sprecher+ schuh

PF Softstarters 5A ... 1250A
User Manual For Series B

February 2011

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Sprecher and Schuh does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Sprecher + Schuh office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we use notes to make you aware of safety considerations:

Attention

Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss

Attention statements help you to:
- identify a hazard
- avoid a hazard
- recognize the consequences

Important

Identifies information that is critical for successful application and understanding of the product.

European Communities (EC) Directive Compliance

If this product has the CE mark it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet the Council Directive 89/336/EC Electromagnetic Compatibility (EMC) per EN/IEC 60947-4-2.

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, per EN/IEC 60947-4-2.

This equipment is classified as open equipment and must be mounted in an enclosure during operation to provide safety protection.

Table of Contents

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Other Related Documents

- PF Softstarter Installation Guide
  Publication TQG-PF_411[①]
- Renewal Part Instructions — 41053-345-01 (5…85 A)
  41053-346-01 (108…135 A)
  41053-347-01 (201…480 A)
  41053-385-01 (625…1250 A)

Description

The PF Softstarter™ controller offers a full range of starting modes as standard:

- Soft Start with Selectable Kickstart
- Current Limit with Selectable Kickstart
- Dual Ramp Start with Selectable Kickstart
- Full Voltage Start
- Preset Slow Speed
- Linear Speed Acceleration with Selectable Kickstart
  (requires Tach feedback)
- Soft-Stop

Other features that offer further user benefit include:

- Expanded protective features
- Metering
- I/O

Innovative starting and stopping options provide enhanced performance:

- Pump Control
- Braking Control
  - SMB Smart Motor Braking
  - Accu-Stop
  - Slow Speed with Braking

These modes, features, and options are further described in this chapter.

① Latest revision.

Operation

The PF Softstarter can operate standard squirrel-cage induction motors rated 1…1250 A or Star-delta (wye-delta) type motors rated 1.8…1600 A; up to 600V AC, 50/60 Hz. Depending upon the controller type ordered, control power input can range from 100…240V AC or 24V AC/DC. Please verify voltage on a product, before applying power.

Modes of Operation (Standard)

Soft Start [1]

This mode has the most general application. The motor is given an initial torque setting, which is user-adjustable from 0…90% of locked rotor torque. From the initial torque level, the output voltage to the motor is steplessly increased during the acceleration ramp time. The acceleration ramp time is user-adjustable from 0…30 seconds. If the PF Softstarter senses that the motor has reached the up-to-speed condition during the voltage ramp operation, the internal bypass contactor will be pulled in.

Figure 1.1 Soft Start
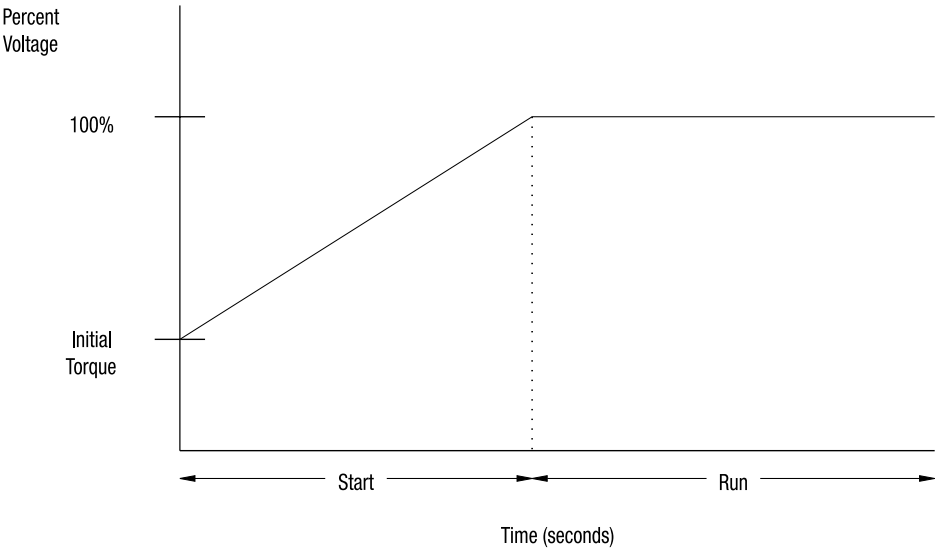
[1] Kickstart is also available with Soft Start

Selectable Kickstart

This feature provides a boost at startup to break away loads that require a pulse of high torque to get started. This is intended to provide a pulse of current that is selectable from 0…90% of locked rotor torque. Selectable kickstart is user-adjustable from 0.0…2.0 seconds.

Figure 1.2   Selectable Kickstart
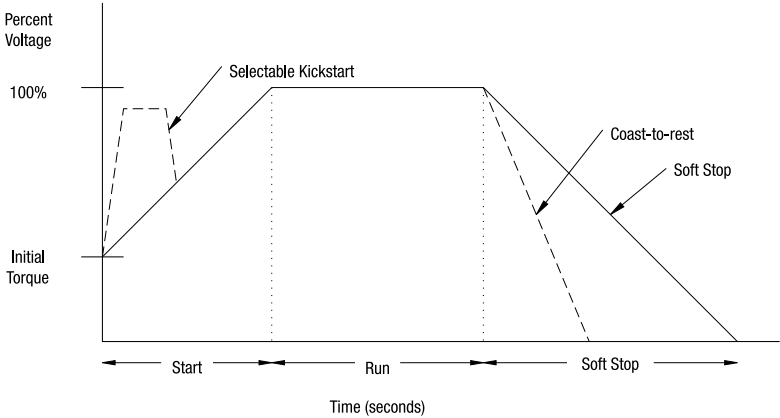
Current Limit Start [1]

This starting mode provides a true current limit start; it is used when limiting maximum starting current is necessary. The Current Limit level is user-adjustable from 50…600% of the motor full load ampere rating; and the current limit time is user-adjustable from 0…30 seconds. If the PF Softstarter senses that the motor has reached the up-to-speed condition during the current limit starting mode, the internal bypass contactor will be pulled in.

Figure 1.3 Current Limit Start
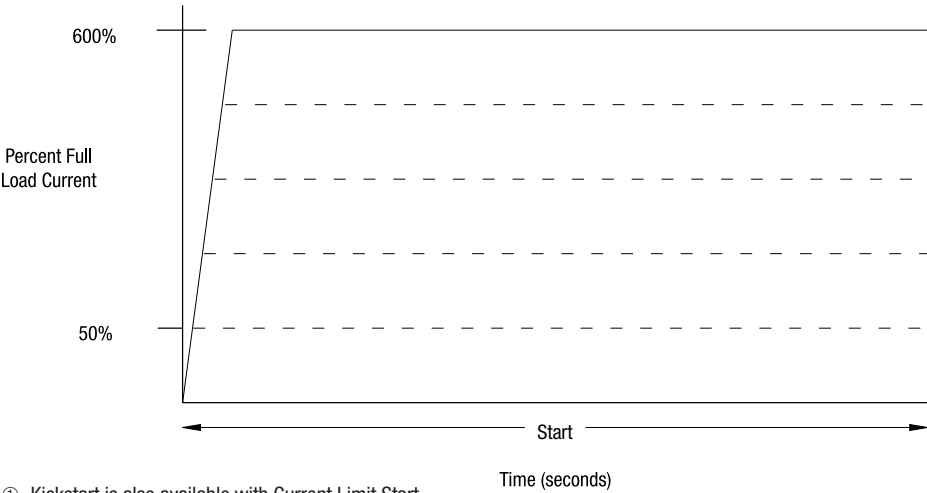
[1] Kickstart is also available with Current Limit Start.

Dual Ramp Start [1]

This starting mode is useful on applications that have varying loads (and therefore varying starting torque requirements). Dual Ramp Start allows the user to select between two separate start profiles with separately adjustable ramp times and initial torque settings.

Figure 1.4 Dual Ramp Start

Percent Voltage

100%

Ramp #2

Initial Torque #2

Ramp #1

Initial Torque #1

Start #1   Run #1
Start #2   Run #2

Time (seconds)
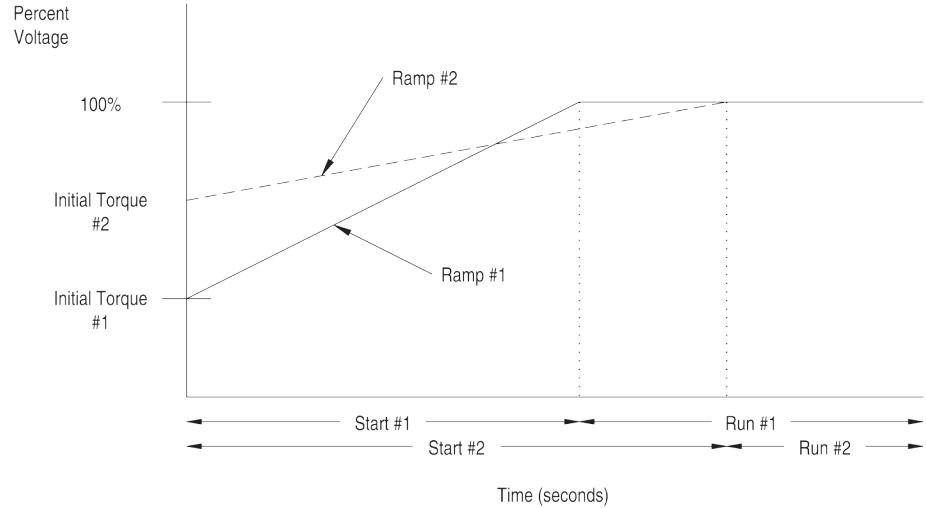
[1]   Dual Ramp Start is available only with the standard controller.

Full Voltage Start

This starting mode is used for applications requiring across-the-line starting. The output voltage to the motor will reach full voltage within 1/4 second.

Figure 1.5 Full Voltage Start

100%

Percent Voltage

Time (seconds)
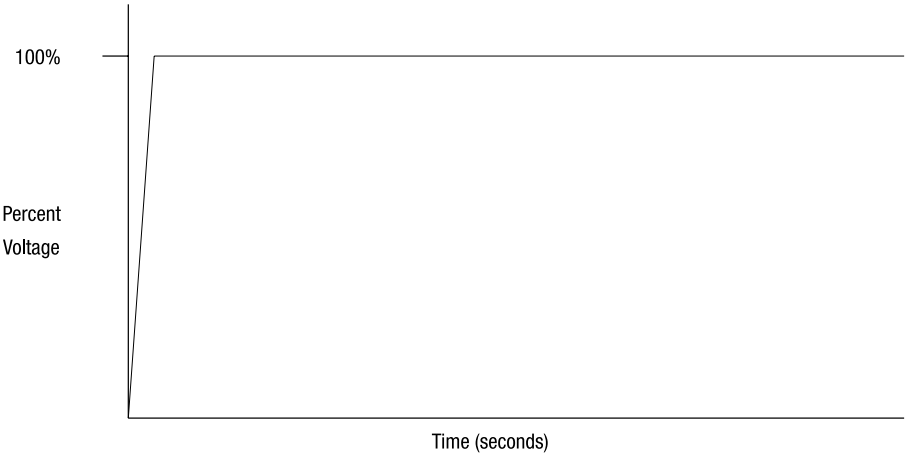
Preset Slow Speed

This option can be used in applications that require a slow speed jog for general purpose positioning. Preset Slow Speed provides either 7% of base speed (low) or 15% of base speed (high) settings in the forward direction. Reverse can also be programmed and offers 10% of base speed (low) and 20% of base speed (high) settings.

Figure 1.6 Preset Slow Speed
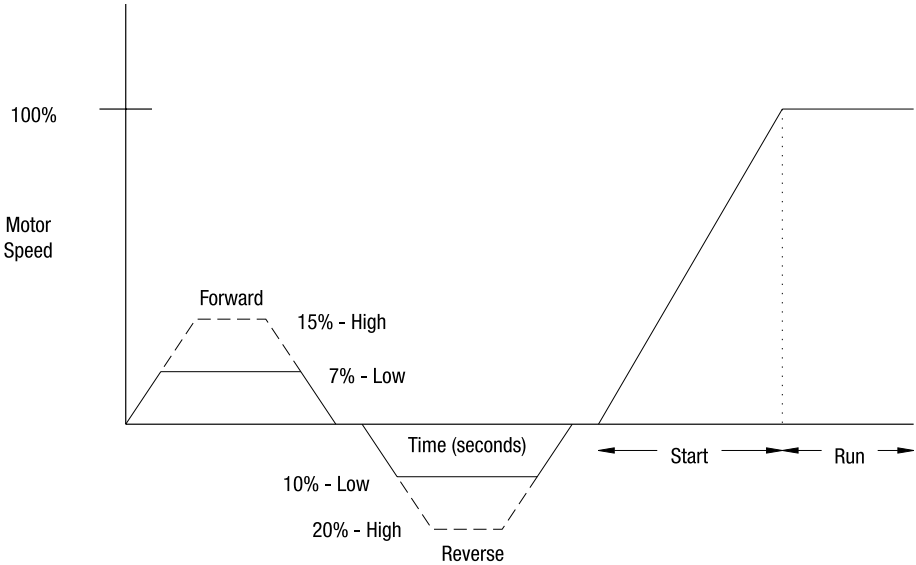
Attention	Slow speed running is not intended for continuous operation due to reduced motor cooling.

Linear Speed Acceleration [1]

The PF Softstarter has the ability to control the motor speed during starting and stopping maneuvers. A tach input (0…5V DC) is required to perform this start mode. The start time is selectable from 0…30 seconds and determines the time the motor will ramp from 0 speed to full speed. Kickstart is available with this option.

Figure 1.7 Linear Speed Acceleration
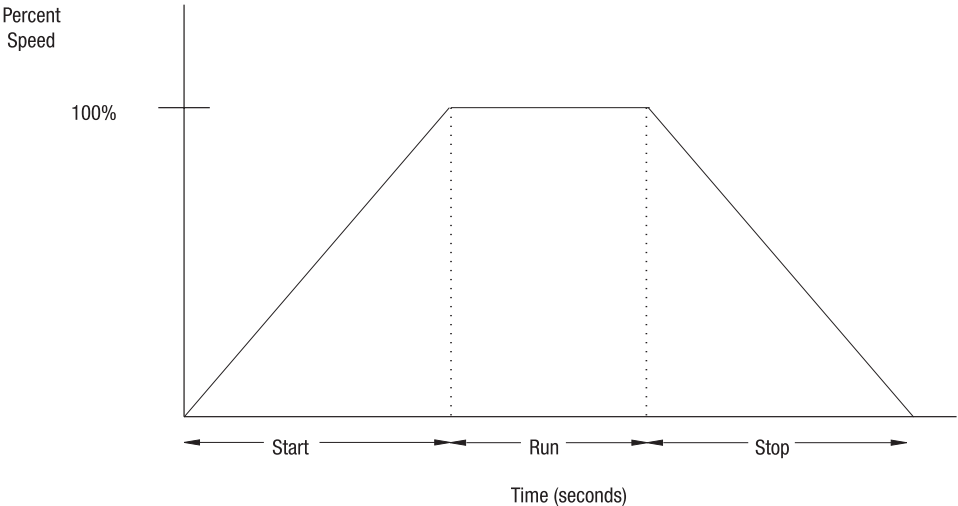
[1] Kickstart is also available with Linear Speed Acceleration.

Attention

Linear Stop is not intended to be used as an emergency stop. Refer to the applicable standards for emergency stop requirements.

The Linear Stop does not need to be set up even if the linear start has been programmed. The Linear Stop can not brake the motor/load and reduce the stopping time.

Soft Stop

This option can be used in applications that require an extended stop time. The voltage ramp down time is user-adjustable from 0…120 seconds and is adjusted independently from the starting time. The load will stop when the output voltage drops to a point where the load torque is greater than the developed motor torque.

