load or a grounded delta system. If the SCR's have been replaced, they may be miswired. Do not attempt to start until the problem is found.



---

### **Circuit Breaker is Tripping – During Starting**

If the shunt trip light comes “ON” during starting it may detect a weak input phase. This is typical of grounded delta and open delta power systems. For proper operation, a four wire WYE system is recommended.

If the shunt trip light is ON and it is determined that input power is correct and there is a motor load; Then, disable the shunt trip circuit and do an SCR resistance test.

1. If the result of the SCR test shows the SCRE's are in good condition, try restarting. If the shunt trip light comes ON again, check the line voltage for a weak phase.
2. If the SCR's test bad, find out why they failed.

SCR's fail due to high voltage. Is there a capacitor bank or a contactor in the circuit? Check MOV's and line voltage. MOV's may be shorted or open due to clearing of previous voltage spike.

SCR's fail due to high current or high temperature.

- a. Check the “T” leads for a phase to phase and phase to ground short circuit.
- b. Check the motor winding.
- c. Check the voltage balance of power supply. If one leg is going to 25 - 30% of nominal voltage or less during starting this will create high current on the other phases.
- d. Make sure the cooling fans are working and the ambient temperature is within specification.

All Baldor starters are tested under load before shipping for proper SCR performance.

### **OC light Comes ON Shutting “OFF” The Starter**

1. If it trips during starting it may mean that S2-5 (CL) needs to be set to “ON”. If it is already ON, be sure there are no capacitors or shorts in the motor leads.
2. If it trips when the Ramp End light comes ON, make sure that S2-2 (CM) is “OFF” or current monitor level is set properly for a given load.
3. The control will turn OFF any time motor current exceeds 450% of the S1 current calibration setting.



## Section 5 Troubleshooting

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### Safety Notice

Be sure to read and understand all notices, warning and caution statements in Section 1 of this manual. If you have any questions about the safe operation of this equipment, please contact your Baldor representative before you proceed.

### Preliminary Checks

In the event of trouble, disconnect all input power to the control and perform these preliminary checks.

#### Power Off Checks

1. Check all connections for tightness and signs of overheating.
2. Check for cracked or damaged insulators and terminal blocks.
3. Ensure the correct setting of the overload relay.
4. Check the fuse in the control transformer.
5. Perform the SCR resistance test for all SCR's.
6. If a shorted SCR is suspected, check for possible shorted connections, system grounds or any other condition which may cause the short circuit condition.
7. Replace the SCR pack or power cell if no other causes were found. However, installing a new SCR pack or power cell without determining the cause of failure can result in repeated failure of the SCR's. Refer to SCR replacement procedure in this manual.

#### Blocking Voltage Check

This check need only be performed if the resistance checks of the power cells or SCR packs (55 and 80 amps) are inconclusive.

**⚠ WARNING: Before power is applied to the control, be sure there is no danger to personnel or equipment if the motor shaft rotates when power is applied. A shorted SCR or damaged control can cause abnormal operation of the motor.**

1. Be sure power is off. Disconnect the load from the motor shaft if possible.
2. The T1, T2 and T3 motor leads should be connected to the control for this test.
3. Disconnect one of the wires at the shunt trip contact on the control to prevent operation of the disconnect circuit during this test.
4. Apply power to the control.
5. Measure the voltage from the line terminal to the load terminal on each of the power phases. The voltage should be about 0.58 times the input line to line voltage. If the voltage on any power cell or SCR pack is significantly less than this value, one or both SCR's in the power cell or SCR pack may be shorted.
6. Remove all power to the control.
7. If a shorted SCR is suspected, check for possible shorted connections, system grounds or any other condition which may cause the short circuit condition.
8. Replace the SCR pack or power cell if no other causes were found. However, installing a new SCR pack or power cell without determining the cause of failure can result in repeated failure of the SCR's. Refer to SCR replacement procedure in this manual.

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## **SCR Tests**

### **Inspection**

If the SCR devices are suspected of failure, these tests can be used to test the SCR's.

Be sure the physical condition of components is correct. Refer to Figure 5-1.

1. Be sure power is off.
2. Inspect power cell connections for tightness and signs of overheating.
3. Replace snubber capacitors if there is any sign of oil or fluid leaking. Snubbers are not used on size 55 and 80 amp power cells.
4. Inspect SCR clamp insulator for cracks.
5. SCR clamps should be tightened evenly. (Use clamp gauge available from Baldor).
6. Inspection and resistance test should be performed when system has experienced:  
Logic Control Module failure  
MOV failure  
Starting or running current imbalance  
SCR replacement  
Phase loss or single phasing
7. Heat sinks and insulating surfaces must be clean and unobstructed.
8. Size 55 and 80 amp power cells do not have snubber networks, SCR clamps or insulating base.

### **Full Voltage Test**

After the motor reaches rated speed and the control is no longer in current limit, the SCR's turn full on and deliver full voltage to the motor. When power factor correction (PF) is used, the control will reduce the voltage to the motor. For this reason, the PF adjustment should be set to "OFF" during this test. Refer to Figure 5-1.

1. Set the PF adjustment should be set fully CW (OFF) during this test.
2. Turn power on. Wait for the motor to reach full speed.
3. With the control in the run mode, measure the voltage across the line side to the load side on each control power cell or SCR pack. The voltage should be about 2 to 20 VAC. The voltage reading will vary depending upon the motor and the type of meter used. Voltage readings must be balanced on all three phases.
4. If the voltage is higher across one or two power cells or SCR packs, not all SCR's are firing properly.
5. If all three cells or SCR packs have approximately the same voltage drop across line to load when the motor is up to speed and motor current is unbalanced, the cause is the motor or unbalanced line voltage.

## Resistance Test

Disconnect the power cell or SCR pack from all external wiring before you perform a resistance check. Use an ohmmeter with 20,000 ohms per volt or greater impedance for the resistance measurements. Refer to Table 5-1 and Figure 5-1.

1. Be sure power is OFF.
2. Remove all wiring from the power cell or SCR pack.
3. Sizes 55 and 80 amps have three SCR packs, one for each phase mounted on a single ground potential heatsink. Check all three SCR packs. For example L-GL must be measured from L1-GL1, L2-GL2 and L3-GL3. Circuit SA-SB requires only one measurement.
4. Sizes 160 through 840 amps have a separate power cell for each phase. Check all three power cells.
5. If any of the resistance measurements are incorrect, the power cell or SCR pack should be repaired or replaced before operating the starter.

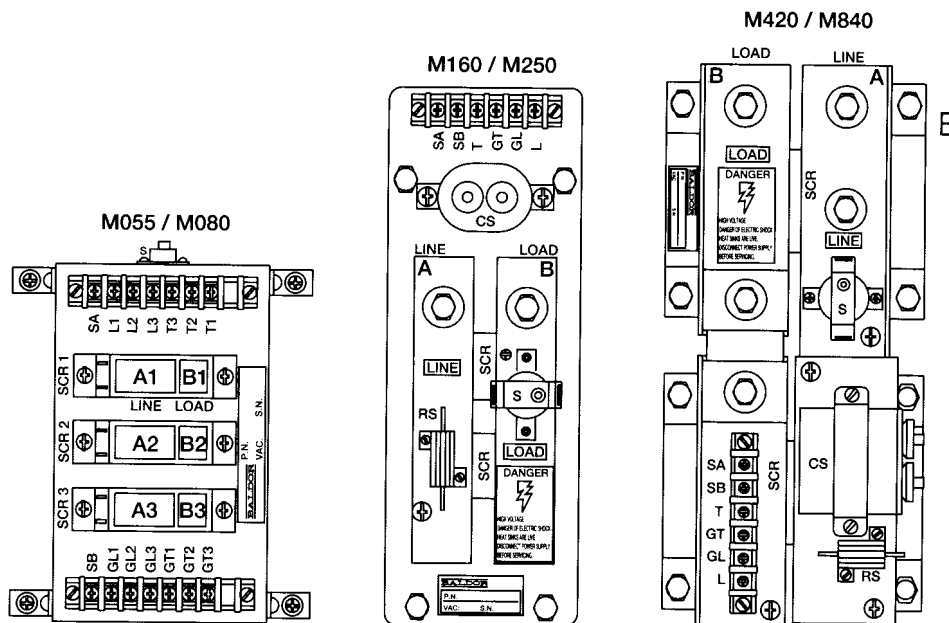
**Table 5-1**

Circuit	Resistance
L-A T-B SA-SB	Less than 5 Ohms
A-B	Greater than 10k Ohms
L-GL T-GT	5 to 100 Ohms

Note: Results from the resistance measurements can be satisfactory and the power cells may still be bad if the power cell is breaking down under voltage.

If resistance checks are not conclusive, perform Blocking Voltage Check and SCR Full Voltage Test.

**Figure 5-1 Power Cell Configurations**

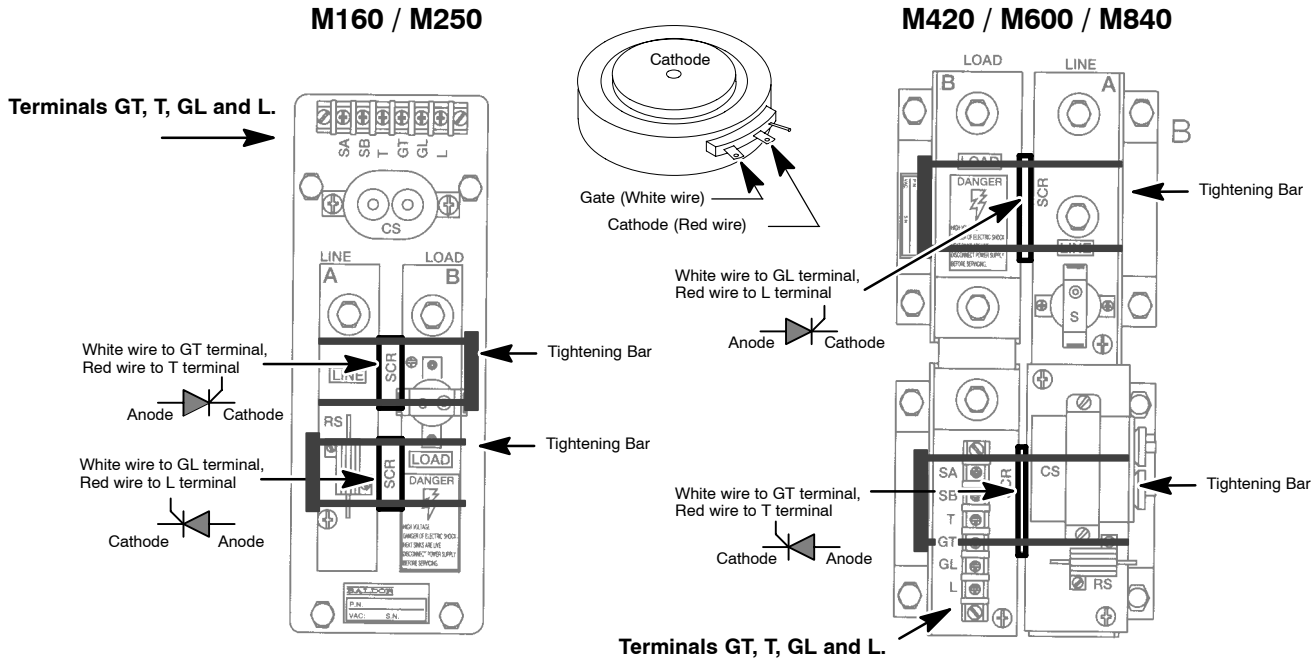


## SCR Replacement

### SCR Polarity

Figure 5-2 shows the polarity and wire colors for correct SCR installation. It also shows the locations of the tightening bars.