Figure 1.8 Soft Stop

Percent
Voltage

Selectable Kickstart

100%

Coast-to-rest

Soft Stop

Initial
Torque

Start   Run   Soft Stop

Time (seconds)
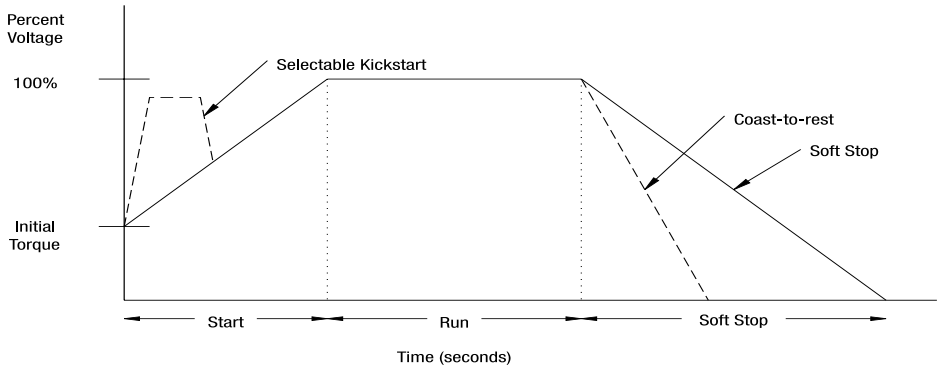
| Attention | Soft Stop is not intended to be used as an emergency stop. Refer to the applicable standards for emergency stop requirements. |

Control Options

The PF Softstarter offers the control options described below.

Important: The options listed in this section are mutually exclusive and must be specified when ordering. An existing controller may be upgraded to another control option by replacing the control module. Consult your local Sprecher + Schuh representative.

Modes of Operation (Pump Control)

Pump Control Option [1]

This option reduces surges during the starting and stopping of a centrifugal pump by smoothly accelerating and decelerating the motor. The microprocessor analyzes the motor variables and generates commands that control the motor and reduce the possibility of surges occurring in the system.

The starting time is programmable from 0…30 seconds, and the stopping time is programmable from 0…120 seconds.

Figure 1.9   Pump Control Option
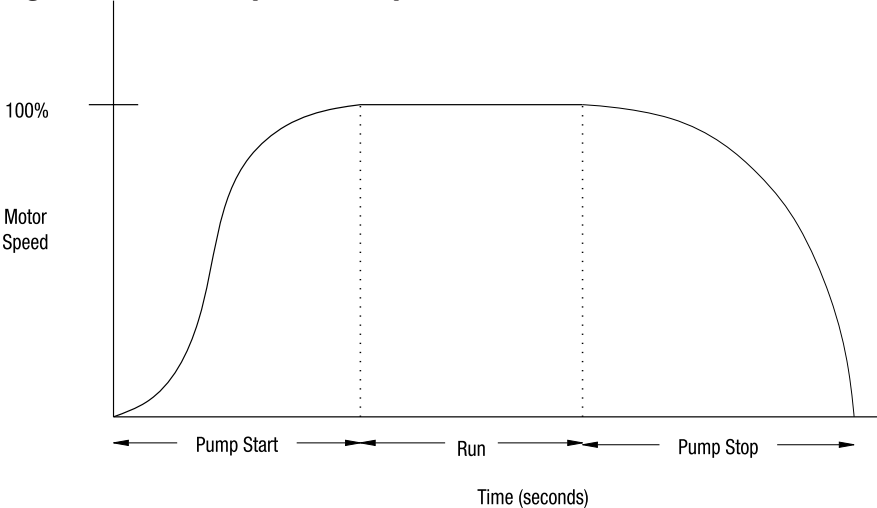
[1] Kickstart is also available with Pump Control.

| **Attention** | Pump stopping is not intended to be used as an emergency stop. Refer to the applicable standard for emergency stop requirements. |

| **Attention** | Pump stopping may cause motor heating depending on the mechanical dynamics of the pumping system. Therefore, select the lowest stopping time setting that will satisfactorily stop the pump. |

Modes of Operation (Braking Control)

SMB Smart Motor Braking Option

This option can be used in applications that require reduced stopping times. The PF Softstarter incorporates a microprocessor-based system that applies braking current to a motor without any additional equipment. This option offers a user-adjustable braking current setting from 0% to 400% of the motor's full load current rating. Further, it provides automatic shut-off at zero speed detection.

Figure 1.10   SMB Smart Motor Braking Option
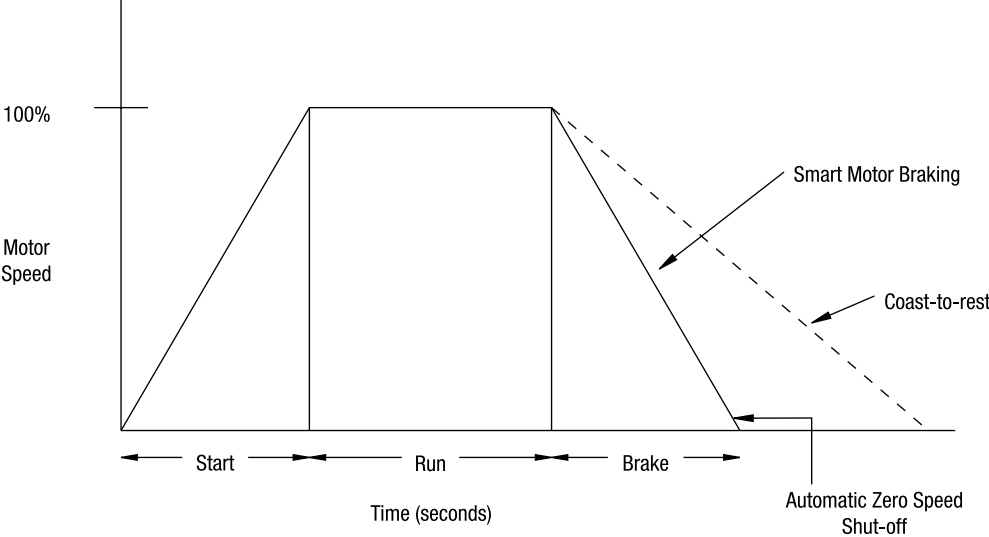
Note: All braking current settings in the range of 1…100% will provide 100% braking current to the motor.

Attention

SMB Smart Motor Braking Option is not intended to be used as an emergency stop. Refer to applicable standards for emergency stop requirements.

Accu-Stop™ Option

This option combines the benefits of the SMB Smart Motor Braking and Preset Slow Speed options. For general purpose positioning, the Accu-Stop option provides a brake from full speed to the preset slow speed setting, then brakes to stop.

Figure 1.11 Accu-Stop Option
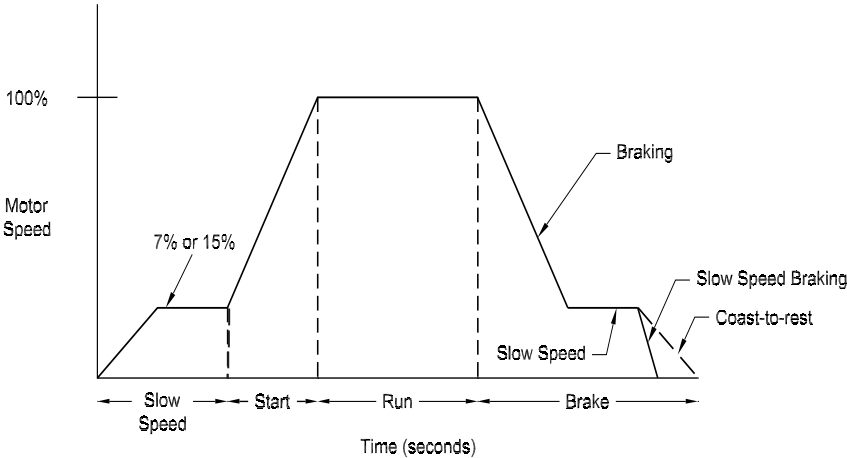
| **Attention** | Accu-Stop and Slow Speed with Braking are not intended to be used as an emergency stop. Refer to applicable standards for emergency stop requirements. |

Slow Speed with Braking Option

The Slow Speed with Braking option provides a job speed for process set-up and braking-to-stop at the end of the cycle.

Figure 1.12 Slow Speed with Braking Option
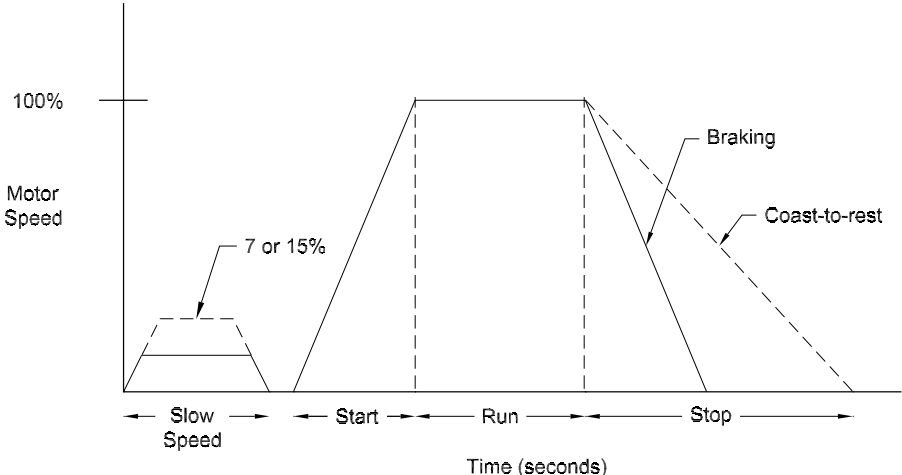
Protection and Diagnostics

The PF Softstarter provides the protective and diagnostic features described below.

Overload

The PF Softstarter meets applicable requirements as a motor overload protective device. Thermal memory provides added protection and is maintained even when control power is removed. The built-in overload controls the value stored in Parameter 12, Motor Thermal Usage; an Overload Fault will occur when this value reaches 100%. The programming parameters below provide application flexibility and easy setup.

Parameter	Range
Overload Class	Off, 10,15, 20, 30
Overload Reset	Manual - Auto
Motor FLC	1.0...2200 A
Service Factor	0.01...1.99

Notes: (1) The factory default setting for Overload Class, which is 10, enables overload protection. The motor's full load current rating must be programmed to properly set overload protection.

(2) Automatic reset of an overload fault requires the start input to be cycled in a 2-wire control scheme.

The trip rating is 117% of the programmed FLC.

Figure 1.13 and Figure 1.14 provide the overload trip curves for the available trip classes.

Underload [1]

Utilizing the underload protection of the PF Softstarter, motor operation can be halted if a sudden drop in current is sensed.

The PF Softstarter provides an adjustable underload trip setting from 0…99% of the programmed motor full load current rating. Trip delay time can be adjusted from 0…99 seconds.

[1] Underload protection is disabled during slow speed and braking operations.

Figure 1.13 Overload Trip Curves

Class 10

Approximate Trip Time (seconds)

Multiples of FLC

Class 15

Approximate Trip Time (seconds)

Multiples of FLC

Class 20

Approximate Trip Time (seconds)

Multiples of FLC

Class 30

Approximate Trip Time (seconds)

Multiples of FLC

—— Approximate trip time for 3-phase balanced condition from cold start.

– – – Approximate trip time for 3-phase balanced condition from hot start.
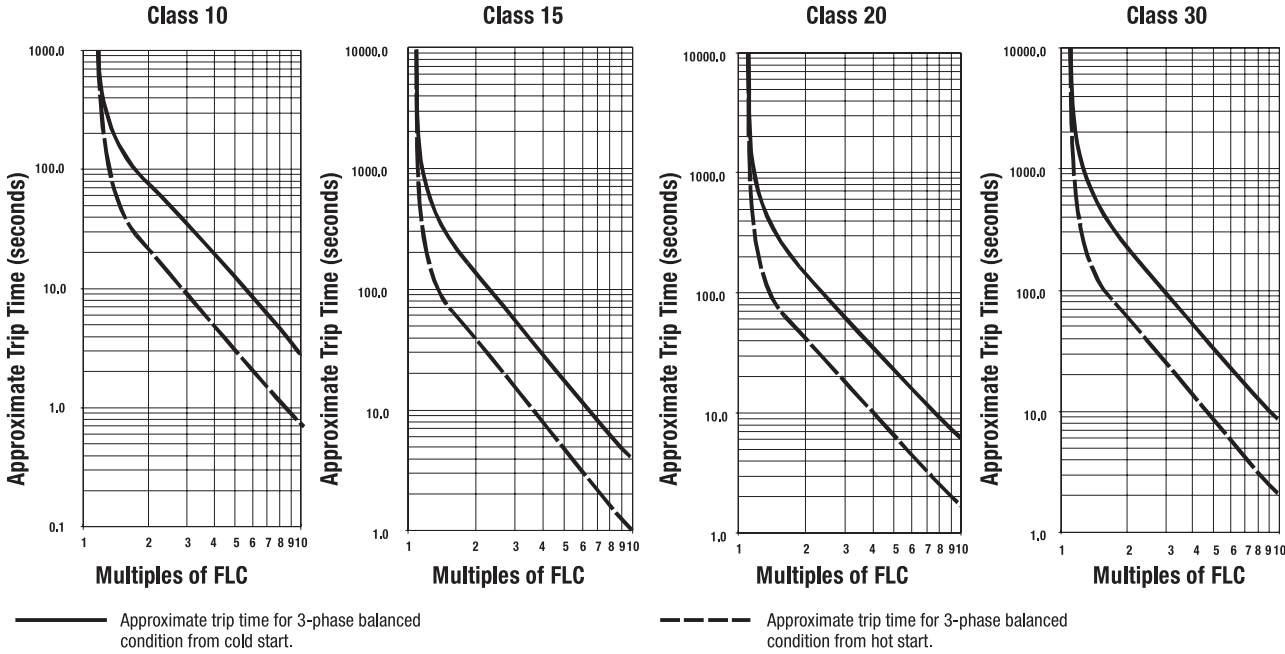
Figure 1.14 Restart Trip Curves after Auto Reset

Seconds

Percent Full Load Current Setting

—— Class 10
– – – Class 15
- - - - Class 20
-·-·- Class 30

Auto Reset Times:
Class 10 = 90s
Class 15 = 135s
Class 20 = 180s
Class 30 = 270s
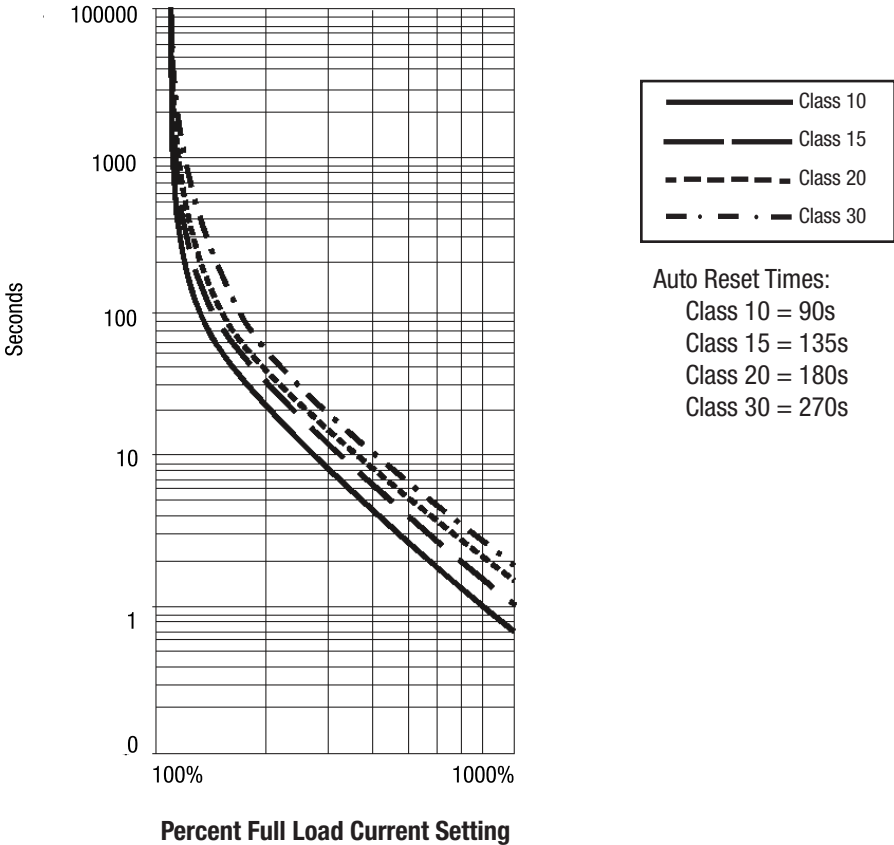
Undervoltage [1]

Utilizing the undervoltage protection of the PF Softstarter, motor operation can be halted if a sudden drop in voltage is detected.