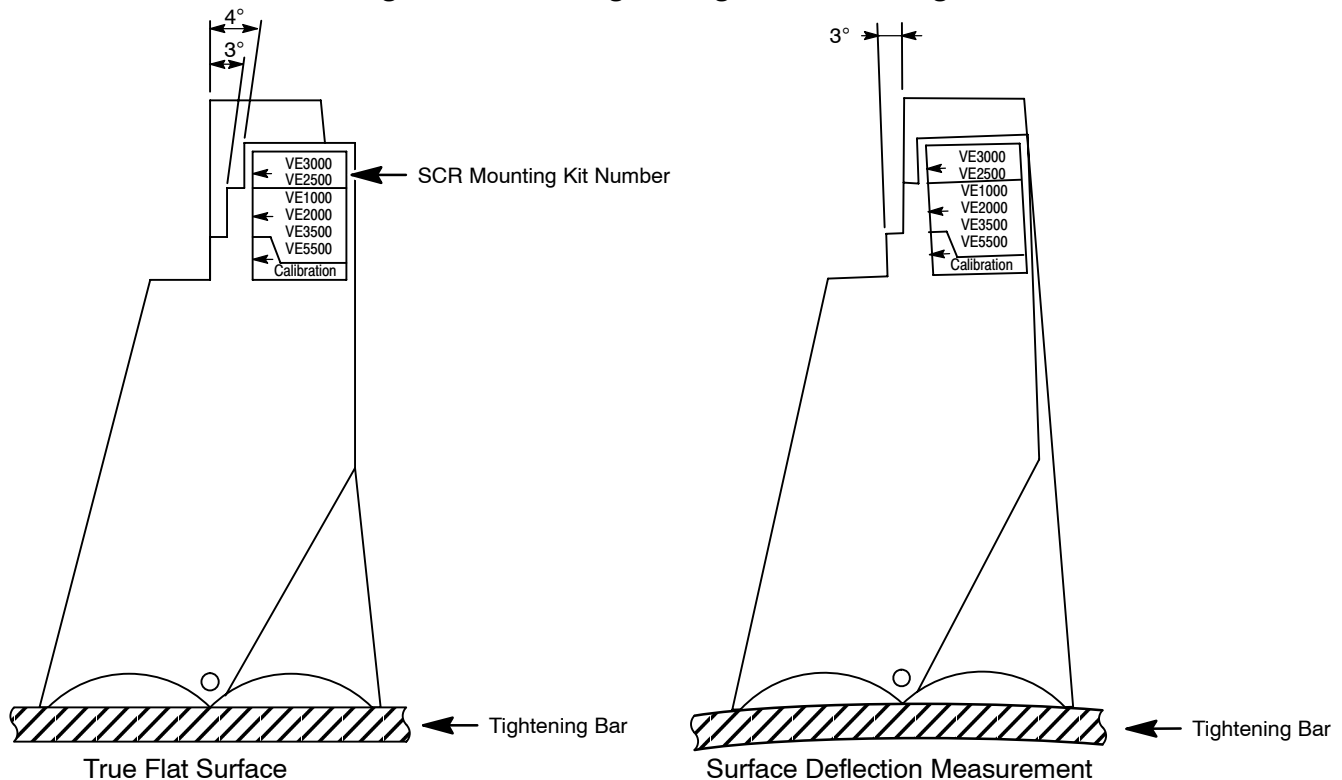
**Figure 5-2 SCR Polarity**



### SCR Pressure Gauge

Figure 5-3 shows how the pressure gauge is used.

**Figure 5-3 SCR Tightening Pressure Gauge**



Continued on next page.

With the SCR device installed with the tightening bar and bolts (Figure 5-2), tighten the bolts as follows: (see Figure 5-3)

1. Tighten the nuts evenly until finger tight.
2. Tighten bolts in 1/4 turn increments.
3. Use the SCR tightening pressure gauge and measure the deflection of the Tightening bar. The middle and both ends of the gauge must be in solid contact with the bar for an accurate reading. Correct pressure is indicated when the gauge notch for the tightening kit number align.

Note: An anti-seize compound may be used on the bolt heads and threads to reduce the torque required to obtain the correct mounting pressure.

**Logic Control Module Resistance Test** Refer to Figures 5-1 and 5-4.

This test will verify resistance measurements within the control.

1. Be sure power is OFF.
2. Disconnect the logic module from all external wiring before conducting resistance checks.
3. Use an ohmmeter with 20,000 ohms per volt greater.
4. Compare the measured values with the values shown in Table 5-2.

**Table 5-2**

Line/Load	
Circuit	Resistance
L1-L2	Greater than 500k Ohms
L1-L3	
L2-L3	
T1-T2	
T1-T3	
T2-T3	
L1-T1	
L2-T2	
L3-T3	

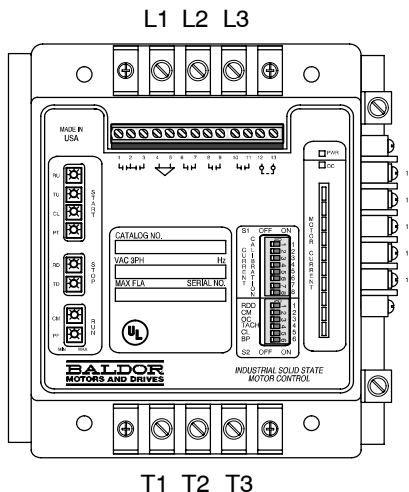
MB Gates	
Circuit	Resistance
L1-GL1	6.5 Ohms to 8.5 Ohms
L2-GL2	
L3-GL3	
T1-GT1	
T2-GT2	
T3-GT3	

MB Control Power Input	
Circuit	Resistance
14-15	130 to 180 Ohms
16-17	

MA Control Power Input	
Circuit	Resistance
14-15	220 - 240
14-16	260 - 560
14-17	615 - 910
14-18	1150 - 1180

**Figure 5-4**

Logic Control Module



**Table 5-3 Troubleshooting Chart**

Symptom	Cause	Corrective Action
MCP trips as it is closed (also see Shunt Trip light comes ON)	Motor is not connected.	Connect motor to T1, T2 and T3 of control.
	ST contact on control is always closed.	Repair or replace logic control module.
	Improper input voltage.	Obtain the correct source voltage at L1, L2 and L3.
	Shorted SCR.	Replace SCR or power cell.
	Control transformer (if equipped) set for wrong voltage.	Change tap connections for correct voltage.
MCP trips as the motor is started (also see Shunt Trip light comes ON)	MCP trip setting is too low.	Increase MCP Trip setting.
	Line voltage decreases during motor starting.	Fix incoming power problem.
	Motor or wiring is defective.	Check terminal and motor wiring.
	Capacitors on output of control.	Remove capacitors or move to line side of control.
	Logic control module is defective.	Replace logic control module.
	Improper current calibration.	Verify S1 settings for motor nameplate FLA rating.
MCP trips after the motor is running (also see Shunt Trip light comes ON)	PF set too high.	Reduce PF adjustment (rotate CCW).
	Occasional line imbalance.	Set S2-6 =ON to disable shunt trip while running.
	Ground or motor fault.	Check motor wiring.
	S2-6=ON but no bypass contactor is installed.	Check setting of S2-6. Should be Off.
Starter does nothing when start button is pressed.	No line voltage.	Restore line voltage.
	Overload is open.	Reset overload.
	No contact closure across terminals 12 and 13.	Check start circuit.
	Current trip occurs.	Check S1 settings for correct current calibration.
	Control module has no power.	Check control transformer jumper.
Control does not accelerate motor to full speed (Stalls)	CL set too low.	Increase CL adjustment (rotate CW).
	Line voltage decreases to less than minimum operating voltage during motor starting.	Fix incoming power regulation problem.
Insufficient torque available from current limit CL.	Improper current feedback.	Verify S1 settings for motor nameplate FLA rating.
	CL set too low.	Increase CL adjustment (rotate CW).
Motor accelerates too slowly.	Ramp up (RU) time set too long.	Decrease RU (rotate CCW).
	Improper current feedback.	Verify S1 settings for motor nameplate FLA rating.
Motor accelerates too quickly.	Current limit (CL) set too high.	Reduce CL (rotate CCW).
	Ramp up time (RU) set too short.	Increase RU (rotate CW).
	Initial pulse time (PT) set too long.	Reduce PT (rotate CCW).
	Improper current feedback.	Verify S1 settings for motor nameplate FLA rating.
	Light or no load (is dependent on motor load). A lightly loaded motor will reach full speed with low starting current or voltage. Motor may require the use of a tachometer.	Decrease TU, increase RU or install tachometer.
Motor current and voltage oscillates after start	Power factor correction set too high.	Reduce PF setting (rotate CCW) until oscillation stops.
Motor is noisy or vibrates when starting	Line voltage decreases to less than minimum operating voltage during motor starting.	Fix incoming power regulation problem.
	Single phasing due to an open phase.	Check wiring and overload heaters.
	Single phasing or unbalanced current due to a non-firing SCR.	Check for shorted SCR and replace.
	Single phasing or unbalanced current due to a defective logic control module.	Repair or replace the logic control module.
	Defective motor.	Check motor for shorts, opens or grounds.



**Table 5-3 Troubleshooting Chart** Continued

Symptom	Cause	Corrective Action
Overload relay trips when starting	Incorrect heater size or setting.	Check overload relay heater table in Appendix A.
	Loose or burned heater.	Tighten or replace heater.
	Long starting time. (high inertia loads may require slow trip overloads.	Evaluate the thermal capabilities of the motor before extending the overload trip time.
	Mechanical failure within the load.	Check machinery for binding or excessive loading.
	Single phasing or unbalanced start circuit.	Refer to "Motor is noisy or vibrates when starting".
	Excessive starting time (CL too low).	Increase CL (rotate CW).
Overload relay trips when running	Incorrect heater size or setting.	Check overload relay heater table in Appendix A.
	Loose or burned heater.	Tighten or replace heater.
	Mechanical failure within the load.	Check machinery for binding or excessive loading.
	Single phasing or unbalanced start circuit.	Refer to "Motor is noisy or vibrates when starting".
	Ambient temperature too high.	Use ambient compensated overload relay.
Motor decelerates too quickly (RDD=OFF)	Ramp down time (RD) set too short.	Decrease RD (rotate CW).
Motor decelerates too slowly (RDD=OFF)	Ramp down time (RD) set too long.	Decrease RD (rotate CCW).
Erratic operation	Loose connections.	Check all connections.
Shunt trip light comes ON	No load attached.	Connect a motor to T1, T2 and T3 terminals.
	Loss of phase or low input voltage to starter.	Repair the input voltage problem.
	Bad or misfiring SCR.	Check resistance and replace SCR if defective.
	Grounded delta power source.	Shunt trip is not effective.
	Note: If the MCP is tripping, remove the relay or disconnect the wires from terminals 8 and 9. You can then determine if the MCP is tripping or if the module is opening the MCP.	

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.

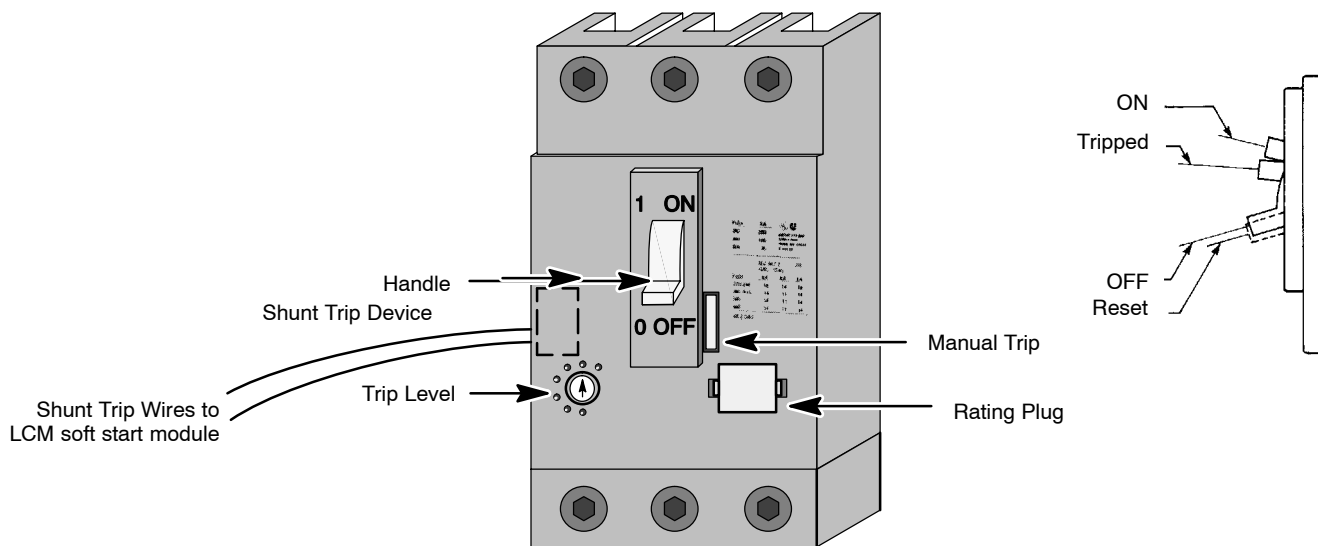
### **Reset the Circuit Breaker**

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 5-5.

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 an overcurrent condition is tripping the circuit breaker (not a shunt trip). If the circuit breaker shunt trip was energized, the trip was caused by the LCM soft start module shunt trip feature. Eliminate the cause of the shunt trip.

**Figure 5-5 Magnetic Circuit Breaker**

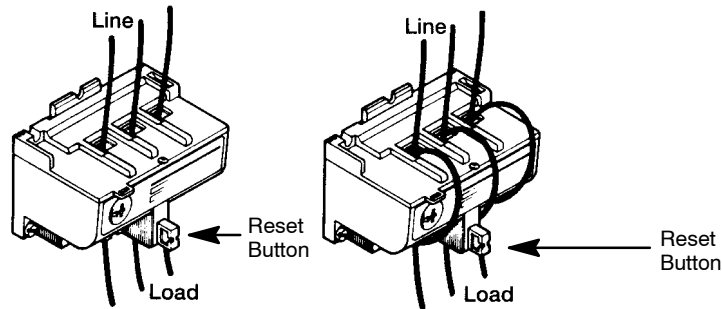


## **Reset an Overload Relay**

If the Overload relay is tripped, the tripped indicator (Reset Button of Figure 5-6) 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 to cool.
4. Press the "Reset Button" (Figure 5-6).

**Figure 5-6 Overload Relay**

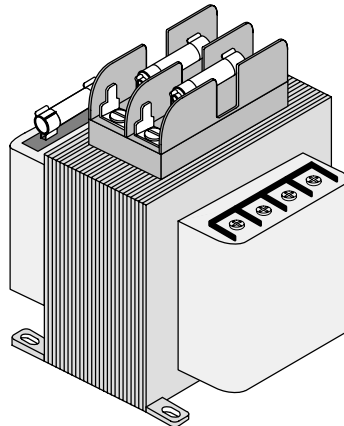


## **Fuse Replacement**

If the control circuit voltage drops to zero volts, the control power transformer fuses (Figure 5-7) 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, rating and interrupting capacity.

**Figure 5-7 Control Transformer with Fuses**





# Section 6

## Specifications and Product Data

### Identification

#### Three Phase Starters

M B 7 - 030 - C B - \* \*

#### Control Type

M- Multipurpose

#### Control Group

A - Self powered logic control module  
B - Logic control modules that require  
115 or 230VAC.

#### Input Voltage Code

7- 208/230/460VAC (60Hz)  
8- 230/460/575VAC (60Hz)  
MA9- 220/380/415 (50Hz)  
MB9- 380/400/415VAC (50Hz)

#### Ampere Rating

008- 8 Amp  
016- 16 Amp  
030- 30 Amp  
055- 55 Amp  
080- 80 Amp  
160- 160 Amp  
250- 250 Amp  
420- 420 Amp  
600- 600 Amp  
840- 840 Amp

#### Bypass Contactor

0 - Normally not shown unless a reduced size bypass is used.  
A - First size smaller bypass.  
B - Second size smaller bypass.  
C - Third size smaller bypass.

#### Disconnect Size

0 - Normally not shown unless a reduced size disconnect is used.  
1 - Reduced size disconnect used:  
i.e. 800 amp breaker on a 840amp control instead of a 1000 amp breaker.

#### Enclosure

A- Open  
B- NEMA1 (IP32)  
C- NEMA12 (IP65)  
P- Panel Mount

#### Configuration

A - Combination with overload & circuit breaker).  
B - Non-combination (with overload).  
C - Starter only.  
D - Combination with fuse disconnect.  
G - Bypass, combination starter.  
H - Bypass, non-combination starter.  
J - Bypass, starter only.  
K - Bypass combination starter with fuse disconnect.

## Multipurpose Control Specifications

### Three Phase Starters

Input Voltage VAC 3PH 60Hz	MA7-008		MA7-016		MA7-030	
	MA8-008		MA8-016		MA8-030	
	HP	I <sub>c</sub>	HP	I <sub>c</sub>	HP	I <sub>c</sub>
230	2	8	5	16	10	30
460	8		10		20	
575	5		10		25	

Input Voltage VAC 3PH 60Hz	MB7-055		MB7-080		MB7-160		MB7-250		MB7-420		MB7-600		MB7-840	
	MB8-055		MB8-080		MB8-160		MB8-250		MB8-420		MB8-600		MB8-840	
	HP	I <sub>c</sub>	HP	I <sub>c</sub>	HP	I <sub>c</sub>	HP	I <sub>c</sub>	HP	I <sub>c</sub>	HP	I <sub>c</sub>	HP	I <sub>c</sub>
208	15	55	25	80	50	160	75	250	150	420	200	600	300	840
230	20		30		60		100		150		250			
460	40		60		125		200		350		500			
575	50		75		150		250		400		600			

I<sub>c</sub> = Continuous Current Rating

### Input Ratings

Input Frequency	60/50 HZ ± 5%
Input Voltage	+10% to -15% of Voltage Rating (except 575 VAC, max= 620VAC)
Overload Rating	Continuous 115% of FLA; 400% for 30 seconds.
Phase	Three Phase
Duty	Continuous

### Storage Conditions

Ambient Temperature:	-4 to 140°F (-20 to 60 °C)
Humidity:	0 - 95% RH Non-Condensing

### Operating Conditions

Enclosure:	Open Panel (Indoor) NEMA 1 (Industrial indoor, general purpose) NEMA 12 (Industrial indoor, dust proof) NEMA 4 (Outdoor)
	The SCR's generate about 3.3 watts of heat per running amp (motor FLA). If the control is mounted in an enclosure, the installer must provide fans or blower with sufficient ventilation. Fan or blower should be rated for at least 0.8 CFM per ampere of motor FLA rating. Baldor provided enclosures are designed to dissipate the heat from the SCR's.
Humidity:	0 - 95% RH Non-Condensing
Control Heat Loss	3.3 Watt per running ampere of input current
Ambient Operating Temperature:	32-113°F (0 to +45 °C) enclosed 32-122°F (0 to +50 °C) open panel
Altitude:	Sea level to 3300 Feet (1000 Meters) Derate 1% per 330 Feet (100 Meters) above 3300 Feet
Derating	Derate Amp rating 1% per 330 Feet (100 Meters) above 3300 Feet Derate Amp rating 1.5% per °C over 45 °C to 55 °C Max

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## Control Specifications

Control Method	6 SCR's connected in inverse parallel for full-wave 3 phase control		
Peak Inverse Voltage	208/230	460	575
	1200VAC minimum	1200VAC minimum	1600VAC
Start Time	Adjustable range 3-50 seconds (current limit starting is not timed).		
Stop Time	Adjustable range 5-50 seconds (can only extend stop time).		
Initial Torque	Adjustable range: Starting 40-75%, Stopping 0-100%.		
Current Limit (Selectable)	Adjustable range 75-400% of FLA (full load amperes).		
Pulse Time (Selectable)	Adjustable range 0.1-1.5 seconds.		
Current Monitor (Selectable)	Adjustable range 50-400% of FLA. Causes contact closure or control shut down when current level is reached (after starting).		
Power Factor	Adjustable for maximum reduced motor voltage, dependent on load.		
Tach input (Selectable)	0-10VDC (maximum 10msec response time from tach).		
Control module power	12VA at 115/230VAC $\pm 5\%$		
Status Contacts	125VAC at 0.5A, normally open. 60VA maximum rating.		
Agency Listings	UL (Underwriters Laboratory) and cUL (Canada)		
Rated Storage Temperature:	-40 °F to +140 °F (- 40 °C to +60 °C)		

Note: A minimum inductance of 0.01 Henry is require for the SCR's to commutate. Some large horsepower motors may not have enough inductance and require adding inductors between the motor and control.

## SCR Specifications

Overcurrent	Over current shut down at 450% of motor FLA nameplate rating.
Shorted SCR detection	Shunt Trip contract.

## Protective Features

Overload	Electronic overload class 30.
SCR Thermostat	Trips on overtemperature of heatsink (sizes 55 amps and larger only).
Phase Loss	Shunt Trip contact (sizes 55 amps and larger only) active only at power-up.
Voltage Transient	MOV (metal oxide varistor).

## Indicator LEDs

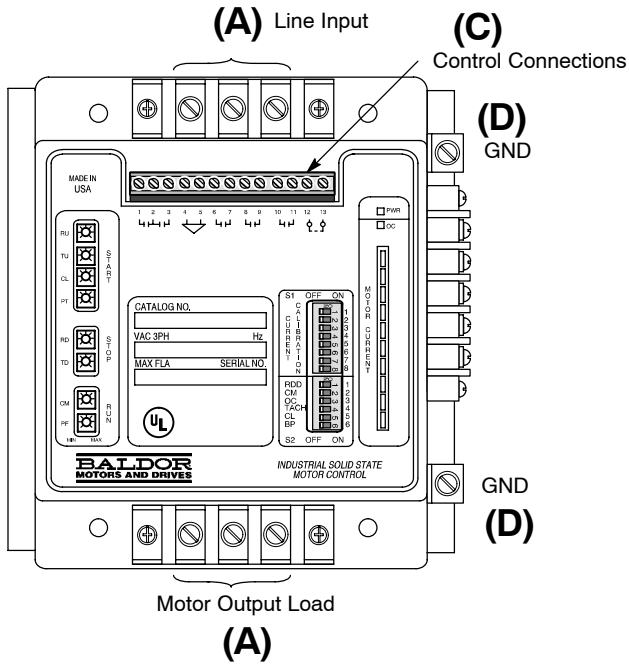
Power ON	Ramp End
Over Current	Shunt Trip
Current Monitor	Start/Run
Motor Power	Motor Current

**MOV Devices** Four varistors connected in wye configuration with one to ground.

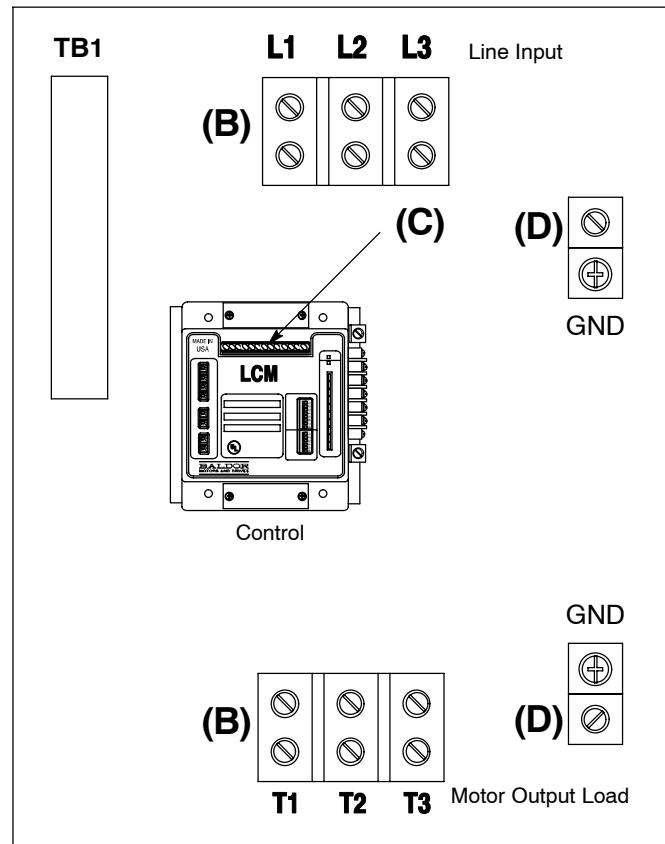
MOV505EL	MOV620E
Max line volts=510VAC	Max line volts=625VAC
Watts = 1.0	Watts = 1.0
Max one time surge of 6500A @ 8V/20 $\mu$ s	Max one time surge of 6500A @ 8V/20 $\mu$ s