The PF Softstarter provides an adjustable undervoltage trip setting from 0…99% of the programmed motor voltage. Trip delay time can be adjusted from 0…99 seconds.

An alarm (pre-fault) indication level can be programmed to indicate the unit is getting close to faulting. The alarm modification information is displayed through the LCD and alarm contact closing.

Overvoltage [1]

Utilizing the overvoltage protection of the PF Softstarter, motor operation can be halted if a sudden increase in voltage is detected.

The PF Softstarter provides an adjustable overvoltage trip setting from 0…199% of the programmed motor voltage. Trip delay time can be adjusted from 0…99 seconds.

An alarm (pre-fault) indication level can be programmed to indicate the unit is getting close to faulting. The alarm modification information is displayed through the LCD and alarm contact closing.

Unbalance [1]

The PF Softstarter is able to detect an unbalance in line voltages. Motor operation can be halted if the unbalance is greater than the desired range.

The PF Softstarter provides an adjustable unbalance setting from 0…25% of the line voltages. Trip delay time can be adjusted from 0…99 seconds.

An alarm (pre-fault) indication level can be programmed to indicate the unit is getting close to faulting. The alarm modification information is displayed through the LCD and alarm contact closing.

[1] Undervoltage, overvoltage, and voltage unbalance protection are disabled during braking operation.

Stall Protection and Jam Detection

The PF Softstarter provides both stall protection and jam detection for enhanced motor and system protection.

- Stall protection is user-adjustable from 0.0…10.0 seconds (in addition to the ramp time programmed).

Figure 1.15 Stall Protection
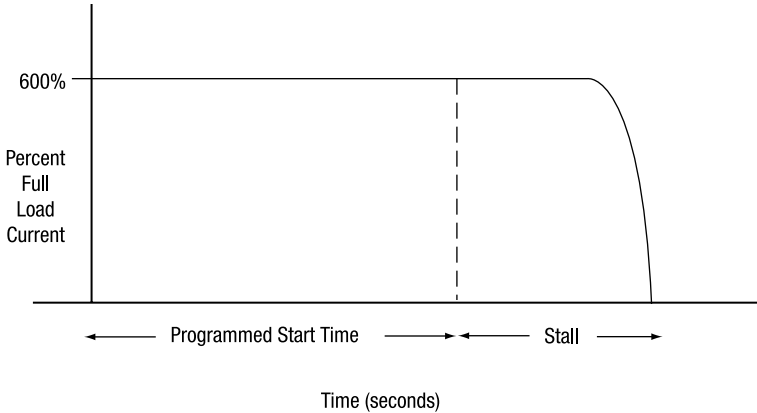
- An alarm (pre-fault) indication level can be programmed to indicate the unit is getting close to faulting. The alarm modification information is displayed through the LCD and alarm contact closing.

- Jam detection allows the user to determine the jam level (up to 1000% of the motor's FLC rating) and the delay time (up to 99.0 seconds) for application flexibility.

Figure 1.16 Jam Detection ①②
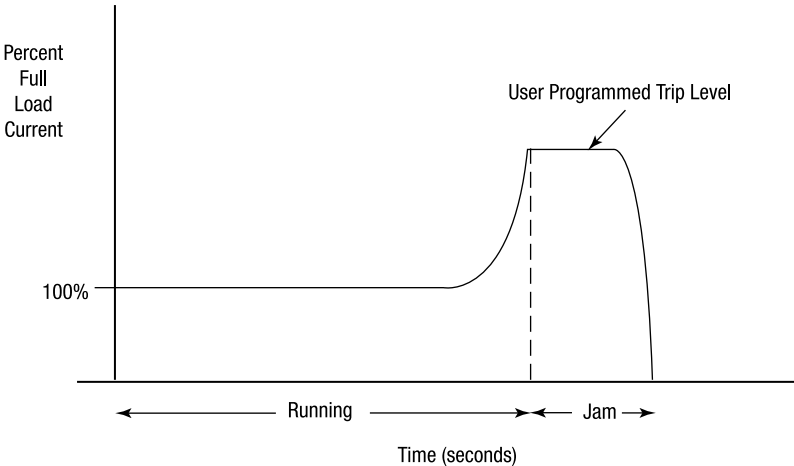
① Jam detection is disabled during slow speed and braking operation.
② Unit will self-protect in a jam condition.

Ground Fault

In isolated or high impedance-grounded systems, core-balanced current sensors are typically used to detect low level ground faults caused by insulation break-downs or entry of foreign objects. Detection of such ground faults can be used to interrupt the system to prevent further damage, or to alert the appropriate personnel to perform timely maintenance.

The PF Softstarter's ground fault detection capabilities require the use of external sensor. Installation of this sensor allows the option of enabling Ground Fault Trip, Ground Fault Alarm, or both.

For the 5...480 Amp devices, the recommended sensor is a Cat. No. 825-CBCT core balance current transformer for 1...5 A core-balanced ground fault protection.

For the 625...1250 A devices, the recommended sensor is shown below and provides 5...25 A core-balanced ground fault protection.

*   Manufacturer: Rockwell Automation
*   Description: 600Volt Rated Current Transformer
*   Catalog Number: 1411-126-252
*   Ratio: 2500: 5

Figure 1.17 Ground Fault Wiring
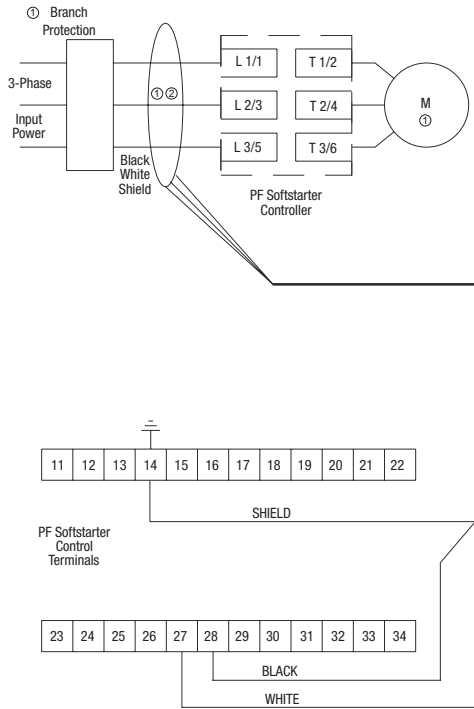
① Customer supplied.
② Cat. No. 825-CBCT or Cat. No. 1411-126-252

Note: When connecting the ground fault sensors, the secondary of the CT should be shorted until the connection to the PF control module is complete.

Ground Fault Trip

The PF Softstarter will trip with a ground fault indication if:
- No other fault currently exists
- Ground fault protection is enabled
- *GF Inhibit Time* has expired
- *GF Current* is equal to or greater than the *GF Trip Level* for a time period greater than the *GF Trip Delay*

Parameter 75, *Gnd Flt Inh Time*, allows the installer to inhibit a ground fault trip from occurring during the motor starting sequence and is adjustable from 0…250 seconds.

Parameter 74, *Gnd Flt Delay*, allows the installer to define the time period a ground fault condition must be present before a trip occurs. It is adjustable from 0.1…250 seconds.

Parameter 73, *Gnd Flt Level*, allows the installer to define the ground fault current at which the PF Softstarter will trip. It is adjustable from 1.0…5.0 A or 5.0...25 A depending on the service size.

Important: The ground fault inhibit timer starts after the maximum phase of load current transitions from 0 A to 30% of the device's minimum *FLA Setting* or the *GF Current* is greater than or equal to 0.5 A. The PF Softstarter does not begin monitoring for a ground fault condition until the *Gnd Flt Inh Time* expires.

Ground Fault Alarm

The PF Softstarter will indicate a Ground Fault Alarm if:
- No warning currently exists
- Ground fault alarm is enabled
- *GF Inhibit Time* has expired
- *GF Current* is equal to or greater than the *Gnd Flt A Lvl*

Parameter 77, *Gnd Flt A Lvl*, allows the installer to define the ground fault current at which the PF Softstarter will indicate a warning. It is adjustable from 1.0…5.0 A or 5.0...25 A, depending on the service size.

Parameter 78, *Gnd Flt A Dly*, allows the installer to define the time period a ground fault alarm condition must be present before a trip occurs. It is adjustable from 0.1…250 seconds.

Thermistor/PTC Protection

The PF Softstarter provides terminals 23 and 24 for the connection of positive temperature coefficient (PTC) thermistor sensors. PTC sensors are commonly embedded in motor stator windings to monitor the motor winding temperature. When the motor winding temperature reaches the PTC sensor's temperature rating, the PTC sensor's resistance transitions from a low to high value. Since PTC sensors react to actual temperature, enhanced motor protection can be provided to address such conditions as obstructed cooling and high ambient temperatures.

The following table defines the PF Softstarter PTC thermistor input and response ratings:

Table 1.A   PTC Input Ratings

Response resistance	$3400\ \Omega \pm 150\ \Omega$
Reset resistance	$1600\ \Omega \pm 100\ \Omega$
Short-circuit Trip Resistance	$25\ \Omega \pm 10\ \Omega$
Maximum Voltage at PTC Terminals ($R_{PTC} = 4k\Omega$)	$< 7.5V$
Maximum Voltage at PTC Terminals (R_{PTC} = open)	30V
Maximum Number of Sensors	6
Maximum Cold Resistance of PTC Sensor Chain	$1500\ \Omega$
Response Time	800 ms

The following figure illustrates the required PTC sensor characteristics, per IEC-34-11-2.

Figure 1.18 PTC Sensor Characteristics per IEC-34-11-2
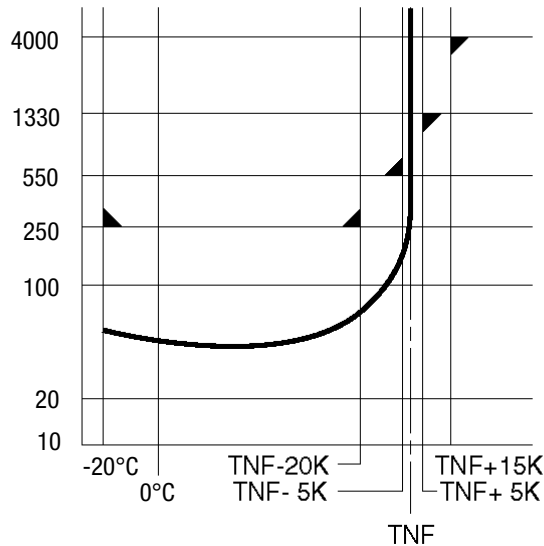
PTC Trip

The PF Softstarter will trip with a PTC indication if:

- No other fault currently exists
- PTC protection is enabled
- The resistance across terminals 23 and 24 is either greater than the relay's response resistance or less than the short-circuit trip resistance.

Excessive Starts/Hour

The PF Softstarter allows the user to program the allowed number of starts per hour (up to 99). This helps eliminate motor stress caused by repeated starting over a short time period.

Overtemperature

The PF Softstarter monitors the temperature of the SCRs and Bypass by using internal thermistors. When the power poles' maximum rated temperature is reached, the unit will shut down and restart is inhibited.

An over temperature condition can indicate inadequate ventilation, high ambient temperature, overloading, or excessive cycling. After the temperature is reduced to allowable levels, the fault can be cleared.

Open Gate

An open gate fault indicates that improper SCR firing, typically caused by an open SCR gate, has been detected on one of the power poles. Before the controller shuts down, it will attempt to start the motor a total of three times.

Line Faults

The PF Softstarter continually monitors line conditions for abnormal factors. Pre-start protection includes:

- Line Fault (with phase indication)
    - Line voltage loss
    - Missing load connection
    - Shorted SCR

Running protection includes:
- Line Fault (no phase indication)
    - Line voltage loss
    - Missing load connection

Phase Reversal[1] protection can be toggled either On or Off.

[1] Phase Reversal protection is functional only at pre-start.

Metering

Power monitoring parameters include:

- Three-phase current
- Three-phase voltage
- Power in kW
- Power usage in kWH
- Power factor
- Motor thermal capacity usage
- Elapsed time

Notes: (1) Voltage measurement is not available during the braking operation of the SMB Smart Motor Brake, Accu-Stop, and Slow Speed with Braking control options.
(2) The elapsed time and kWH values are automatically saved to memory every 12 hours.
(3) Motor thermal capacity usage is determined by the built-in electronic thermal overload. An overload fault occurs when this value reaches 100%.

I/O

The PF Softstarter has the ability to accept up to two (2) inputs and four (4) outputs controlled over a network. The two inputs are controlled at terminal 16 (Option Input #1), and terminal 15 (Option Input #2). For these two inputs, see Chapter 4 for the parameter settings. By using these two terminals as inputs, the Stop Input will need to be programmed to meet the desired stop functionality.

The four (4) outputs are Aux #1, Aux #2, Aux #3, and Aux #4. All auxiliary contacts are programmable to the function found on page 4-15.

Status Indication

Four programmable hard contact outputs are provided as standard. All auxiliary contacts are programmable for the following states:

- Normal (N.O./N.C.)
- Up-to-Speed (N.O./N.C.)
- Alarm (N.O./N.C.)
- Fault (N.O./N.C.)
- Network Control (N.O./N.C.)
- External Bypass (N.O.)

Figure 1.19 Control Terminals
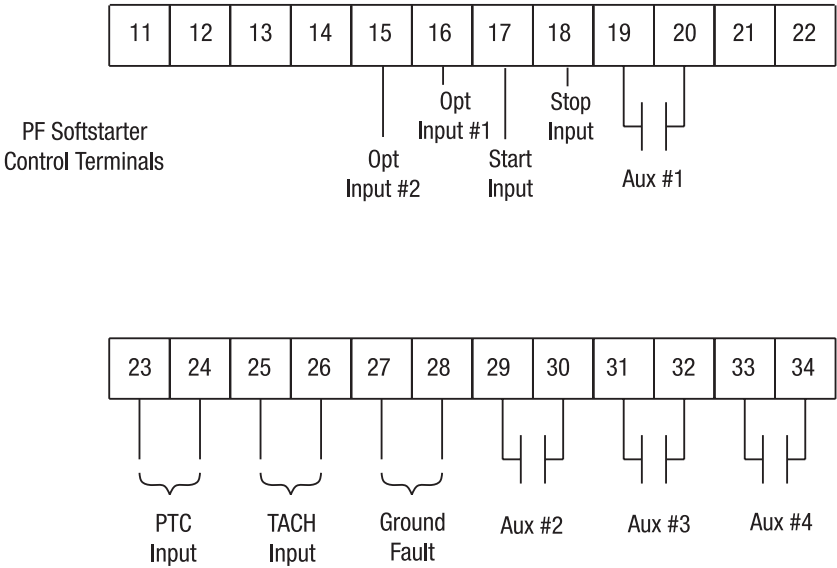
Network inputs can be obtained through proper programming of Option #1 and Option Input #2.