## Wire Size & Tightening Torque Specifications

### 8, 16 Amp Control Only



### Combination Starter and Non-Combination Starter and Control Only



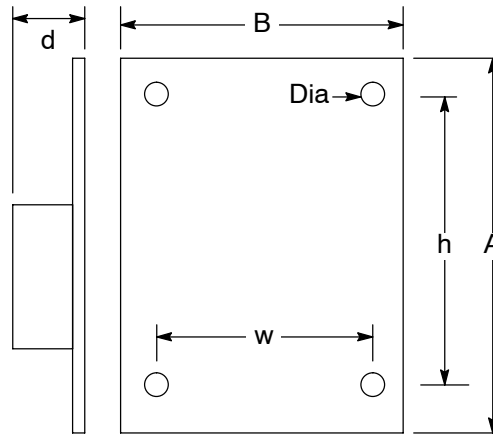
### Wire Size Torque Specifications Size 8,16

Terminal (Identifier)	Amps	Wire Size AWG	Torque lb-in	Note1: Refer to the label on the equipment panel for line and load tightening torque values. Note2: Refer to the label on the equipment panel for ground wire sizes.
A	8, 16	10 - 16	20	
B	30	8 - 18	35	
	55	4	Note 1	
	80	3	Note 1	
	160	3/0	Note 1	
	250	350 KCMIL	Note 1	
	420	(2) 300 KCMIL	Note 1	
	600	(2) 500 KCMIL	Note 1	
C	All	12 - 22	12	
	840	(3) 500 KCMIL	Note 1	
D	8, 16, 30	6-14	45	
	55	Note 2	Note 1	
	80	Note 2	Note 1	
	160	Note 2	Note 1	
	250	Note 2	Note 1	
	420	Note 2	Note 1	
	600	Note 2	Note 1	
	840	Note 2	Note 1	



## Mounting Dimensions

### Open Panel

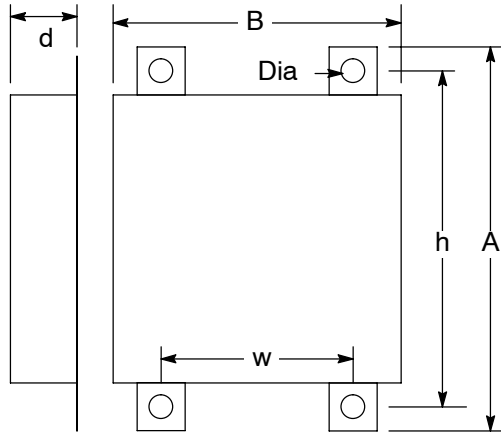


### Open/Panel Dimensions

Amp Rating	Control Only						Non-Combination Starter						Combination Starter					
	A	B	h	w	d	Dia	A	B	h	w	d	Dia	A	B	h	w	d	Dia
8	12.25	10.25	11.63	9.63	10.16	0.25	21.00	14.50	19.50	13.00	10.16	0.50	21.00	14.50	19.50	13.00	10.16	0.50
16	12.25	10.25	11.63	9.63	10.16	0.25	21.00	14.50	19.50	13.00	10.16	0.50	21.00	14.50	19.50	13.00	10.16	0.50
30	12.25	10.25	11.63	9.63	10.16	0.25	21.00	14.50	19.50	13.00	10.16	0.50	21.00	14.50	19.50	13.00	10.16	0.50
55	21.00	21.00	19.24	19.24	12.62	0.50	21.00	21.00	19.24	19.24	12.62	0.50	21.00	21.00	19.24	19.24	12.62	0.50
80	21.00	21.00	19.24	19.24	12.62	0.50	21.00	21.00	19.24	19.24	12.62	0.50	21.00	21.00	19.24	19.24	12.62	0.50
160	39.00	27.00	31.24	25.24	9.35	0.50	39.00	27.00	31.24	25.24	9.35	0.50	39.00	27.00	31.24	25.24	9.35	0.50
250	39.00	27.00	31.24	25.24	11.35	0.50	39.00	27.00	31.24	25.24	11.35	0.50	39.00	27.00	31.24	25.24	11.35	0.50
420	45.00	33.00	43.24	31.24	13.35	0.50	45.00	33.00	43.24	31.24	13.35	0.50	45.00	33.00	43.24	31.24	13.35	0.50
600	57.00	33.00	55.24	31.24	13.35	0.50	57.00	33.00	55.24	31.24	13.35	0.50	57.00	33.00	55.24	31.24	13.35	0.50
840	57.00	33.00	55.24	31.24	13.35	0.50	57.00	33.00	55.24	31.24	13.35	0.50	57.00	33.00	55.24	31.24	13.35	0.50

## Mounting Dimensions Continued

### NEMA 1, 3R and 12



### NEMA 1 Dimensions

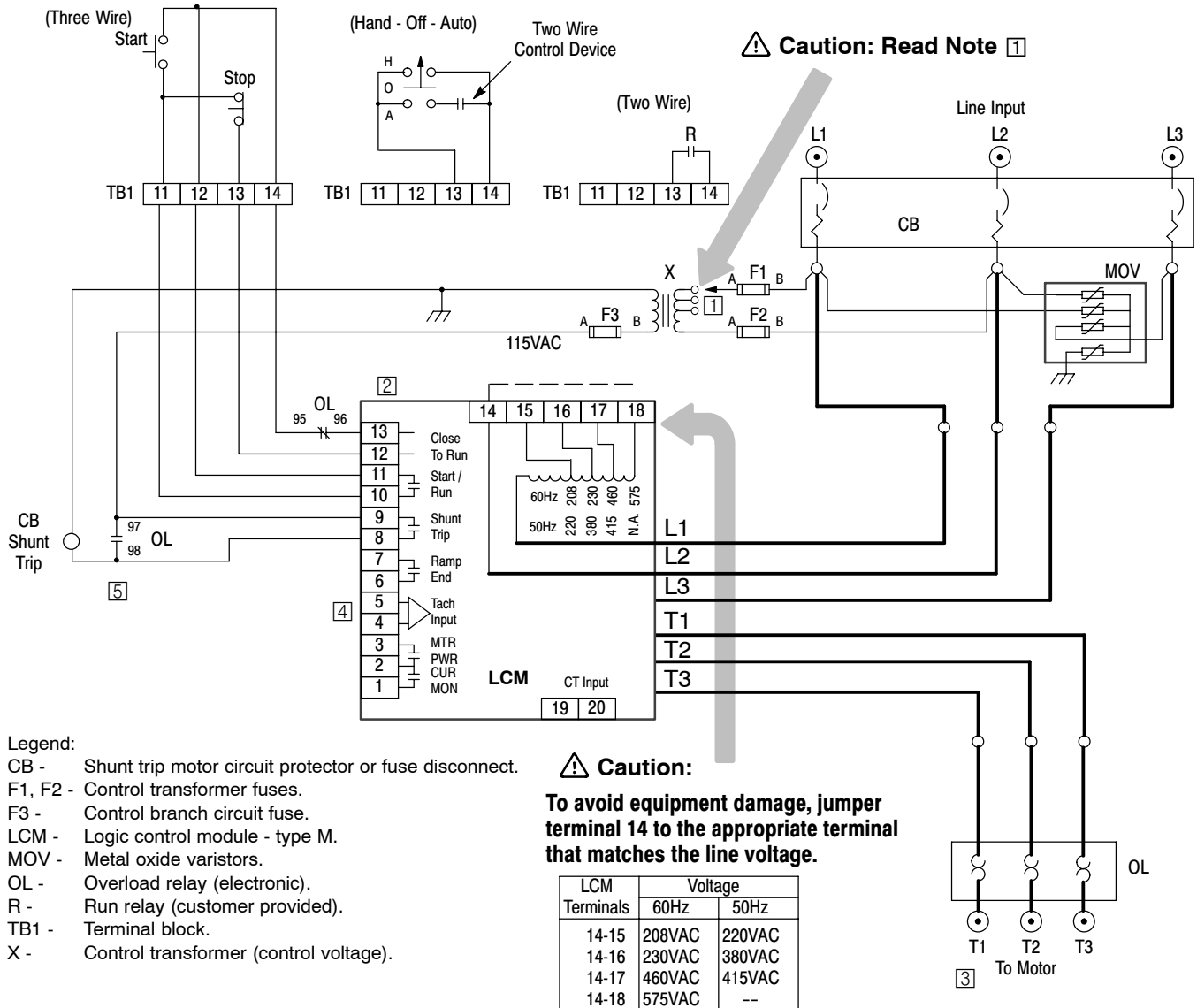
Amp Rating	Control Only						Non-Combination Starter						Combination Starter					
	A	B	h	w	d	Dia	A	B	h	w	d	Dia	A	B	h	w	d	Dia
8	14.00	12.00	11.00	11.00	11.35	0.28	24.00	16.00	21.88	11.00	11.35	0.31	24.00	16.00	21.88	11.00	11.35	0.31
16	14.00	12.00	11.00	11.00	11.35	0.28	24.00	16.00	21.88	11.00	11.35	0.31	24.00	16.00	21.88	11.00	11.35	0.31
30	14.00	12.00	11.00	11.00	11.35	0.28	24.00	16.00	21.88	11.00	11.35	0.44	24.00	16.00	21.88	11.00	11.35	0.31
55	24.00	24.00	25.24	18.00	12.62	0.44	24.00	24.00	25.24	18.00	12.62	0.44	24.00	24.00	25.24	18.00	12.62	0.44
80	24.00	24.00	25.24	18.00	12.62	0.44	24.00	24.00	25.24	18.00	12.62	0.44	24.00	24.00	25.24	18.00	12.62	0.44
160	42.00	30.00	37.24	24.00	9.35	0.44	42.00	30.00	37.24	24.00	9.35	0.44	42.00	30.00	37.24	24.00	9.35	0.44
250	42.00	30.00	37.24	24.00	11.35	0.44	42.00	30.00	37.24	24.00	11.35	0.44	42.00	30.00	37.24	24.00	11.35	0.44
420	48.00	36.00	49.24	30.00	13.35	0.44	48.00	36.00	49.24	30.00	13.35	0.44	48.00	36.00	49.24	30.00	13.35	0.44
600	60.00	36.00	61.24	30.00	13.35	0.44	60.00	36.00	61.24	30.00	13.35	0.44	60.00	36.00	61.24	30.00	13.35	0.44
840	60.00	36.00	61.24	30.00	13.35	0.44	60.00	36.00	61.24	30.00	13.35	0.44	60.00	36.00	61.24	30.00	13.35	0.44