Installation

Degree of Protection

The PF soft starters have an IP00 or IP2X protection rating depending on the size. Taking into account the ambient conditions, the device must be installed in IP54 (Type 2) switchgear cabinets. Make sure that no dust, liquids, or conductive parts can enter the soft starter. Soft starter operation produces waste heat (heat loss). See Table 2.A or *Specifications* on page A-1, for details.

Receiving

It is the user's responsibility to thoroughly inspect the equipment before accepting the shipment from the freight company. Check the item(s) received against the purchase order. If any items are damaged, it is the responsibility of the user not to accept delivery until the freight agent has noted the damage on the freight bill. Should any concealed damage be found during unpacking, it is again the responsibility of the user to notify the freight agent. The shipping container must be left intact and the freight agent should be requested to make a visual inspection of the equipment.

Unpacking

Remove all packing material, wedges, or braces from within and around the controller.

After unpacking, check the item(s) nameplate catalog number against the purchase order.

Inspecting

Storing

The controller should remain in its shipping container prior to installation. If the equipment is not to be used for a period of time, it must be stored according to the following instructions in order to maintain warranty coverage.

- Store in a clean, dry location.
- Store within an ambient temperature range of –20°C to +75°C (–4°F to +167°F).
- Store within a relative humidity range of 0% to 95%, noncondensing.
- Do not store equipment where it could be exposed to a corrosive atmosphere.
- Do not store equipment in a construction area.

Lifting

For controllers rated 625...1250 A, the device should only be lifted from designated lifting points. The lifting points are designed to accept a 1/2 - 13 threaded hoist ring capable of lifting 2500 pounds. These points are identified in Figure 2.1

Figure 2.1 Lifting Points.
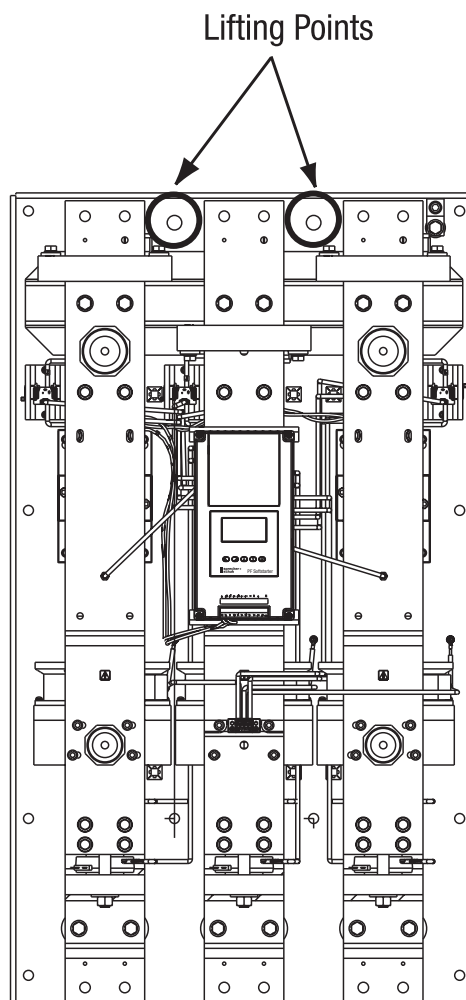
General Precautions

In addition to the precautions listed throughout this manual, the following statements, which are general to the system, must be read and understood.

Attention

The controller contains ESD- (electrostatic discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing, or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to applicable ESD protection handbooks.

Attention

An incorrectly applied or installed controller can damage components or reduce product life. Wiring or application errors, such as undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures, may result in malfunction of the system.

Attention

Only personnel familiar with the controller and associated machinery should plan or implement the installation, start-up, and subsequent maintenance of the system. Failure to do this may result in personal injury and/or equipment damage.

Attention

Hazardous voltages that can cause shock, burn, or death are present on L1, L2, L3, T1, T2, T3, T4, T5, and T6.

Power terminal covers can be installed to prevent inadvertent contact with terminals. Disconnect the main power before servicing the motor controller or associated wiring.

Heat Dissipation

The following table provides the maximum heat dissipation at rated current for the controllers. For currents lower than rated value, heat dissipation will be reduced.

Table 2.A Maximum Heat Dissipation

PF Rating	5 A	25 A	43 A	60 A	85 A	108 A	135 A	201 A	251 A	317 A	361 A	480 A	625 A	700 A	970 A	1250 A
Max. Watts	70	70	81	97	129	91	104	180	198	225	245	290	446	590	812	1222

Enclosures

The open-style design of the PF Softstarter requires that it be installed in an enclosure. **The internal temperature of the enclosure must be kept within the range of 0…50°C.**

For Type 12 (IP54) enclosures, the following guidelines are recommended to limit the maximum controller ambient temperature.There should be a clearance of at least 15 cm (6 in.) above and below the controller. This area allows air to flow through the heatsink.

Table 2.B Minimum Enclosure Size

Controller Rating (A)		IP65 (Type 4/12)	
	B Height	A Width	C Depth
Non-Combination Controller			
5	610 (24)	508 (20)	254 (10)
25	610 (24)	508 (20)	254 (10)
43	610 (24)	508 (20)	254 (10)
60	610 (24)	508 (20)	254 (10)
85	610 (24)	508 (20)	254 (10)
108	760 (30)	610 (24)	305 (12)
135	760 (30)	610 (24)	305 (12)
201	914 (36)	762 (30)	406 (16)
251	914 (36)	762 (30)	406 (16)
317	1524 (60)	914 (36)	406 (16)
361	1524 (60)	914 (36)	406 (16)
480	1524 (60)	914 (36)	406 (16)
625	2286 (90)	1829 (72)	508 (20)
780	2286 (90)	1829 (72)	508 (20)
970 ③	2286 (90)	1829 (72)	508 (20)
1250 ③	2286 (90)	1829 (72)	508 (20)
Combination Controllers with Fusible Disconnect			
5	610 (24)	508 (20)	254 (10)
25	610 (24)	508 (20)	254 (10)
43	610 (24)	508 (20)	254 (10)
60	610 (24)	508 (20)	254 (10)
85	610 (24)	508 (20)	254 (10)
108	914 (36)	762 (30)	406 (16)
135	914 (36)	762 (30)	406 (16)
201	1219 (48)	914 (36)	406 (16)
251	1219 (48)	914 (36)	406 (16)
317	1524 (60)	914 (36)	406 (16)
361	1524 (60)	914 (36)	406 (16)
480 ①	1524 (60)	914 (36)	406 (16)
480 ②	2286 (90)	508 (20)	508 (20)
625	2286 (90)	1829 (72)	508 (20)
780	2286 (90)	1829 (72)	508 (20)
970 ③	2286 (90)	1829 (72)	508 (20)
1250 ③	2286 (90)	1829 (72)	508 (20)
Combination Controllers with Circuit Breaker			
5	610 (24)	508 (20)	254 (10)
25	610 (24)	508 (20)	254 (10)
43	610 (24)	508 (20)	254 (10)
60	610 (24)	508 (20)	254 (10)
85	610 (24)	508 (20)	254 (10)
108	914 (36)	762 (30)	406 (16)
135	914 (36)	762 (30)	406 (16)
201	1219 (48)	914 (36)	406 (16)
251	1219 (48)	914 (36)	406 (16)
317	1524 (60)	914 (36)	406 (16)
361	1524 (60)	914 (36)	406 (16)
480	1524 (60)	914 (36)	406 (16)
625	2286 (90)	1829 (72)	508 (20)
780	2286 (90)	1829 (72)	508 (20)
970 ③	2286 (90)	1829 (72)	508 (20)
1250 ③	2286 (90)	1829 (72)	508 (20)

① Use this row for 460V -58 and 575V -59.
② Use this row for 460V -59 and 575V -60 and -61.
③ 970...1250 rated devices are only available as Type 1 and require a door-mounted fan, capable of delivering 240 cfm.

Mounting

All units are fan cooled. It is important to locate the controller in a position that allows air to flow vertically through the power module. **The controller must be mounted in a vertical plane and have a minimum of 15 cm (6 in.) free space above and below the controller.**

When drilling or installing near the softstarter, make sure that adequate measures are taken to protect the device from dust and debris. See Figure 2.2

Figure 2.2 PF Softstarter Mounting Protection
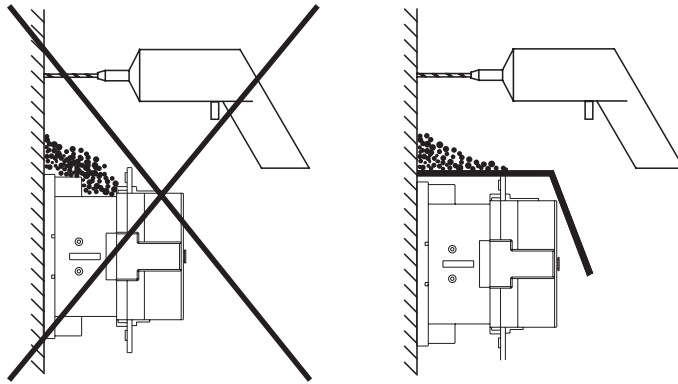
Dimensions

Figure 2.3 Dimensions: 5...85 A Controllers
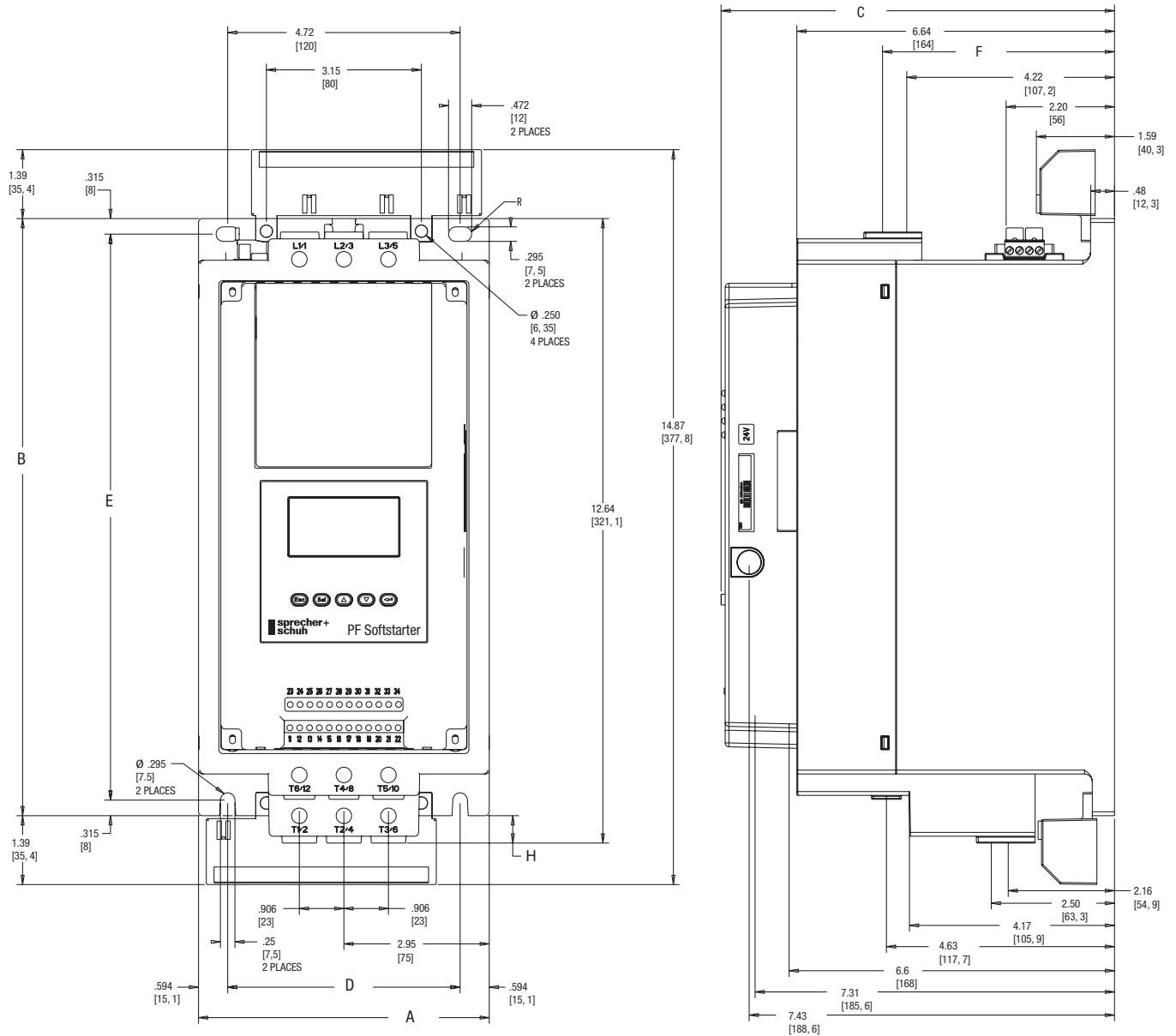
NOTE:
1) DIMENSIONS IN INCHES [MILLIMETERS].
2) DIMENSIONS ARE NOT INTENDED TO BE USED FOR MANUFACTURING PURPOSES.

	Unit	A Width	B Height	C Depth	D	E	F	H	Approx. Ship Wt.
5...85 A	mm	150.1	307	203.1	120	291	119.8	14.1	5.7 kg
Controller	in.	5.91	12.09	8.0	4.72	11.46	4.72	0.56	12.6 lb.

All dimensions are approximate and are not intended for manufacturing purposes.

Figure 2.4 Dimensions: 108...135 A Controllers
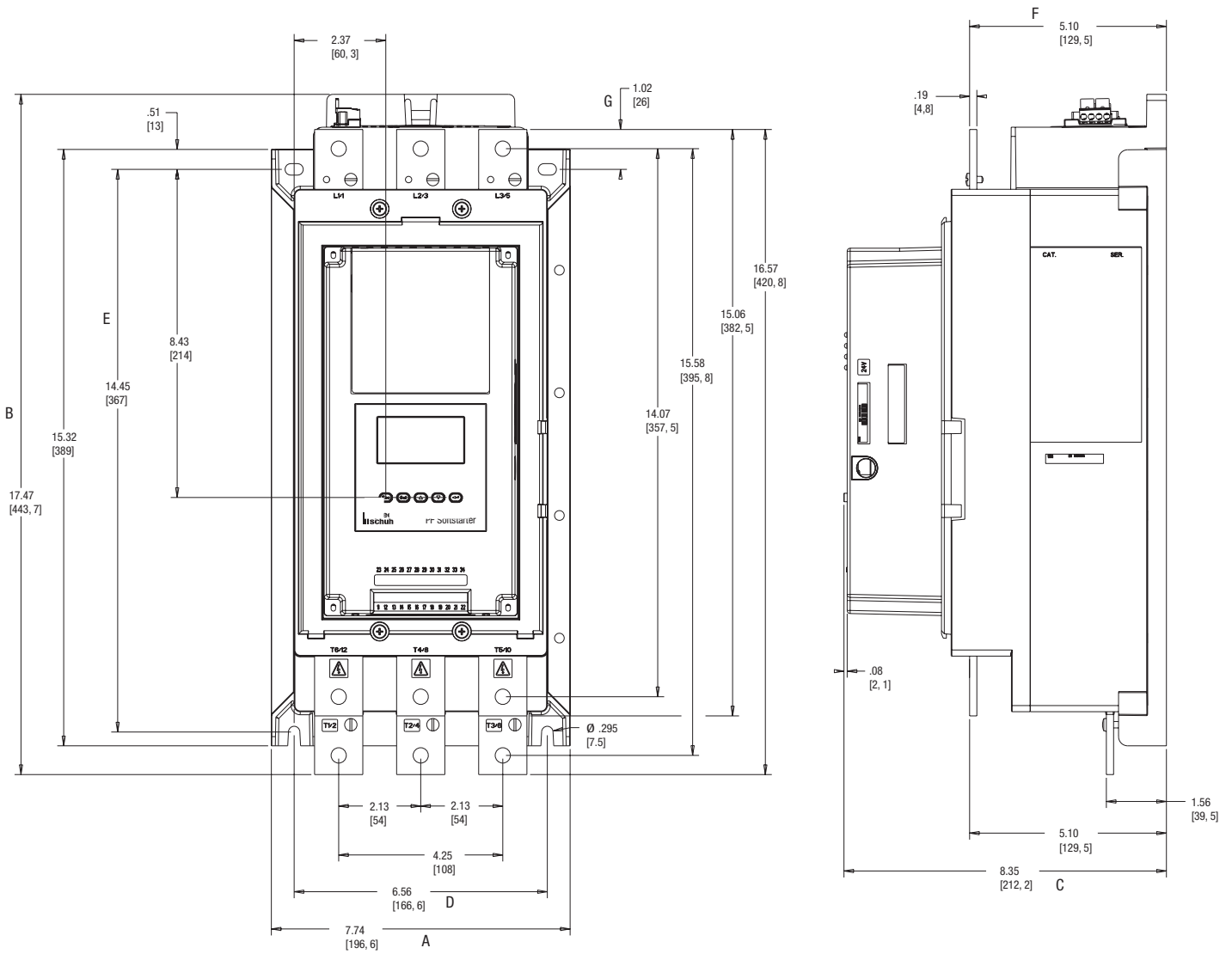
	Unit	A Width	B Height	C Depth	D	E	F	G	Approx. Ship Wt.
108...135 A	mm	196.4	443.7	212.2	166.6	367	129.5	26	15 kg
Controller	in.	7.74	17.47	8.35	6.56	14.45	5.10	1.02	33 lb.