### NEMA 12/3R Dimensions

Amp Rating	Control Only						Non-Combination Starter						Combination Starter					
	A	B	h	w	d	Dia	A	B	h	w	d	Dia	A	B	h	w	d	Dia
8	20.00	16.00	21.24	10.00	11.35	0.44	20.00	16.00	21.24	10.00	11.35	0.44	24.00	20.00	25.24	14.00	11.35	0.44
16	20.00	16.00	21.24	10.00	11.35	0.44	20.00	16.00	21.24	10.00	11.35	0.44	24.00	20.00	25.24	14.00	11.35	0.44
30	20.00	16.00	21.24	10.00	11.35	0.44	20.00	16.00	21.24	10.00	11.35	0.44	24.00	20.00	25.24	14.00	11.35	0.44
55	30.00	24.00	31.24	18.00	11.35	0.44	30.00	24.00	31.24	18.00	11.35	0.44	30.00	24.00	31.24	18.00	11.35	0.44
80	30.00	24.00	43.24	18.00	11.35	0.44	30.00	24.00	31.24	18.00	11.35	0.44	30.00	24.00	31.24	18.00	11.35	0.44
160	42.00	36.00	43.24	30.00	9.35	0.44	42.00	36.00	43.24	30.00	9.35	0.44	42.00	36.00	43.24	30.00	9.35	0.44
250	42.00	36.00	43.24	30.00	11.35	0.44	42.00	36.00	43.24	30.00	11.35	0.44	42.00	36.00	43.24	30.00	11.35	0.44
420	60.00	36.00	61.24	30.00	13.35	0.44	60.00	36.00	61.24	30.00	13.35	0.44	60.00	36.00	61.24	30.00	13.35	0.44
600	60.00	48.00	61.24	42.00	13.35	0.44	60.00	48.00	61.24	42.00	13.35	0.44	60.00	48.00	61.24	42.00	13.35	0.44
840	60.00	48.00	61.24	42.00	13.35	0.44	60.00	48.00	61.24	42.00	13.35	0.44	60.00	48.00	61.24	42.00	13.35	0.44

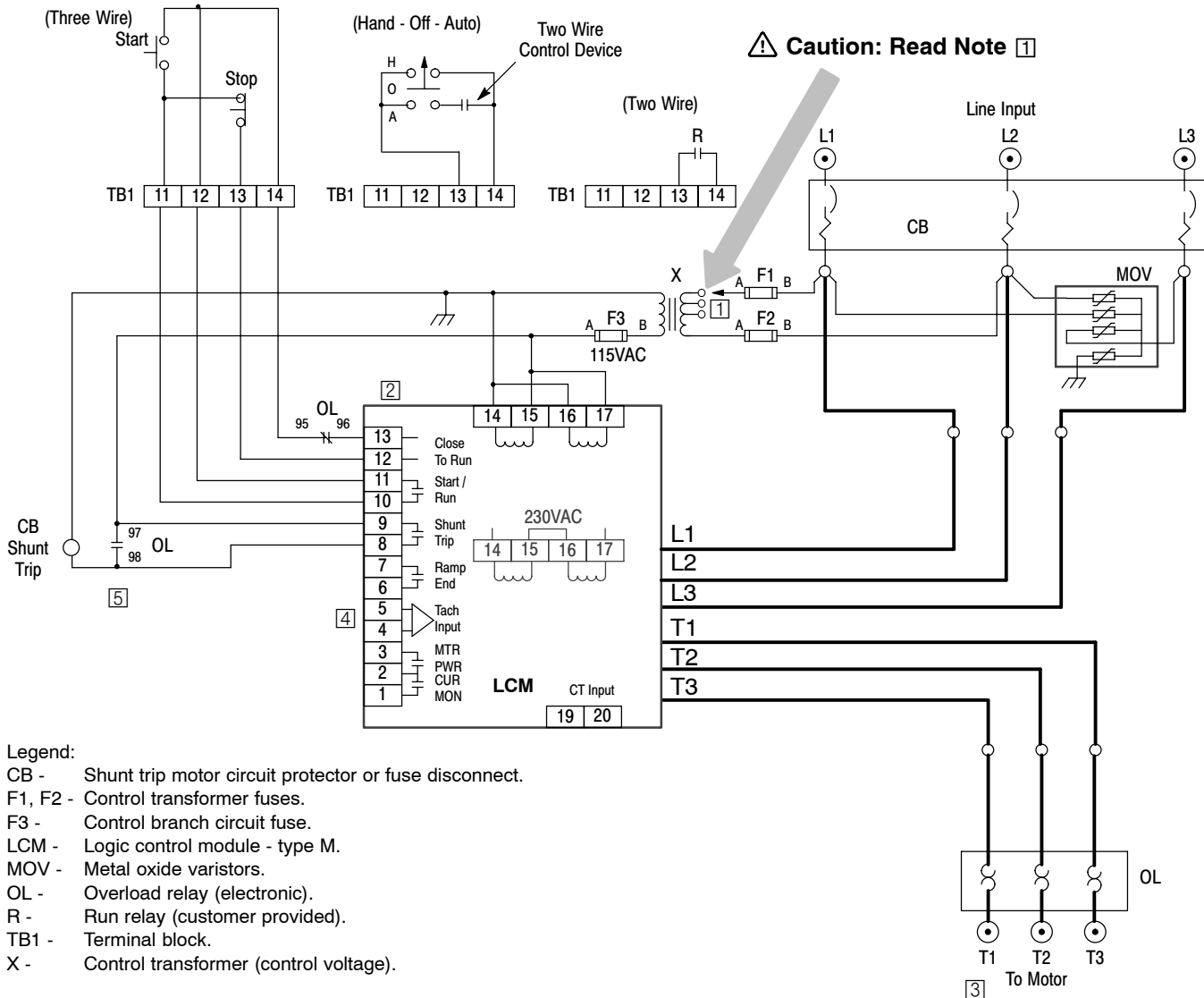
## Connection Diagrams

### MA Style 8, 16 and 30 AMP Combination and Non-Combination Starter and Control only



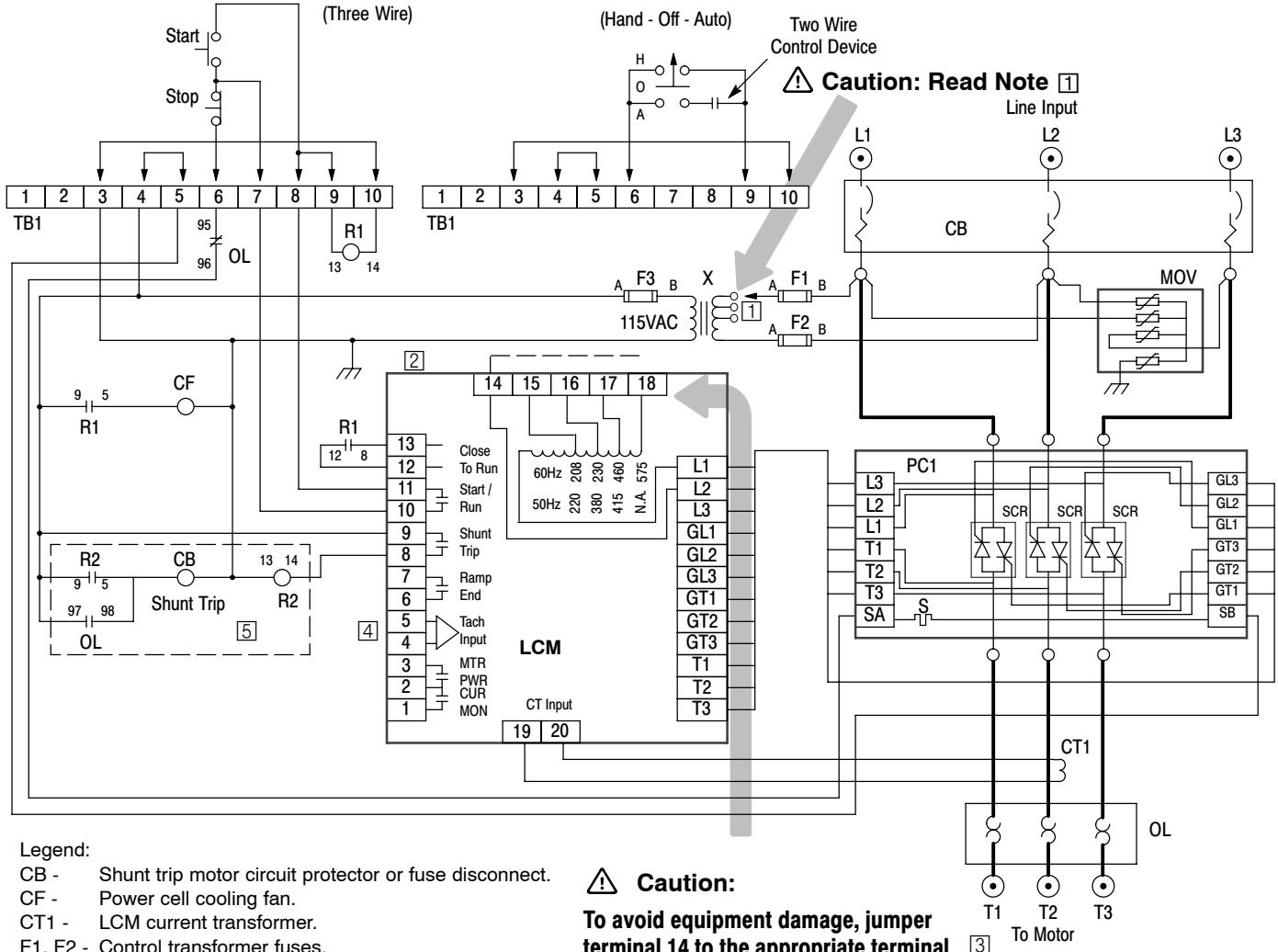
## Connection Diagrams Continued

### MB Style 8, 16 and 30 AMP Combination and Non-Combination Starter and Control only



## Connection Diagrams Continued

### MA Style 55 and 80 AMP NEMA 1 and Panels Combination and Non-Combination Starter and Control only



#### Legend:

- CB - Shunt trip motor circuit protector or fuse disconnect.
- CF - Power cell cooling fan.
- CT1 - LCM current transformer.
- F1, F2 - Control transformer fuses.
- F3 - Control branch circuit fuse.
- LCM - Logic control module - type M.
- MOV - Metal oxide varistors.
- OL - Overload relay (electronic).
- PC1 - SCR power cell.
- R1 - Run relay, DPDT.
- R2 - Shunt trip relay, DPDT.
- S - SCR overtemperature switch.
- SCR - Silicon controlled rectifier.
- TB1 - Terminal block.
- X - Control transformer (control voltage).

#### Caution:

To avoid equipment damage, jumper terminal 14 to the appropriate terminal that matches the line voltage.