All dimensions are approximate and are not intended for manufacturing purposes.

Figure 2.5   Dimensions: 201...251 A Controllers
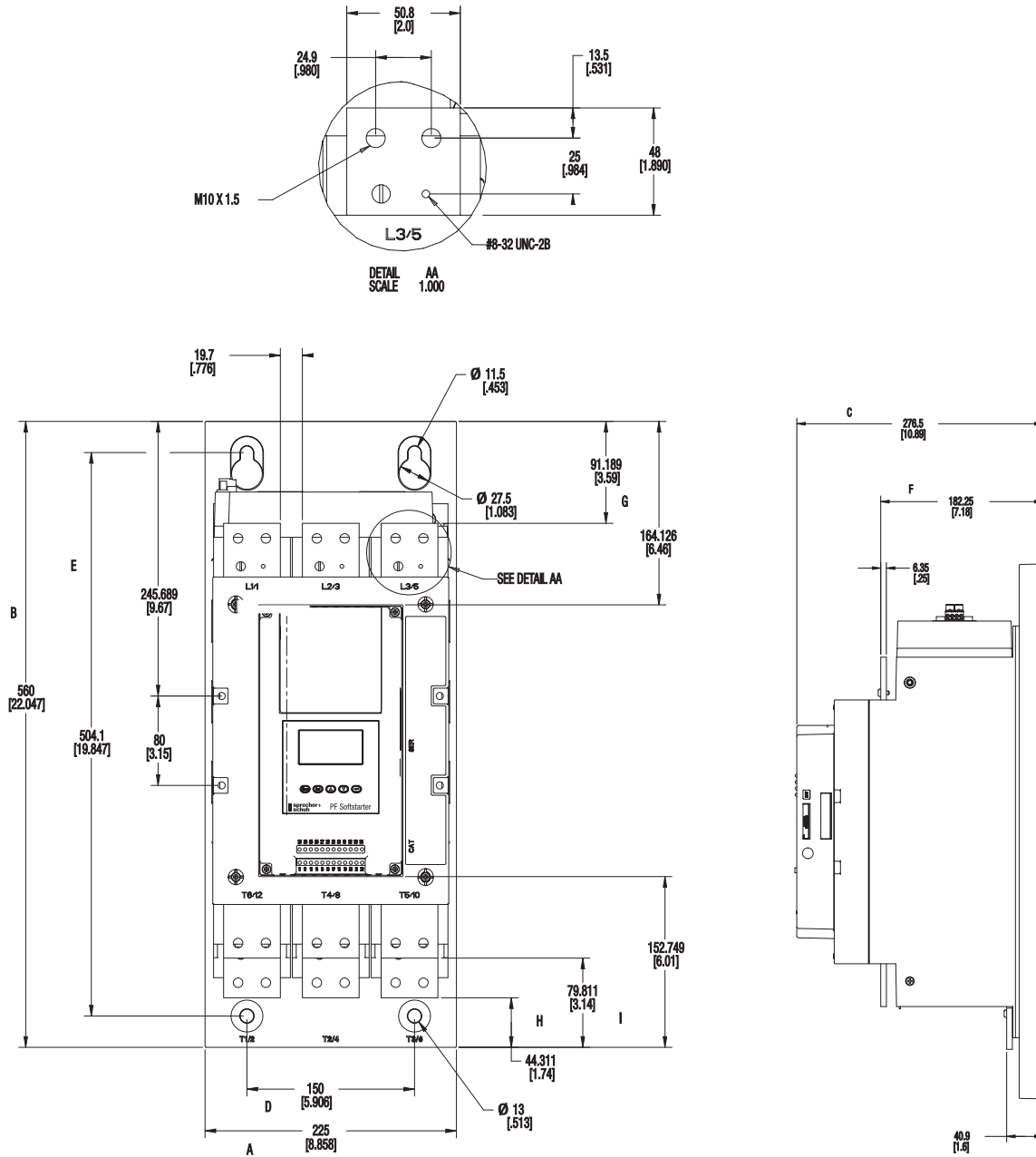
	Unit	A Width	B Height	C Depth	D	E	F	G	H	I	Approx. Ship Wt.
201...251 A	mm	225	560	253.8	150	504.1	157.25	91.189	44.311	79.811	30.4 kg
Controller	in.	8.858	22.047	9.992	5.906	19.847	6.2	3.59	1.74	3.14	67 lb.

All dimensions are approximate and are not intended for manufacturing purposes.

Figure 2.6   Dimensions: 317...480 A Controllers
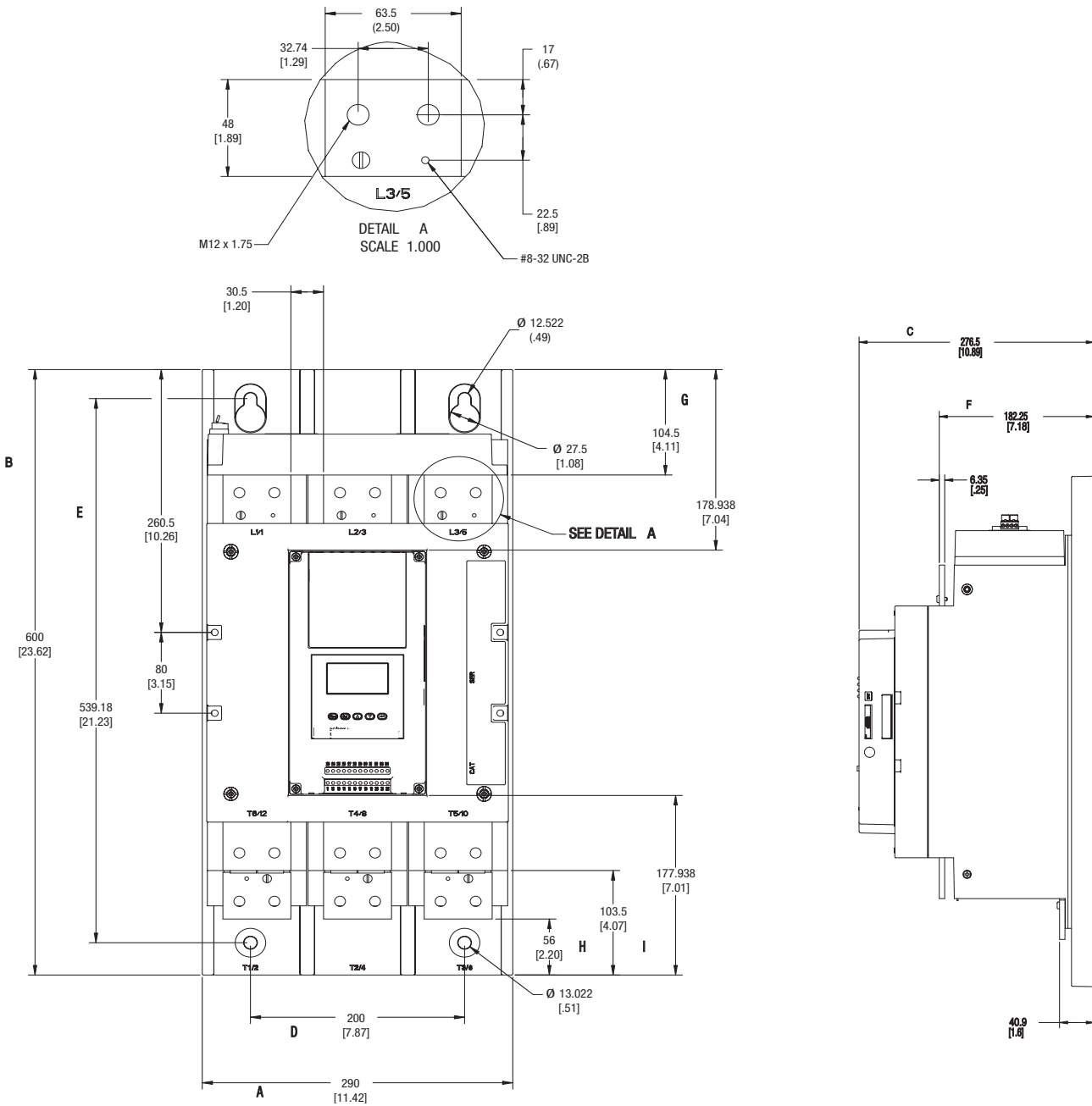
	Unit	A Width	B Height	C Depth	D	E	F	G	H	I	Approx. Ship Wt.
317...480 A	mm	290	600	276.5	200	539.18	182.25	104.5	55.5	103.5	45.8 kg
Controller	in.	11.42	23.62	10.89	7.87	21.23	7.18	4.11	2.19	4.07	101 lb.

All dimensions are approximate and are not intended for manufacturing purposes.

Figure 2.7   Dimensions: 625...780 A Controllers
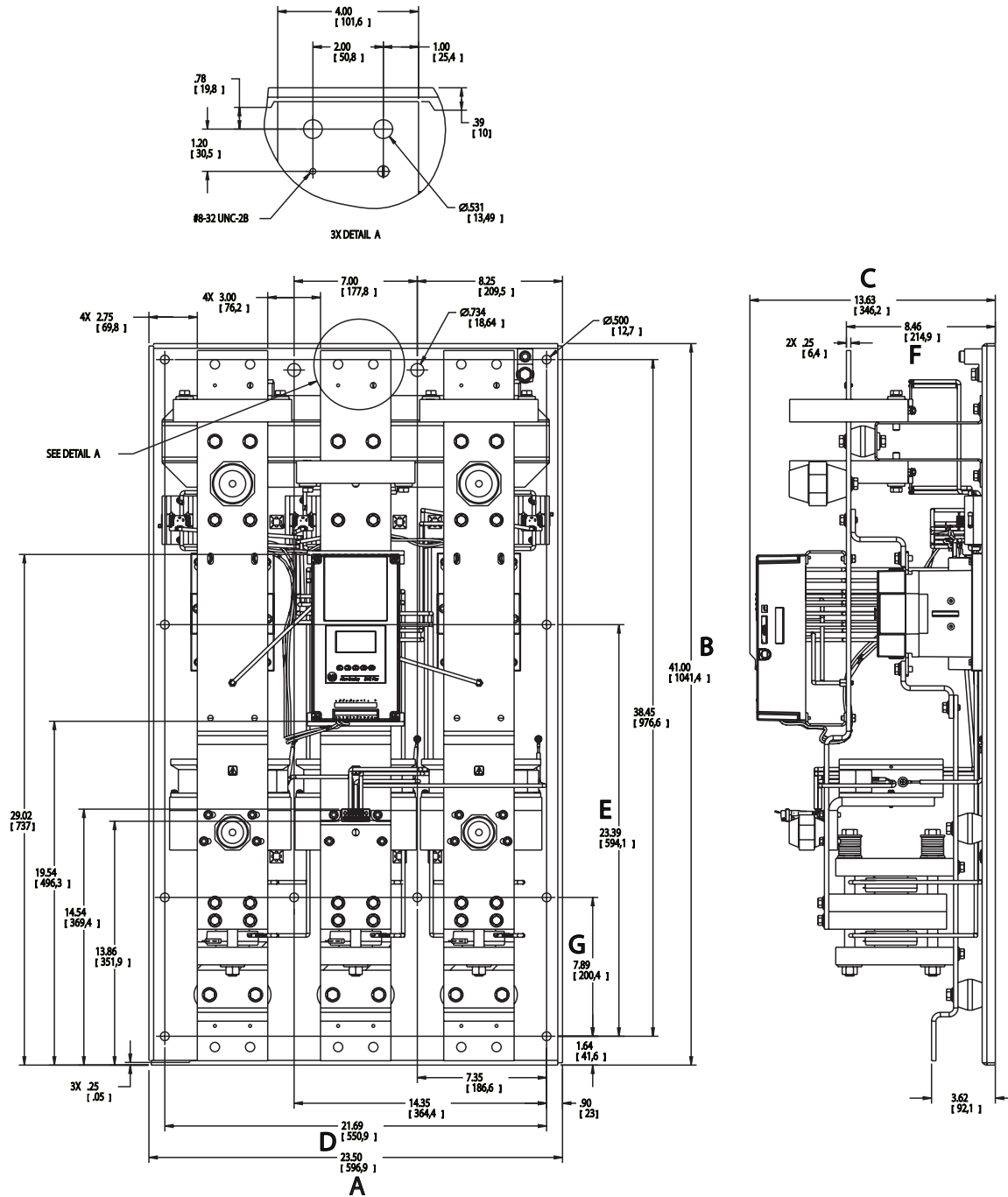
	Unit	A Width	B Height	C Depth	D	E	F	G	Approx. Ship Wt.
625...780 A	mm	596.9	1041.4	346.2	550.9	594.1	214.9	200.4	179 kg
Controller	in.	23.5	41.0	13.63	21.69	23.39	8.46	7.89	395 lb

All dimensions are approximate and are not intended for manufacturing purposes.
Consult your local Sprecher + Schuh representative for complete dimension drawings.