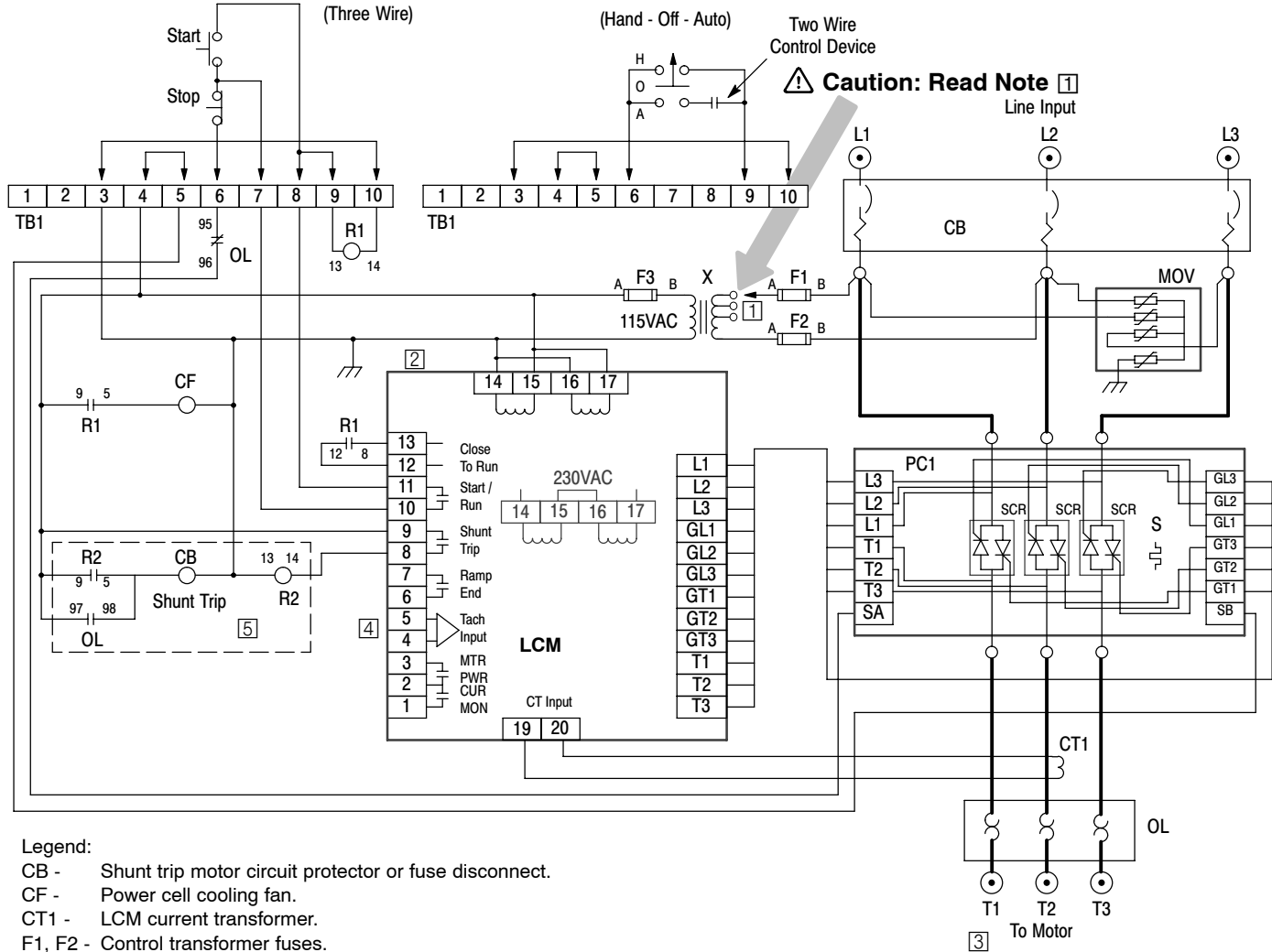
LCM Terminals	Voltage	
	60Hz	50Hz
14-15	208VAC	220VAC
14-16	230VAC	380VAC
14-17	460VAC	415VAC
14-18	575VAC	--

#### Notes:

- 1 Control transformer must be properly connected for line voltage (see transformer nameplate).
- 2 Do not apply voltage to LCM terminals 12 and 13. Dry contact type only.
- 3 Motor must be connected before power is applied. Otherwise, the shunt trip will trip the motor circuit protector.
- 4 Tachometer is only required when LCM is used in Tach Feedback mode.
- 5 Motor circuit protector and this circuit are not provided with the non-combination starters and fuse disconnect versions.

## Connection Diagrams Continued

### MB Style 55 and 80 AMP NEMA 1 and Panels Combination and Non-Combination Starter and Control only



#### Legend:

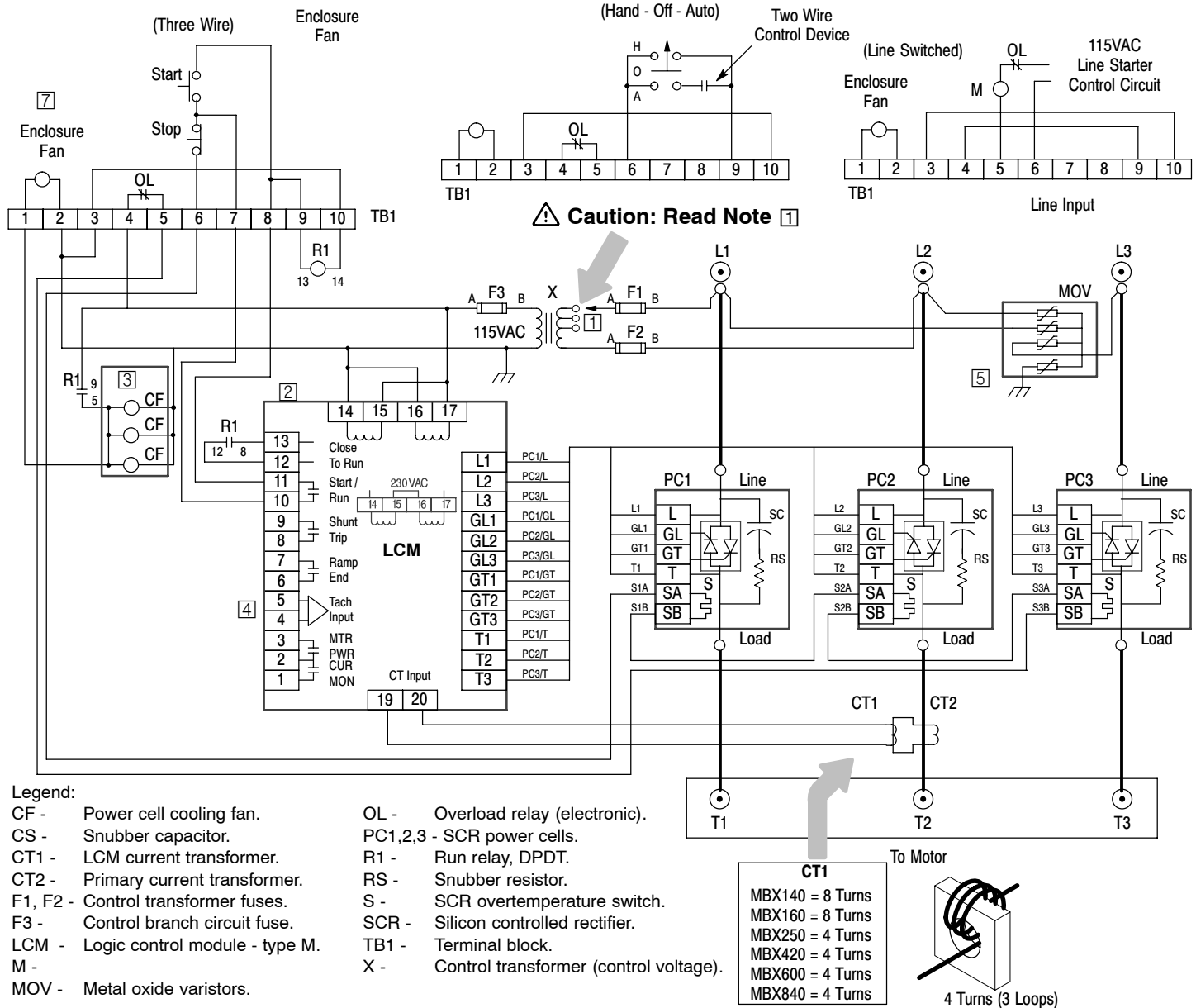
- CB - Shunt trip motor circuit protector or fuse disconnect.
- CF - Power cell cooling fan.
- CT1 - LCM current transformer.
- F1, F2 - Control transformer fuses.
- F3 - Control branch circuit fuse.
- LCM - Logic control module - type M.
- MOV - Metal oxide varistors.
- OL - Overload relay (electronic).
- PC1 - SCR power cell.
- R1 - Run relay, DPDT.
- R2 - Shunt trip relay, DPDT.
- S - SCR overtemperature switch.
- SCR - Silicon controlled rectifier.
- TB1 - Terminal block.
- X - Control transformer (control voltage).

#### Notes:

- 1 Control transformer must be properly connected for line voltage (see transformer nameplate).
- 2 Do not apply voltage to LCM terminals 12 and 13. Dry contact type only.
- 3 Motor must be connected before power is applied. Otherwise, the shunt trip will trip the motor circuit protector.
- 4 Tachometer is only required when LCM is used in Tach Feedback mode.
- 5 Motor circuit protector and this circuit are not provided with the non-combination starters and fuse disconnect versions.

## Connection Diagrams Continued

### NEMA 1 & Panel Mounted Size 160–840 AMP Control Only

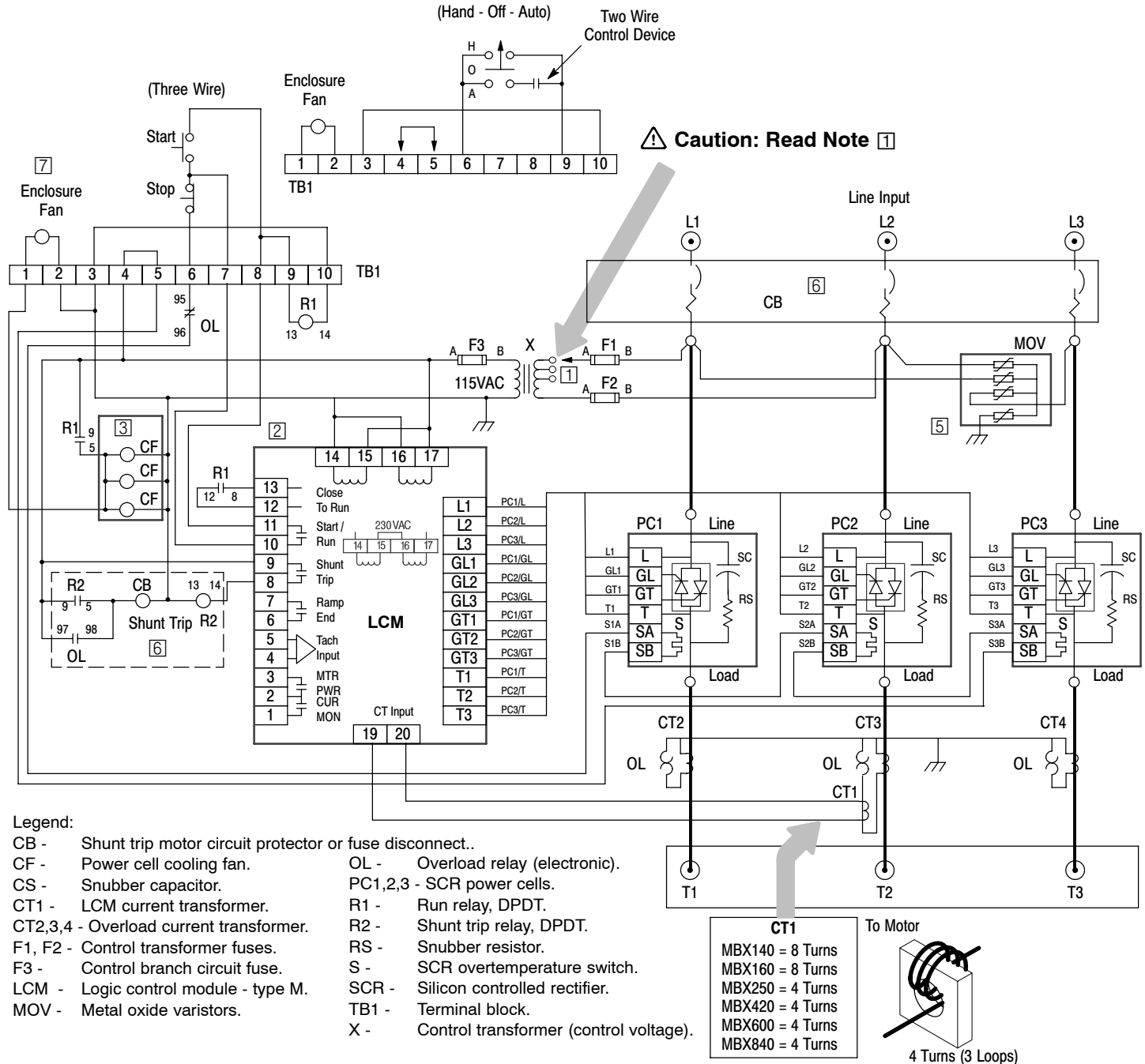


#### Notes:

- 1 Control transformer must be properly connected for line voltage (see transformer nameplate).
- 2 Do not apply voltage to LCM terminals 12 and 13. Dry contact type only.
- 3 Number of cooling fans depends on the FLA rating.
- 4 Tachometer is only required when LCM is used in Tach Feedback mode.
- 5 MOVs are connected in parallel for greater energy absorption for control sizes above 420Amp FLA.
- 6 For factory supplied enclosure fans only.