Figure 2.8   Dimensions: 970...1250 A Controllers
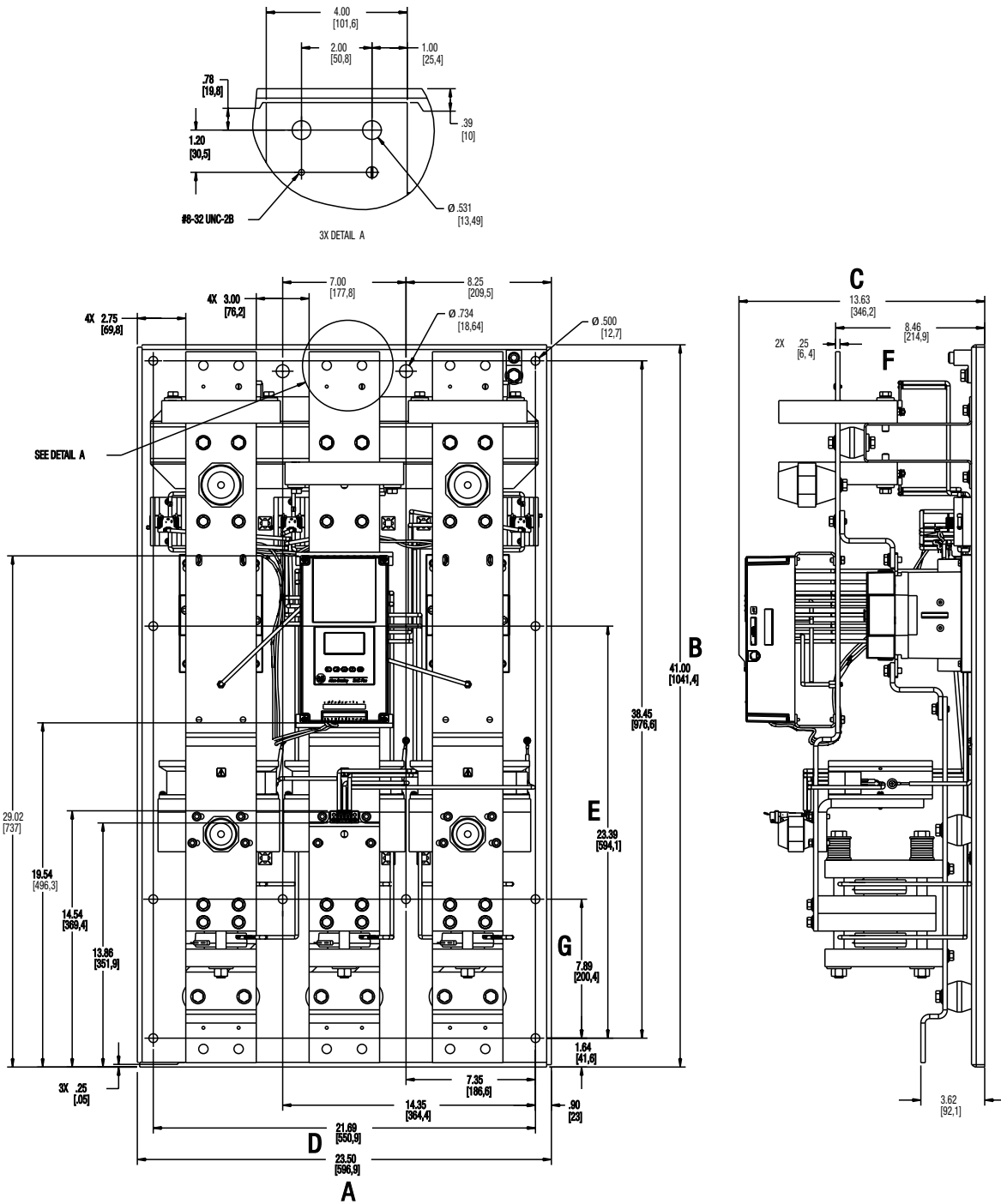
	Unit	A Width	B Height	C Depth	D	E	F	G	Approx. Ship Wt.
970...1250 A	mm	596.9	1041.4	346.2	550.9	594.1	214.9	200.4	224 kg
Controller	in.	23.5	41.0	13.63	21.69	23.39	8.46	7.89	495 lb

All dimensions are approximate and are not intended for manufacturing purposes.
Consult your local Sprecher + Schuh representative for complete dimension drawings.

Power Factor Correction Capacitors

The controller can be installed on a system with power factor correction (PFC) capacitors. The capacitors **must** be located on the line side of the controller. This must be done to prevent damage to the SCRs in the PF Softstarter.

When discharged, a capacitor essentially has zero impedance. For switching, sufficient impedance should be connected in series with the capacitor bank to limit the inrush current. One method for limiting the surge current is to add inductance in the capacitor's conductors. This can be accomplished by creating turns or coils in the power connections to the capacitors.

• 250V — 15 cm (6 in.) diameter coil, 6 loops
• 480…600V — 15 cm (6 in.) diameter coil, 8 loops

Take care in mounting the coils so that they are not stacked directly on top of each other; stacking will cause a cancelling effect. Also, mount the coils on insulated supports away from metal parts so they will not act as induction heaters. If an isolation contactor is used, put capacitors in front of contactor.

Note: For further instructions, consult the PFC capacitor vendor.

Figure 2.9 Typical Wiring Diagram for Power Factor Correction Capacitors
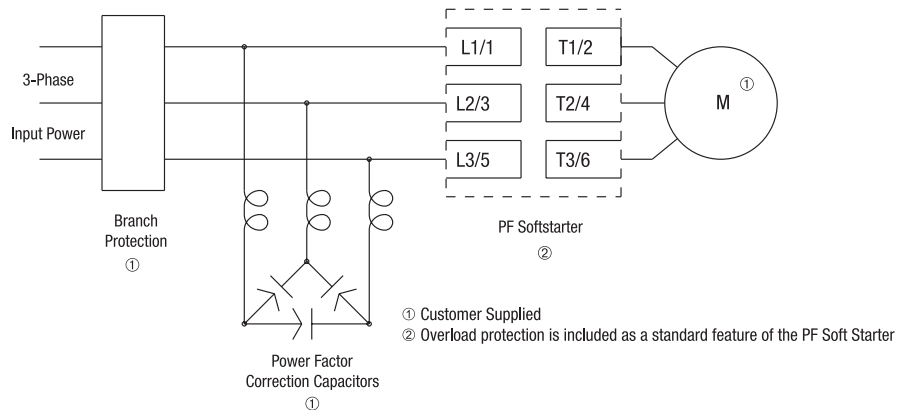
Figure 2.10 Typical Wiring Diagram for Power Factor Correction Capacitors and Contactor
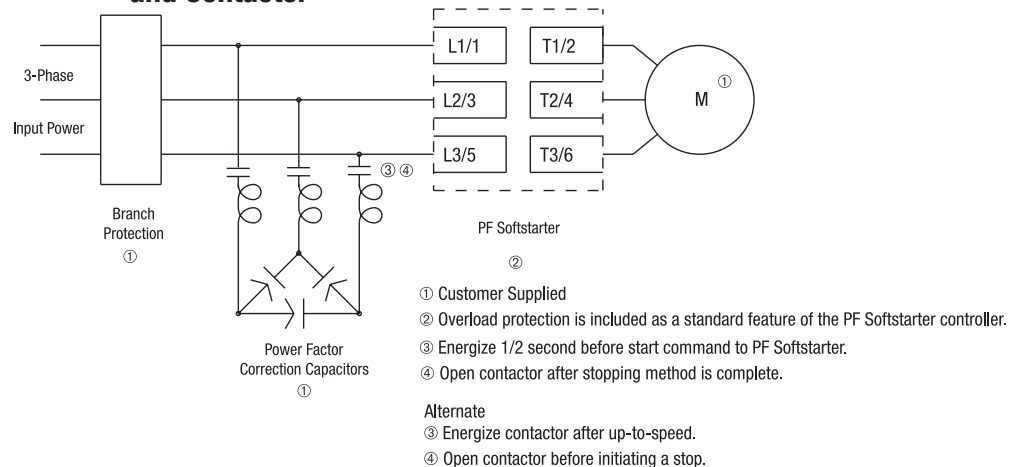
Protective Modules

Protective modules containing metal oxide varistors (MOVs) can be installed on controllers rated 5...1250 A and 200...600V, to protect the power components from electrical transients. The protective modules clip voltage transients generated on the lines to prevent such surges from damaging the SCRs.

Attention	When installing or inspecting the protective module, make sure that the controller has been disconnected from the power source. The protective module should be inspected periodically for damage or discoloration. Replace if necessary.

Motor Overload Protection

Thermal motor overload protection is provided as standard with the PF Softstarter. If the overload trip class is less than the acceleration time of the motor, nuisance tripping may occur.

Attention	Overload protection should be properly coordinated with the motor.

Two applications require special consideration: two-speed motors, and multi-motor protection.

Two-speed Motors

The PF Softstarter has overload protection available for single speed motors. When the PF Softstarter is applied to a two-speed motor, the Overload Class parameter must be programmed to OFF and separate overload relays must be provided for each speed.

Multi-motor Protection

If the PF Softstarter is controlling more than one motor, individual overload protection is required for each motor.

Electromagnetic Compatibility (EMC)

Attention

This product has been designed for Class A equipment. Use of the product in domestic environments may cause radio interference, in which case, the installer may need to employ additional mitigation methods.

The following guidelines are provided for EMC installation compliance.

Enclosure

Install the product in a grounded metal enclosure.

Wiring

Wire in an industrial control application can be divided into three groups: power, control, and signal. The following recommendations for physical separation between these groups is provided to reduce the coupling effect.

- Different wire groups should cross at 90° inside an enclosure.
- Minimum spacing between different wire groups in the same tray should be 16 cm (6 in.).
- Wire runs outside an enclosure should be run in conduit or have shielding/ armor with equivalent attenuation.
- Different wire groups should be run in separate conduits.
- Minimum spacing between conduits containing different wire groups should be 8 cm (3 in.).
- For additional guidelines, please refer to Wiring and Ground guidelines, publication DRIVES-IN001A-EN-P.

Additional Requirements

- If linear acceleration is used, a separate conduit or wire way should be used for the tachometer leads.
- Wire earth ground to control terminal 14.
- Use shielded wire for PTC, Tachometer, and ground fault input.
- Terminate shielded wires to terminal 14.
- Ground fault CT must be inside or within 3 m of metal enclosure.

Terminal Locations

The PF Softstarter wiring terminal locations are shown in Figure 3.1 and Figure 3.2. Make wiring connections as indicated in the typical connection diagrams. incoming three-phase power connections are made to terminals L1/1, L2/3, and L3/5. Load connections to Line motors are made to T1/2, T2/4, and T3/6, while load connections to Wye-Delta motors are made to T1/2, T2/4, T3/6, T4/8, T5/10, and T6/12.

Figure 3.1 Wiring Terminal Locations (5..85 A)
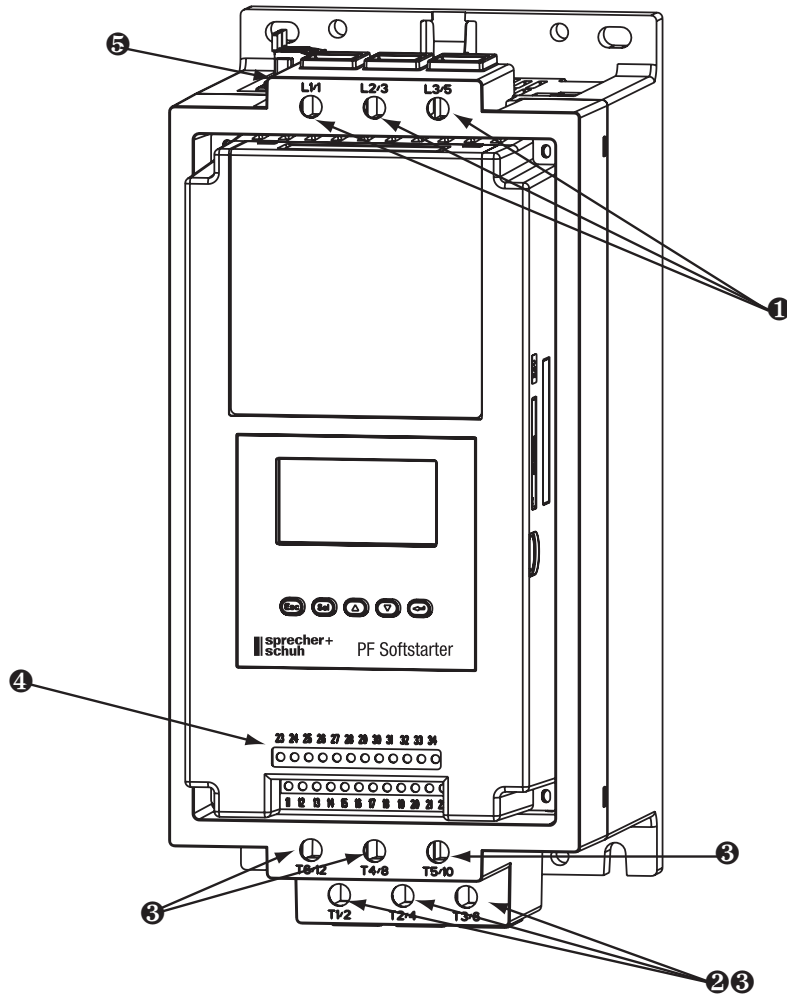
Table 3.A Wiring Terminal Locations

1	Incoming Line Termination
2	Line Motor Connections
3	Delta Motor Connections
4	Control Terminations
5	Fan Terminations

① IP20 protective covers on Delta termination must be removed when connecting in a Delta configuration.

Figure 3.2 Wiring Terminal Locations (108...480 A)
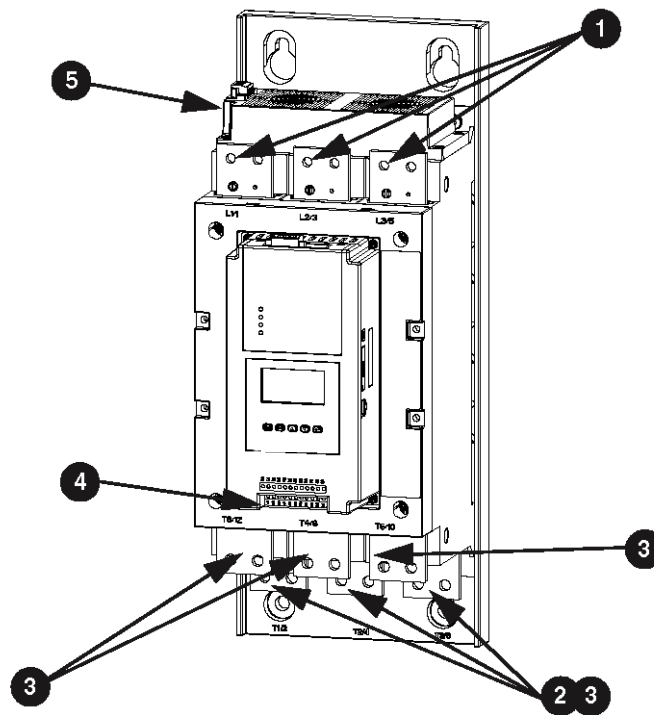
Table 3.A Wiring Terminal Locations

1	Incoming Line Termination
2	Line Motor Connections
3	Delta Motor Connections
4	Control Terminations
5	Fan Terminations

Figure 3.3 Wiring Terminal Locations (625...1250 A)
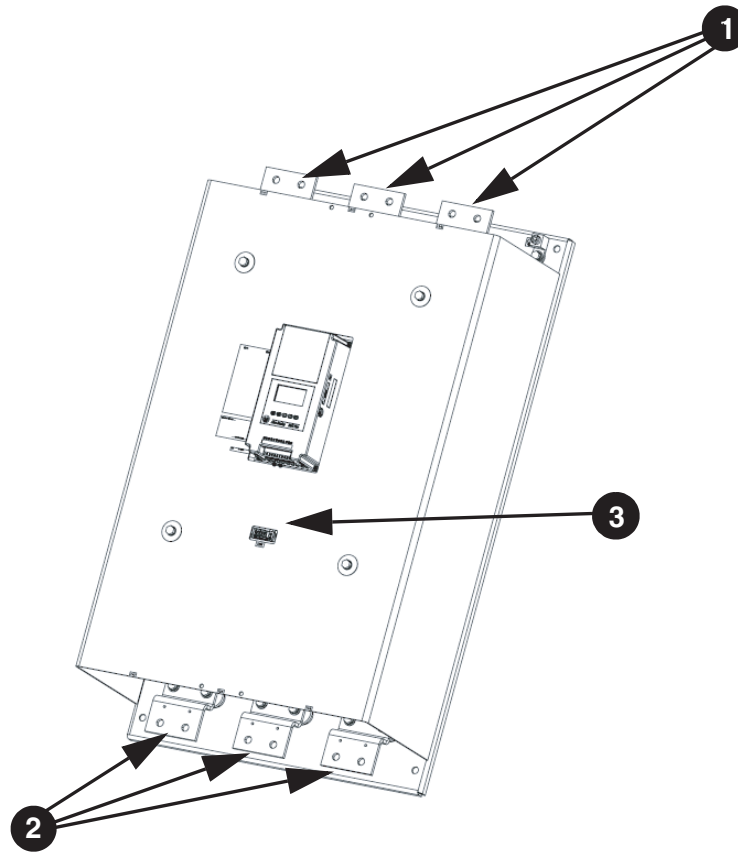
Table 3.B Wiring Terminal Locations

1	Incoming Line Termination
2	Line Motor Connections
3	Terminal Block CP1 - Control Power Connections (Fans, Contactors, and Control Modules)

Power Structure

The PF Softstarter product has an integrated mechanical run contactor on each phase of the motor to minimize heat generation during run time. These contacts are pulled in sequentially in the 108...1250 A units. In the 5...85 A units, these contacts are pulled in, all at once. The PF Softstarter product also has a Current Transformer (CT), built in on each phase of the motor to provide current readings.