## Connection Diagrams Continued

### NEMA 1 & Panel Mounted Size 160–840 AMP Combination & Noncombination



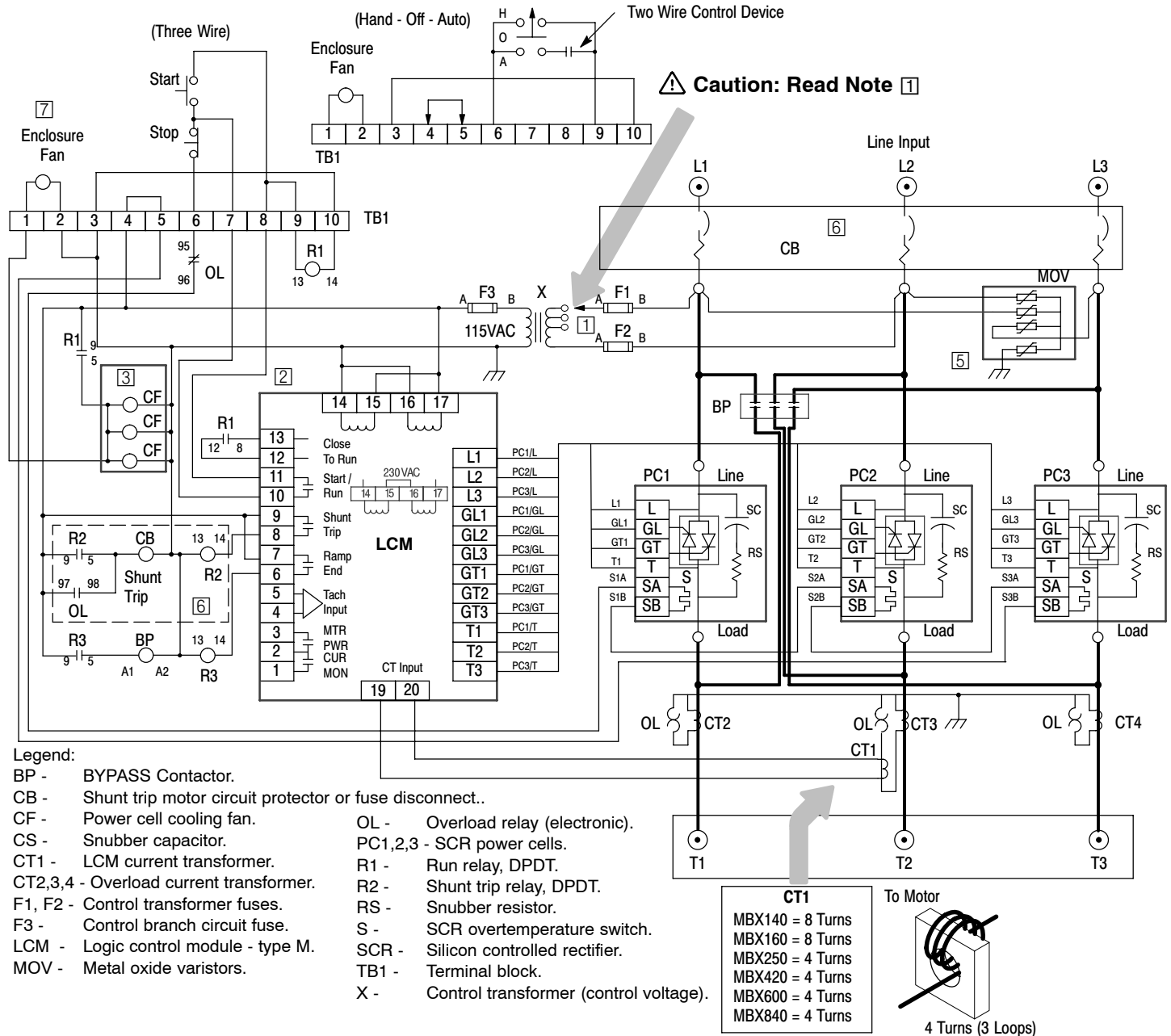
#### Notes:

- 1 Control transformer must be properly connected for line voltage (see transformer nameplate).
- 2 Do not apply voltage to LCM terminals 12 and 13. Dry contact type only.
- 3 Number of cooling fans depends on the FLA rating.
- 4 Tachometer is only required when LCM is used in Tach Feedback mode.
- 5 MOVs are connected in parallel for greater energy absorption for control sizes above 420Amp FLA.
- 6 Motor circuit protector and this circuit are not provided with the non-combination starters and fuse disconnect versions.
- 7 For factory supplied enclosure fans only.



## Connection Diagrams Continued

### NEMA 12 Size 160–840 AMP Combination & Noncombination Bypass



#### Notes:

- 1 Control transformer must be properly connected for line voltage (see transformer nameplate).
- 2 Do not apply voltage to LCM terminals 12 and 13. Dry contact type only.
- 3 Number of cooling fans depends on the FLA rating.
- 4 Tachometer is only required when LCM is used in Tach Feedback mode.
- 5 MOVs are connected in parallel for greater energy absorption for control sizes above 420Amp FLA.
- 6 Motor circuit protector and this circuit are not provided with the non-combination starters and fuse disconnect versions.
- 7 For factory supplied enclosure fans only.



# Appendix A

## Reference Information

### Glossary

BP	Bypass Contactor	PF	Power Factor Correction
CC	Current Calibrator	PIV	Peak Inverse Voltage
CCW	Counterclockwise	PT	Starting Pulse Time
CL	Current Limit	PWR	Power
CM	Current Monitor	Ramp End	End of Voltage Ramp
CS & RS	Resistor & Capacitor series circuit	RD	Ramp Down Time
CUR MON	Current Monitor	RDD	Ramp Down Disable
CT	Current Transformer	RMS	Root Means Squared
CW	Clockwise	RU	Ramp Up Time
FLA	Full Load Amperes (Motor)	SCR	Silicon Controlled Rectifier
LCM	Logic Control Module	Shunt Trip	Shorted SCR Detection
LED	Light Emitting Diode	SSC	Soft Start Control
MCP	Motor Circuit Protector	TACH	Tachometer
MOV	Metal Oxide Varistor	TD	Reduced torque value at start of Ramp Down Time
MTR PWR	Motor Power	TU	Initial starting torque at Ramp Up Time
OC	Over Current Shutdown	X	Control Transformer
OL	Overload Relay		
PC	Power Cells		

**Current Calibration Chart** Settings for S1 are based on motors with 600% locked rotor amps. Motors with locked rotor amps greater than 600% should use a higher setting. Baldor Super-E® motors on high inertia loads should be set 1 or 2 settings higher than the suggested S1 setting. If a load takes too long to start, use the next higher setting.

**⚠ Caution:** Select the table that matches you starter size only. Do not use the switch settings for a starter size that is different than the one you are setting up. Using the wrong switch setting can damage the Multipurpose Soft Starter control.

Size 008 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
1.0-1.1	1	1	1	0	0	0	0	1
1.1-1.2	0	0	0	0	1	0	0	1
1.2-1.3	0	0	0	1	1	0	0	1
1.3-1.4	0	0	0	0	0	1	0	1
1.4-1.5	0	1	1	0	0	1	0	1
1.5-1.6	0	0	1	1	0	1	0	1
1.6-1.7	1	0	0	0	1	1	0	1
1.7-1.8	0	1	1	0	1	1	0	1
1.8-1.9	0	0	1	1	1	1	0	1
1.9-2.1	0	0	0	0	0	0	1	1
2.1-2.3	1	0	1	0	0	0	1	1
2.3-2.5	0	1	0	1	0	0	1	1
2.5-2.7	0	1	1	1	0	0	1	1
2.7-3.0	0	1	0	0	1	0	1	1
3.0-3.3	0	1	1	0	1	0	1	1
3.3-3.6	1	0	0	1	1	0	1	1
3.6-3.9	0	0	1	1	1	0	1	1
3.9-4.4	0	0	0	0	0	0	1	1
4.4-4.8	1	1	0	0	0	1	1	1
4.8-5.2	1	0	1	0	0	1	1	1
5.2-5.6	1	1	1	0	0	1	1	1
5.6-6.0	1	0	0	1	0	1	1	1
6.0-6.4	0	1	0	1	0	1	1	1
6.4-6.8	0	0	1	1	0	1	1	1
6.8-7.4	0	1	1	1	0	1	1	1
7.4-8.0	1	1	1	1	0	1	1	1

Size 016 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
6.0-6.5	1	0	0	0	0	1	1	1
6.5-7.0	0	0	1	0	0	1	1	1
7-8	1	1	1	0	0	1	1	1
8-9	1	0	0	1	0	1	1	1
9-10	1	1	0	1	0	1	1	1
10-11	1	0	1	1	0	1	1	1
11-12	1	1	1	1	0	1	1	1
12-13	0	0	0	0	1	1	1	1
13-14	0	1	0	0	1	1	1	1
14-16	1	1	0	0	1	1	1	1

Size 030 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
12-13	1	0	0	0	0	1	1	1
13-14	1	1	0	0	0	1	1	1
14-15	1	0	1	0	0	1	1	1
15-16	1	1	1	0	0	1	1	1
16-18	1	0	0	1	0	1	1	1
18-20	1	1	0	1	0	1	1	1
20-22	1	0	1	1	0	1	1	1
22-24	0	1	1	1	0	1	1	1
24-27	0	0	0	0	1	1	1	1
27-30	0	1	0	0	1	1	1	1

Note: 0=Off, 1=On

Size 055 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
24-26	0	1	0	0	0	1	1	1
27-30	1	0	1	0	0	1	1	1
31-34	0	0	0	1	0	1	1	1
35-38	0	1	0	1	0	1	1	1
39-42	0	0	1	1	0	1	1	1
43-45	0	1	1	1	0	1	1	1
46-48	1	1	1	1	0	1	1	1
49-51	0	0	0	0	1	1	1	1
52-55	1	0	0	0	1	1	1	1

Size 250 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
108-113	1	1	0	0	1	0	1	0
114-127	0	1	0	0	0	1	1	0
128-144	0	0	1	0	1	1	1	0
145-161	1	1	0	0	0	0	0	1
162-180	0	0	0	0	1	0	0	1
181-201	1	1	0	1	1	0	0	1
202-224	0	1	1	0	0	1	0	1
225-250	0	0	0	0	1	1	0	1

Size 080 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
44-46	0	1	1	1	0	1	1	1
47-52	0	0	0	0	1	1	1	1
53-58	1	0	0	0	1	1	1	1
59-64	1	1	0	0	1	1	1	1
65-69	0	0	1	0	1	1	1	1
70-75	1	0	1	0	1	1	1	1
76-80	0	1	1	0	1	1	1	1

Size 420 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
200-214	1	1	0	0	0	1	0	1
215-234	0	1	0	1	0	1	0	1
235-249	1	0	0	0	1	1	0	1
250-274	1	1	1	0	1	1	0	1
275-299	0	0	1	1	1	1	0	1
300-329	1	1	0	0	0	0	1	1
330-361	0	0	0	1	0	0	1	1
362-390	0	0	1	1	0	0	1	1
391-420	0	0	0	0	1	0	1	1

Size 140 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
58-63	0	1	0	0	0	1	1	0
64-70	1	0	0	0	1	1	1	0
71-78	1	1	1	1	1	1	1	0
79-86	0	0	1	1	0	0	0	1
87-95	0	1	1	0	1	0	0	1
96-105	0	0	0	0	0	1	0	1
106-120	1	1	0	1	0	1	0	1
121-128	1	0	0	0	1	1	0	1
129-140	0	0	0	1	1	1	0	1