Power Wiring

Refer to the product nameplate or User Manual for power lug termination information including:
- Lug wire capacity
- Tightening torque requirements
- Lug kit catalog numbers (108...1250 A)

Attention	Failure of solid state power switching components can cause overheating due to a single phase condition in the motor. To prevent injury or equipment damage, the following is recommended:

Use of an isolation contactor shunt trip type circuit breaker on the line side of the PF. This device should be capable of interrupting the motor's lock rotor current.

Connection of this isolation device to an auxiliary contact on the PF Softstarter. The auxiliary contact should be programmed for the "normal" condition. See Chapter 4 for additional information on programming.

Line Connected

The PF Softstarter by default is programmed to be connected to a line controlled motor as shown in Figure 3.4. These motors typically have 3 leads and must be rated between 1...1250 amps. An **optional** isolation contactor can be added to the circuit to provide galvanic isolation of the motor and final electro-mechanical removal of power.

Figure 3.4
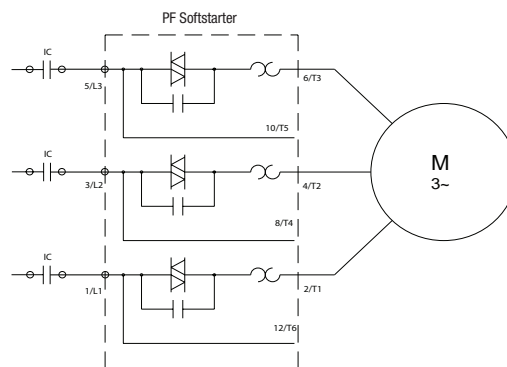
Delta Connected

The PF Softstarter can be programmed and connected to a delta controlled motor as shown in Figure 3.5. These motors typically have 6 or 12 leads and must be rated between 1.8...1600 amps. **It is recommended that an isolation contactor be added to the circuit to provide galvanic isolation of the motor and final electro-mechanical removal of power.**

Figure 3.5
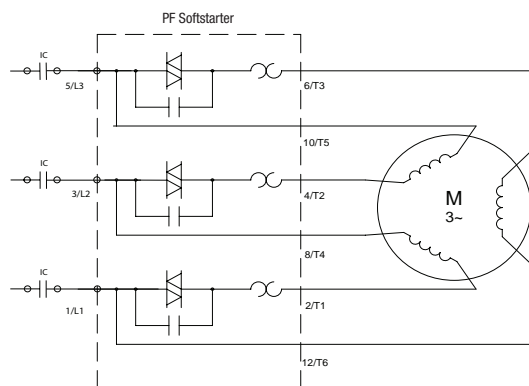
Power Lugs

Power lugs are required for devices rated 108...1250 A. In some cases these lugs are sold in kits. Each kit contains three lugs. The number and type of lugs required is listed in the following tables.

Table 3.C lists the recommended lugs for the PF Softstarter when configured as a line connection. Table 3.D lists the recommended lugs when using the PF Softstarter with a delta connection. Note that devices rated 625...1250 A require use of a power distribution block when used with a delta connection.

| **Attention** | Terminal covers are available for units rated 108...480 A which can make the product deadfront (IP2X) safe. See Appendix D for the appropriate catalog numbers for ordering. |

Table 3.C PF Softstarter 5...1250 A, Line Connection Lug Information

PF Rating	Lug Kit Cat. No.	Wire Strip Length	Conductor Range	Max. No. Lugs/Pole		Tightening Torque	
				Line Side	Load Side	Wire - Lug	Lug - Busbar
5...85 A	—	18...20 mm	2.5...85 mm^2 (#14...3/0 AWG)	—	—	11.3 N•m (100 lb.-in.)	—
108...135 A	PNX-1120	18...20 mm	16...120 mm^2 (#6...250 MCM)	1	1	31 N•m (275 lb.-in.)	16.9 N•m (150 lb.-in.)
201...251 A	PNX-1120	18...20 mm	16...120 mm^2 (#6...250 MCM)	2	2	31 N•m (275 lb.-in.)	23 N•m (200 lb.-in.)
317...480 A	PNX-1240	18...25 mm	25...240 mm^2 (#4...500 MCM)	2	2	42 N•m (375 lb.-in.)	28 N•m (250 lb.-in.)
625...780 A	CA6-L630	32 mm / 64 mm	70...240 mm^2 (2/0...500 MCM)	2	2	45 N•m (400 lb.-in.)	68 N•m (600 lb.-in.)
970 A	CA6-L860	26 mm / 48 mm	120...240 mm^2 (4/0...500 MCM)	1	1	45 N•m (400 lb.-in.)	68 N•m (600 lb.-in.)
1250 A [1]	CA6-L630	32 mm / 64 mm	70...240 mm^2 (2/0...500 MCM)	1	1	45 N•m (400 lb.-in.)	68 N•m (600 lb.-in.)
	CA6-L860	26 mm / 48 mm	120...240 mm^2 (4/0...500 MCM	1	1		

[1] The 1250 A device requires one (1) each of the CA6-L630 and CA6-L860.

Table 3.D   PF Softstarter 108...1250 A, Delta Connection Lug Information (for inside-the-Delta applications)

PF Softstarter Rating	Suggested Lug Cat. No.	Conductor Range	Max. No. Lugs/Pole Line Side ②	Tightening Torque	
				Wire — Lug	Lug — Busbar
108...135 A	1494R-N15	25...240 mm² (#4...500 AWG)	1	42 N•m (375 lb.-in.)	16.9 N•m (150 lb.-in.)
201...251 A	1494R-N14	50...120 mm² (#1/0...250 AWG)	2	31 N•m (275 lb.-in.)	23 N•m (200 lb.-in.)
317...480 A	150-LG5MDC	95...240 mm² (#3/0...500 AWG)	1	33.9 N•m (300 lb.-in.)	28 N•m (250 lb.-in.)
625...780 A ①	—	25...240 mm² (#4...500 AWG)	2	42 N•m (375 lb.-in.)	N/A
970...1250 A ①	—	25...240 mm² (#4...500 AWG)	4	42 N•m (375 lb.-in.)	N/A

① For 625…1250 A inside-the-delta connections, terminal blocks are required for line side connections.
Required terminal blocks are as follows:
- Part # 1492-BG (625…780 A: 2 per phase, 970…1250 A: 4 per phase).
  Short-Circuit Protection = Fuses
- Cooper Bussmann Part# 16504-2 (625…780 A: 1 per phase, 970…1250 A: 2 per phase).
  Short-Circuit Protection = Circuit breaker
② Load side lug information for inside-the-delta applications is contained in Table 3.C.

Control Power

Control Wiring

Refer to the product nameplate for control terminal wire capacity and tightening torque requirements. Each control terminal will accept a maximum of two wires. Refer to the product nameplate prior to applying control power. Depending on the specific application, additional control circuit transformer VA capacity may be required.

Controllers rated 5...480 Amps

The PF Softstarter controllers rated 5...480 amps accept control power input of 100...240V AC or 24V AC/DC, (+10/-15%) single-phase, 50/60 Hz. A control power source of 125 VA is required. The control power requirement for the control module is 75VA. The control power requirement for the fans is 20 or 50 VA. The control module and fans are separately wired. The control module requirements are shown in Table 3.E. The fans require additional power as defined in Table 3.G.

Table 3.E Control Module Requirements

120...240V AC	Transformer	75 VA
24V AC	Transformer	130 VA
24V DC	Inrush Current	5 A
	Inrush Time	250 ms
	Transient Watts	60 W
	Transient Time	500 ms
	Steady State Watts	24 W
	Minimum Power Supply	1606-XLP50E

Controllers rated 625...1250 Amps

For controllers rated 625...1250 A, common control is required for proper operation. Control power is connected to the product through terminal block CP1, at terminals 1 and 4. This single connection point feeds the control module, contactors, and fans. Control power must be supplied as 110/120 VAC or 230/240 VAC, 50/60 Hz only. A control power source of at least 800 VA is required. The control power requirements include the control module (75 VA), bypass contactors (526 VA max), and fan power (150 VA).

Depending on the specific application, additional control circuit transformer VA capacity may be required.

Figure 3.6   230V Control Undervoltage Relay Settings for 625...1250 A Devices
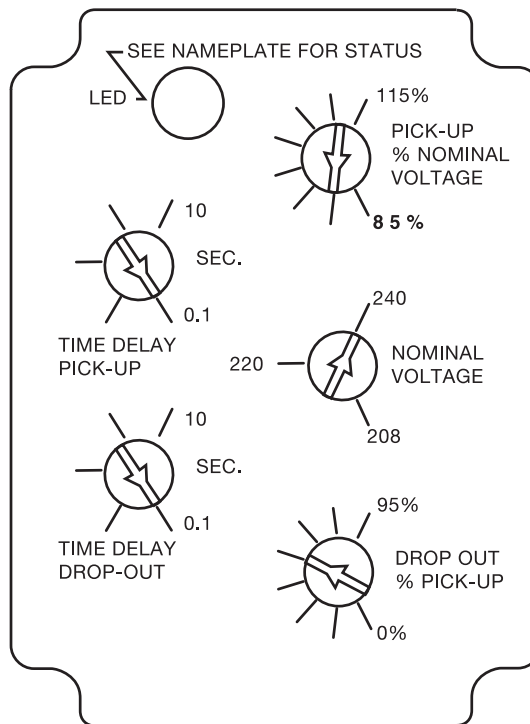
GENERAL NOTES:
1. SET ALL RELAY POTENTIOMETERS PER ILLUSTRATION.

Figure 3.7   Internal Wiring and 230V Control Undervoltage Relay Connection Diagram for 625...1250 A Devices
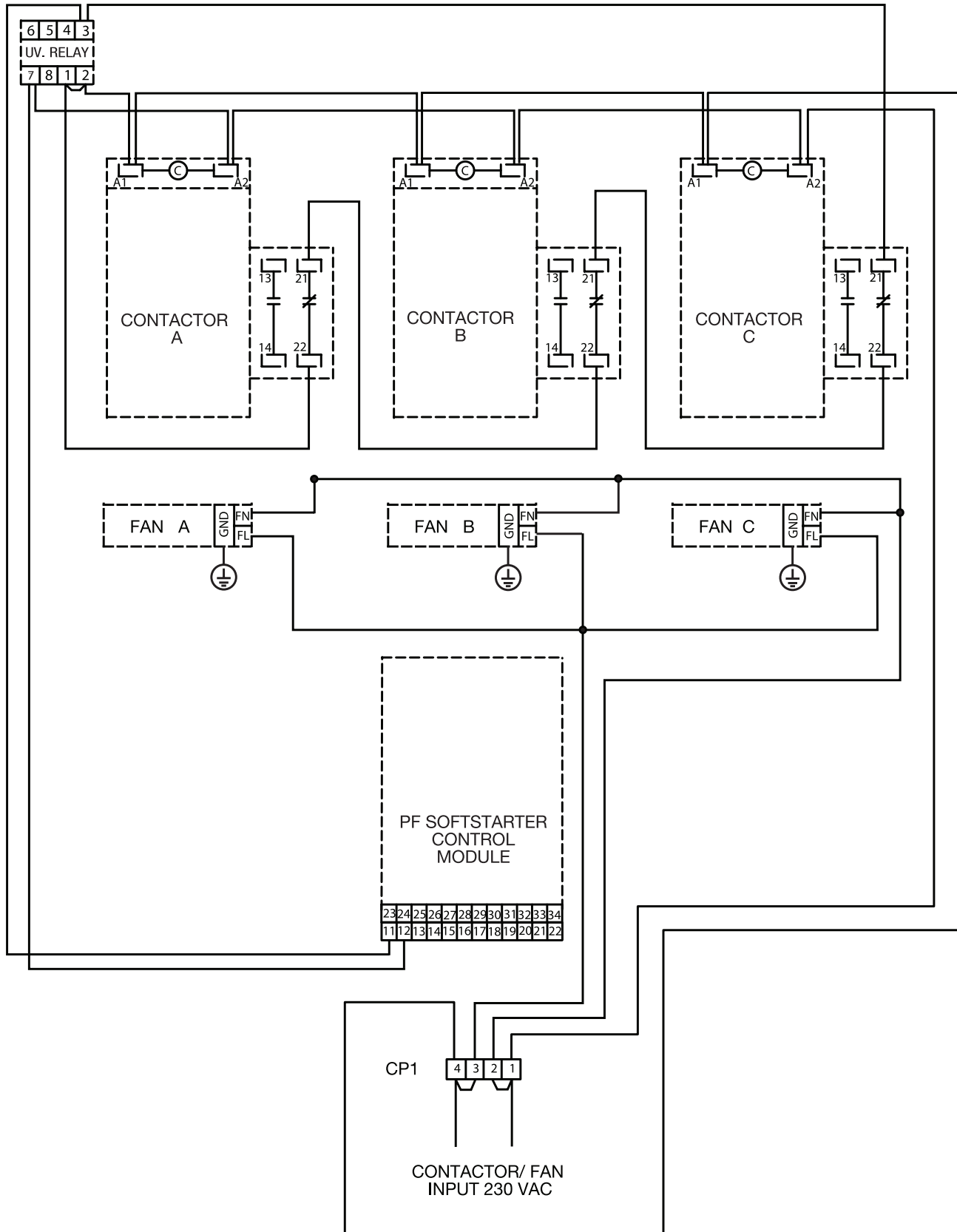
Figure 3.8   Internal Wiring and 120V Control Connection Diagram for 625...1250 A Devices