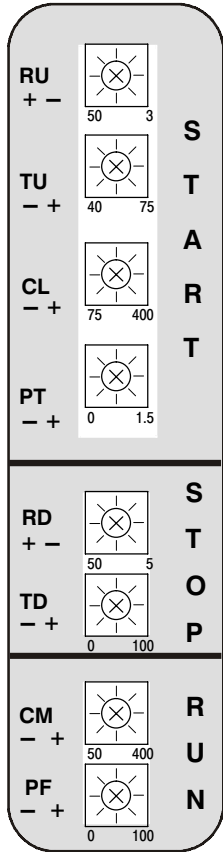
Size 600 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
320-340	1	1	0	1	0	0	0	1
341-360	0	1	0	0	1	0	0	1
361-390	0	1	0	1	1	0	0	1
391-430	1	1	0	0	0	1	0	1
431-470	1	1	0	1	0	1	0	1
471-520	0	1	0	0	1	1	0	1
521-570	1	0	0	1	1	1	0	1
571-600	1	1	1	1	1	1	0	1

Size 160 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
65-70	1	0	0	0	1	1	1	0
71-78	1	1	1	1	1	1	1	0
79-87	0	0	1	1	0	0	0	1
88-97	1	1	1	0	1	0	0	1
98-108	0	1	0	0	0	1	0	1
109-120	1	1	0	1	0	1	0	1
121-135	0	0	1	0	1	1	0	1
136-148	1	1	0	1	1	1	0	1
149-160	1	0	0	0	0	0	1	1

Size 840 Motor FLA	S1 Switch Position and Setting							
	1	2	3	4	5	6	7	8
471-520	0	1	0	0	1	1	0	1
521-570	1	0	0	1	1	1	0	1
571-630	1	1	1	1	1	1	0	1
631-690	0	1	1	0	0	0	1	1
691-740	1	0	0	1	0	0	1	1
741-800	1	0	1	1	0	0	1	1
801-840	0	0	0	0	1	0	1	1

Note: 0=Off, 1=On

## Quick Reference Chart



**RU** Ramp Up Time (3-50 sec.)  
Tachometer: Time to reach full speed.  
Voltage: Time to reach full speed.

**TU** Torque Up (40-75% voltage)  
Tachometer: Disabled.  
Voltage: Initial starting voltage for ramp.

**CL** Current Limit (75-400% FLA)  
Tachometer or voltage: Enabled by S2-5=ON. Maximum current during ramp up and ramp down.

**PT** Pulse Time (0-1.5 sec.)  
Tachometer: Disabled.  
Voltage: Duration of 400% FLA starting pulse.

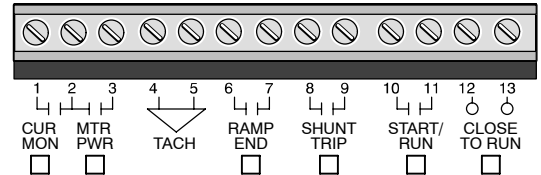
**RD** Ramp Down Time (5-50 sec.) – (Disabled with S2-1=ON)  
Tachometer: Time to reach zero speed.  
Voltage: Time to reach zero speed.

**TD** Torque Down Advance (0-100%) – (Disabled with S2-1=ON)  
Tachometer or voltage: Percentage reduction from full motor voltage for starting ramp down to zero volts.

**CM** Current Monitor (50-400% FLA) Enabled at end of start cycle.  
S2-2=ON: If motor current exceeds CM value, control will shutdown, CUR MON contact will close and CUR MON light is ON.  
S2-2=OFF: Control will not shutdown, contact will close, LED is ON.

**PF** Power Factor (0-100%)  
0 to maximum allowable motor voltage reduction to improve power factor.

**CUR MON:** Indicates CM or CL have been exceeded.  
**MTR PWR:** Indicates voltage is applied to motor during start, run & ramp down.  
**TACH:** Tachometer input (0-10VDC).  
**RAMP END:** End of start ramp (full run condition).  
**SHUNT TRIP:** Shunt trip due to shorted SCR.  
**START/RUN:** Confirm Close to Run contact is closed.  
**CLOSE TO RUN:** Start contact is closed.

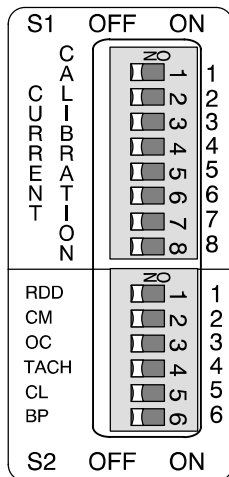


Power applied to control.

PWR

Overcurrent shut down (450% FLA)

OC



MOTOR CURRENT

**S1** Current Calibration and "Motor Current" bar graph. S1 selects 255 calibration points for motor FLA. See "Current Calibration Chart" in this section for the proper setting. Bar Graph, displays the value of motor current during operation.

**RDD:** S2-1, Ramp Down Disable.  
ON Control is immediately disabled when the "Close to Run" input is opened.  
OFF Control will ramp down when the "Close to Run" input is opened.

**CM:** S2-2, Current Monitor Trip.  
ON Control will disable and CUR MON light and contact will indicate an overcurrent condition.  
OFF CUR MON light and contact will indicate an overcurrent condition.

**OC:** S2-3, Over current shut down.  
ON Overcurrent shutdown will turn on CUR MON light and close the CUR MON contact.  
OFF Overcurrent shutdown will disable control with no affect to CUR MON light and contact.

**TACH:** S2-4, Tachometer input enable.  
ON Control is in tachometer feedback ramp mode.  
OFF Control is in voltage ramp mode.

**CL:** S2-5, Current Limit enable.  
ON Current will not exceed Current Limit adjustment during ramp up and down except during pulse start.  
OFF Current Limit adjustment has no effect.

**BP:** S2-6, Bypass contactor enable.  
ON Shunt trip circuit is disabled during full on condition for bypass contactor to be used.  
OFF Shunt trip circuit is enabled in all conditions.

## Overload Relay Adjustment

A class 30 electronic relay is provided with combination and non-combination starters. Read the FLA from the motor nameplate and set the overload dial to the correct ampere setting. Refer to the table that represents the starter size.

**⚠ Caution:** Select the table that matches your starter size only. Do not use the switch settings for a starter size that is different than the one you are setting up. Using the wrong switch setting can damage the Multipurpose Soft Starter control.

**⚠ Caution:** For starters size 8, 16 and 30A is direct reading. Using the wrong setting may damage the multipurpose soft start control.

### Overload Relay - Electronic Class 30

Size 055# Passes through the window	Dial Setting / Amps					
	45	50	60	70	80	90
1 (Straight through)	45	50	60	70	80	90
2 (1 loop)	22.5	25	30	35	40	45
3 (2 loop)	11	12.5	15	17.5	20	22.5

Size 080# Passes through the window	Dial Setting / Amps					
	45	50	60	70	80	90
1 (Straight Through)	45	50	60	70	80	90
2 (1 loop)	22.5	25	30	35	40	45

Size 160 # Passes through the window	Dial Setting / Amps			
	3	4	5	6
3 (2 loops)	100	133	167	-
4 (3 loops)	75	100	125	150
5 (4 loops)	60	80	100	120
6 (5 loops)	50	67	83	100

# Passes	9	10	11	12	14	16	18
6 (5 loops)	160	-	-	-	-	-	-
7 (6 loops)	128	143	157	-	-	-	-
8 (7 loops)	112	125	137	150	-	-	-

Size 420 # Passes through the window	Dial Setting / Amps			
	3	4	5	6
1 (Straight Through)	300	400	500	-
2 (1 loop)	150	200	250	300
3 (2 loop)	100	133	167	200
4 (3 loop)	75	100	125	150

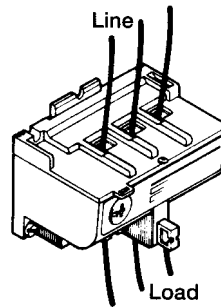
# Passes	9	10	11	12	14	16	18
3 (2 loops)	300	333	366	400	-	-	-
4 (3 loops)	225	250	275	300	350	400	-
5 (4 loops)	180	200	220	240	280	320	360

Size 250 # Passes through the window	Dial Setting / Amps			
	3	4	5	6
2 (1 loop)	150	200	250	-
3 (2 loop)	100	133	167	200
4 (3 loop)	75	100	125	150
5 (4 loop)	60	80	100	120

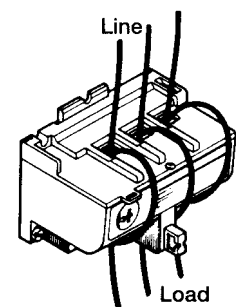
# Passes	9	10	11	12	14	16	18
5 (4 loops)	180	200	220	240	-	-	-
6 (5 loops)	166	185	203	216	-	-	-
7 (6 loops)	126	140	154	168	196	224	254

Size 840 # Passes through the window	Dial Setting / Amps			
	3	4	5	6
1 (Straight Through)	600	800	1000	-
2 (1 loop)	300	400	500	600
3 (2 loop)	150	200	250	300

# Passes	9	10	11	12	14	16	18
3 (2 loops)	600	667	734	800	-	-	-
4 (3 loops)	450	500	550	600	700	800	-
5 (4 loops)	360	400	440	480	560	640	720



1 Pass (Straight Through)



2 Pass (1 Loop)

## Appendix B Circuit Breaker Adjustments

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### 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 soft start applications, the initial voltage applied to the motor is reduced to approximately 40% to 70% of nominal line voltage. It is necessary to set the trip current for the circuit breaker to the proper inrush current value. 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 B-1 shows these code letters. (KVA = Kilovolt-Amperes; HP = Horsepower).

#### KVA/HP Calculation of motor

**Table B-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.

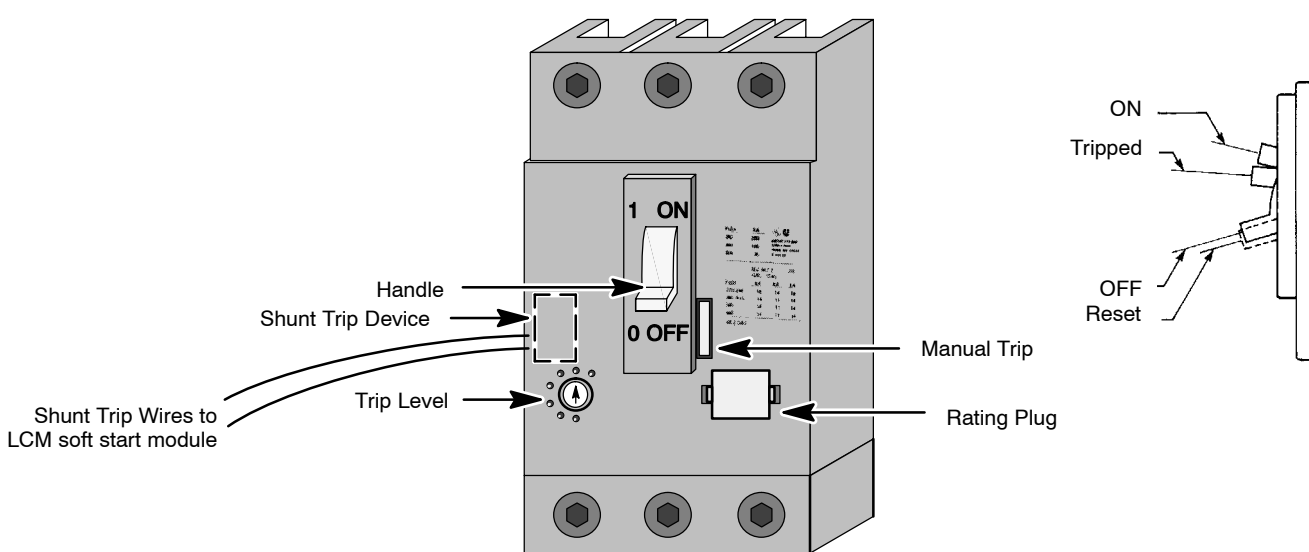
$$I_{\text{Inrush}} = \left( \frac{7.5 \times 50 \times 577}{460} \right) = 470 \text{ Amperes}$$

**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 B-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 and the shunt trip indicator on the LCM soft start control module is OFF, the circuit breaker tripped for an overcurrent condition. 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. If the shunt trip causes the breaker to trip, refer to Troubleshooting Section 5 of this manual.
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 B-1 Magnetic Circuit Breaker**





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