CONTACTOR A

CONTACTOR B

CONTACTOR C

FAN A

FAN B

FAN C

PF SOFTSTARTER CONTROL MODULE

CP1

CONTACTOR/ FAN INPUT 120 VAC
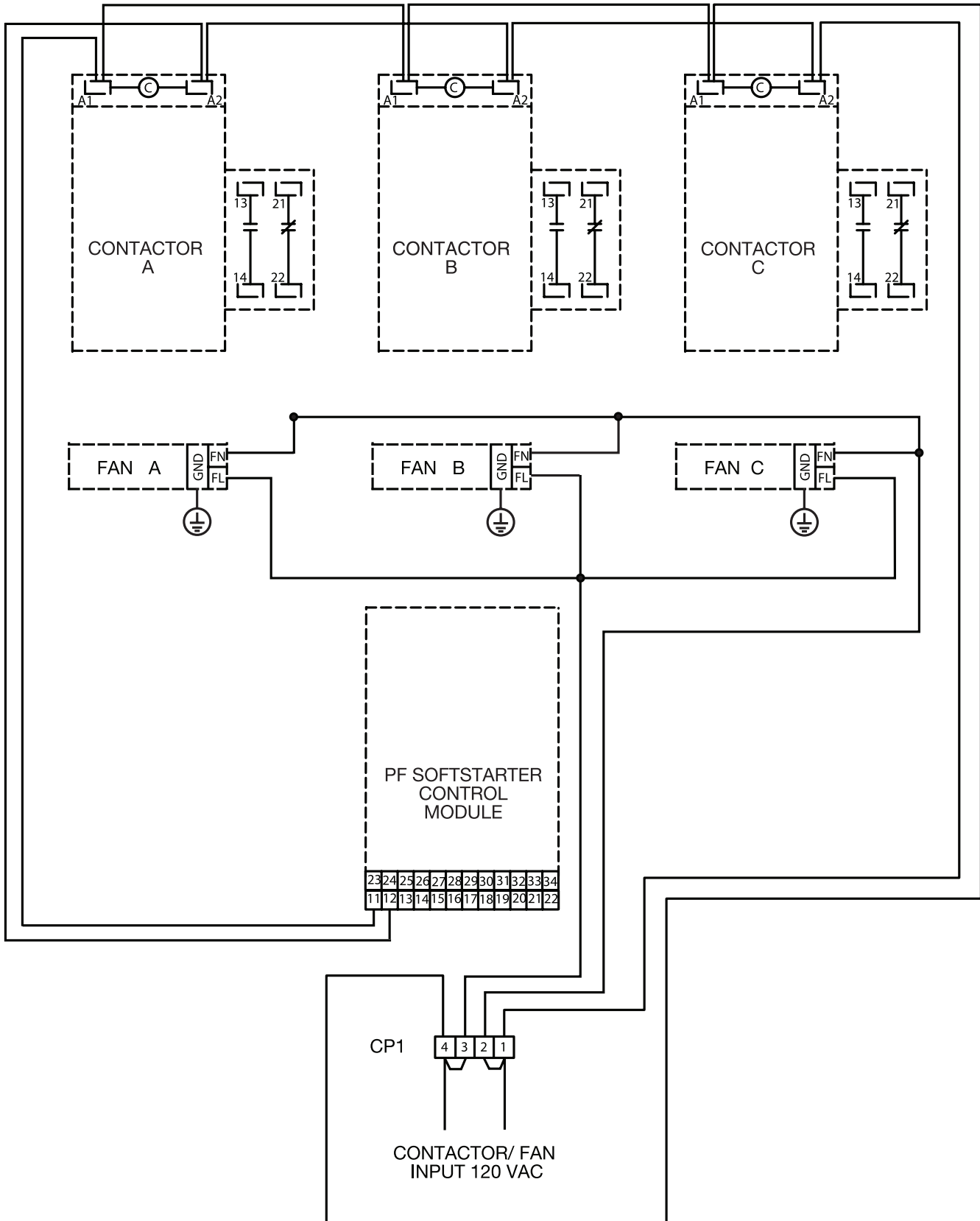
Control Wire Specifications

Table 3.F provides the control terminal wire capacity, the tightening torque requirements, and the wire strip length. Each control terminal will accept a maximum of two wires.

Table 3.F   Control Wiring and Tightening Torque

Wire Size	Torque	Wire Strip Length
0.75...2.5 mm^2 (#18...14AWG)	0.6 N•m(5 lb.-in.)	5.6...8.6mm (0.22...0.34 in.)

Fan Power

Controllers rated 5...1250 A have heatsink fans). Refer to Table 3.G for the control power VA requirements of the heatsink fans.

Fan Terminations

See Figure 3.1, 3.2 and 3.3 for fan power connection locations.

Attention	The fan jumpers have been factory installed for 110/120V AC input. Refer to Figure 3.9 for 220/240V AC fan wiring (5...480A devices only).

Figure 3.9 Power Terminations
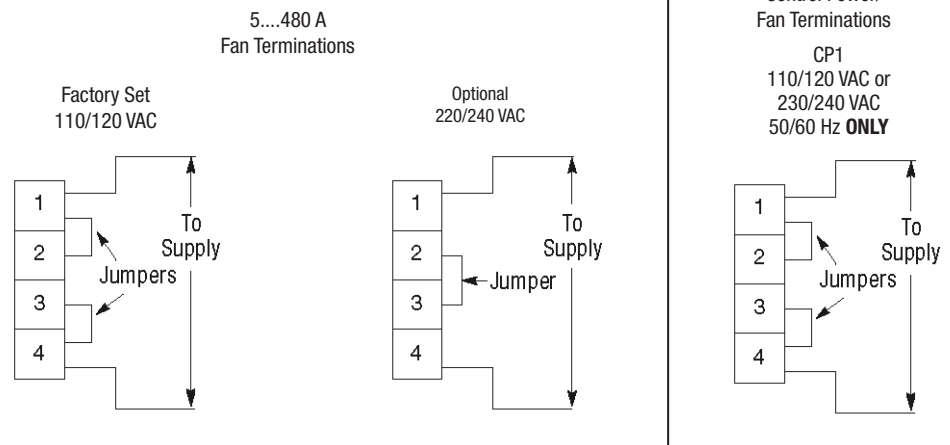
Table 3.G   Heatsink Fan Control Power

PF Rating	Heatsink Fan VA
5...135 A	20
201...251 A	40
317...480 A	60
625...780 A	150 ①
970...1250 A	150 ①

① Internally Wired

Control Terminal Designations

As shown in Figure 3.10, the PF Softstarter contains 24 control terminals on the front of the controller.

Figure 3.10 PF Softstarter Control Terminals

Terminal Number	Description	Terminal Number	Description
11	Control Power Input ①④	23	PTC Input ②
12	Control Power Common ①④	24	PTC Input ②
13	Controller Enable Input ②	25	Tach Input
14	Control Module Ground	26	Tach Input
15	Option Input #2 ①②	27	Ground Fault Transformer Input ②
16	Option Input #1 ①②	28	Ground Fault Transformer Input ②
17	Start Input ①②	29	Aux. Contact #2 ①③
18	Stop Input ①②	30	Aux. Contact #2 ①③
19	Aux. Contact #1 ①③	31	Aux. Contact #3 ①③
20	Aux. Contact #1 ①③	32	Aux. Contact #3 ①③
21	Not Used	33	Aux. Contact #4 ①③
22	Not Used	34	Aux. Contact #4 ①③

① RC Snubbers are required on loads connected to auxiliary.
② Do not connect any additional loads to these terminals. These "parasitic" loads may cause problems with operation, which may result in false starting and stopping.
③ External Bypass operates an external contactor and overload relay once the motor reaches full speed. The PF Softstarter overload functionality, diagnostics and metering are disabled when the external bypass is activated. Proper sizing of the contactor and overload is required.
④ Control power on units rated 625...1250 A is pre-wired internally, from terminal block CP1.

Standard Controller Wiring Diagrams

Figure 3.11 through Figure 3.20 show typical wiring for the PF Softstartercontroller.

Figure 3.11 Typical Wiring Diagram for Standard Controller
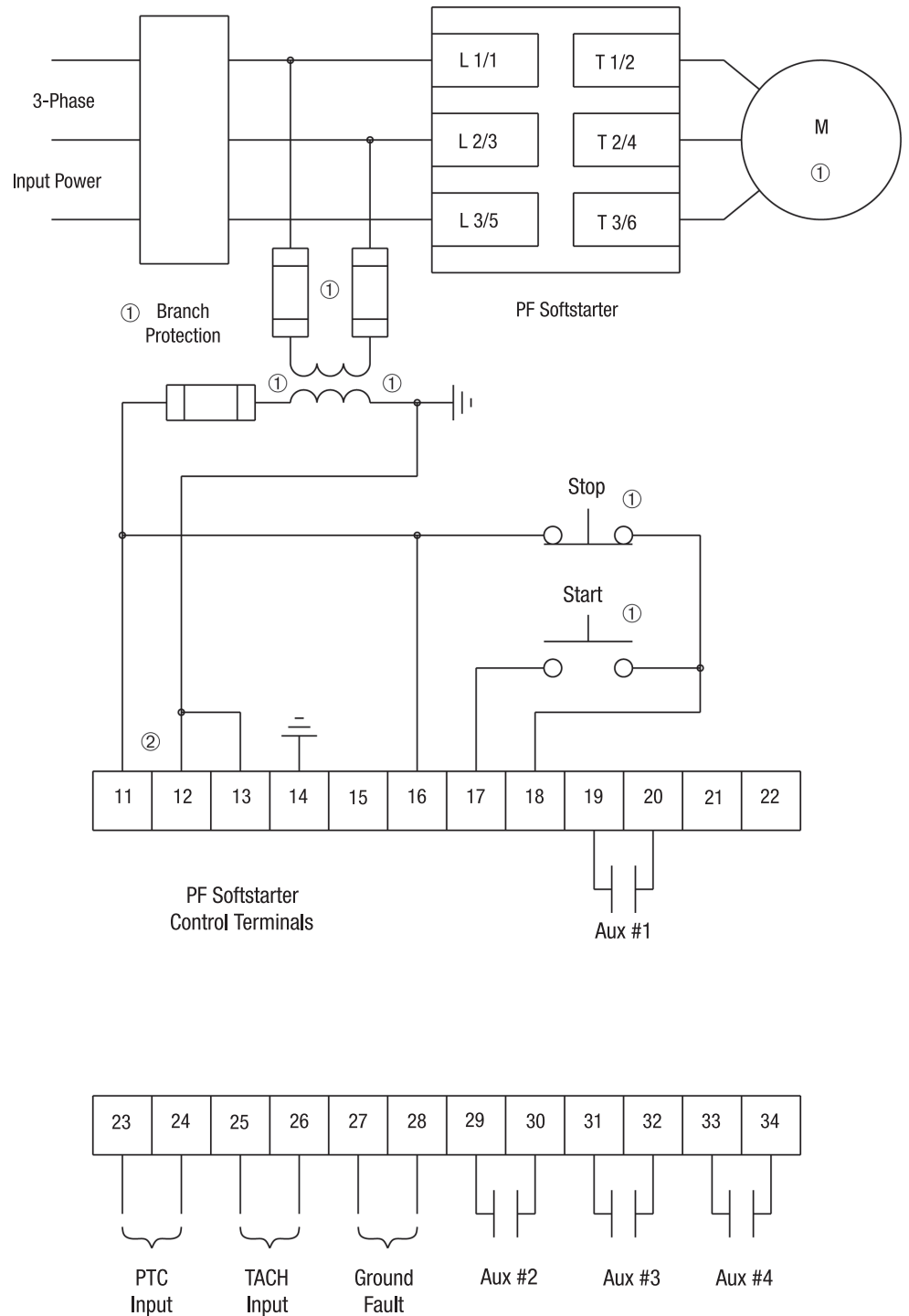
① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage.
For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.

Figure 3.12   Typical Wiring Diagram for Two-Wire Control with Stopping Control

① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.

Notes: (1) Programmable controller interfacing in this diagram refers to hard-wiring between the PLC's output contacts and
        the PF Softstarter's control terminals.
       (2) The OFF state leakage current for a solid-state device must be less than 6 mA.

Figure 3.13 Typical Wiring Diagram for Dual Ramp Applications

① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block
   CP1 - terminals 1 & 4.

Note: The Dual Ramp feature is available only with the standard control version.

Figure 3.14 Typical Wiring Diagram for Retrofit Applications

① Customer supplied.
② Overload protection should be disabled in the PF Softstarter.
③ Refer to the controller nameplate to verify the rating of the control power input voltage.
  For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.
④ Aux #4 should be set for normal operation

Figure 3.15 Typical Wiring Diagram for Isolation Applications
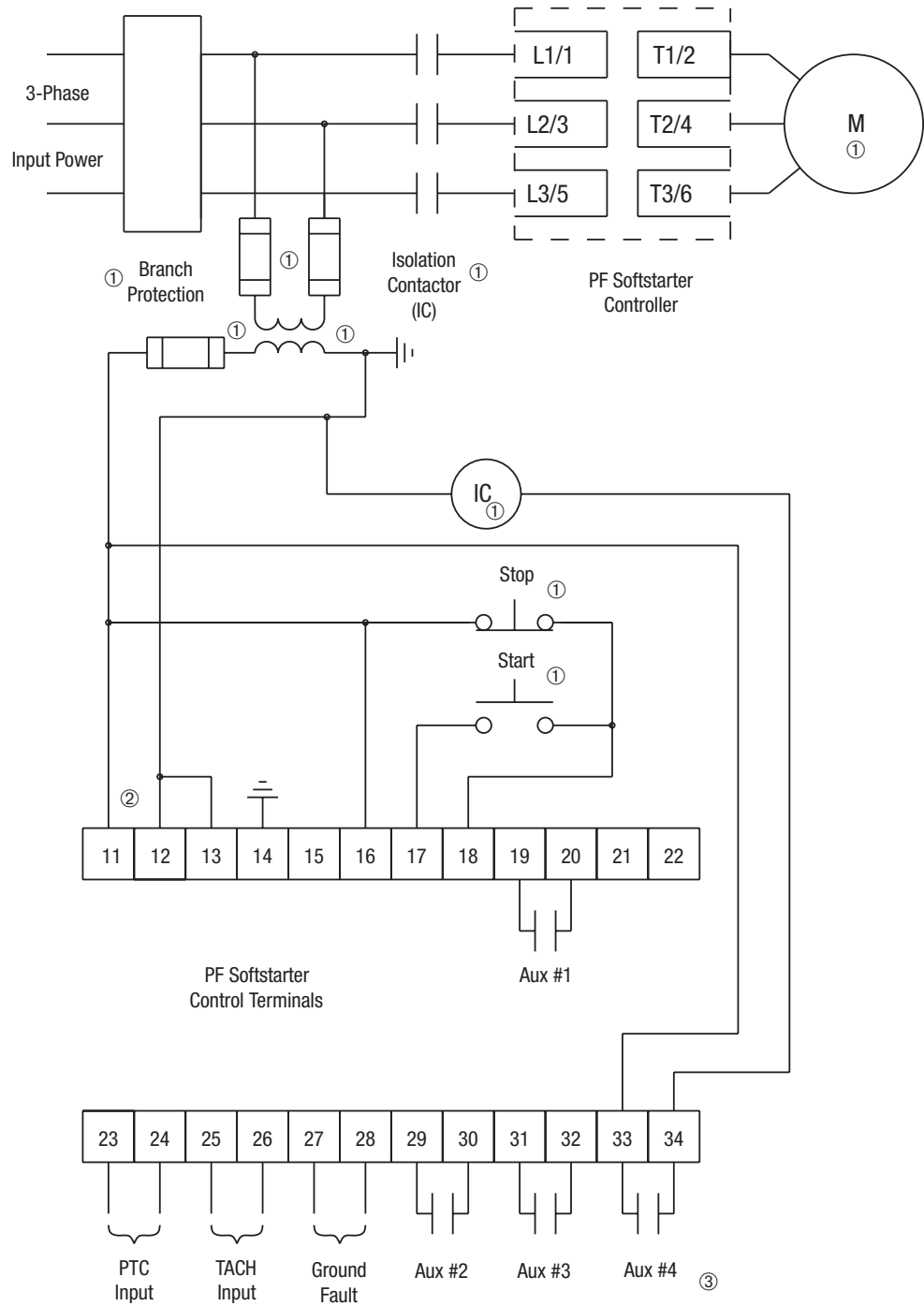
① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.
③ Aux #4 should be set for normal operation.

Figure 3.16 Typical Wiring Diagram for Shunt Trip Applications
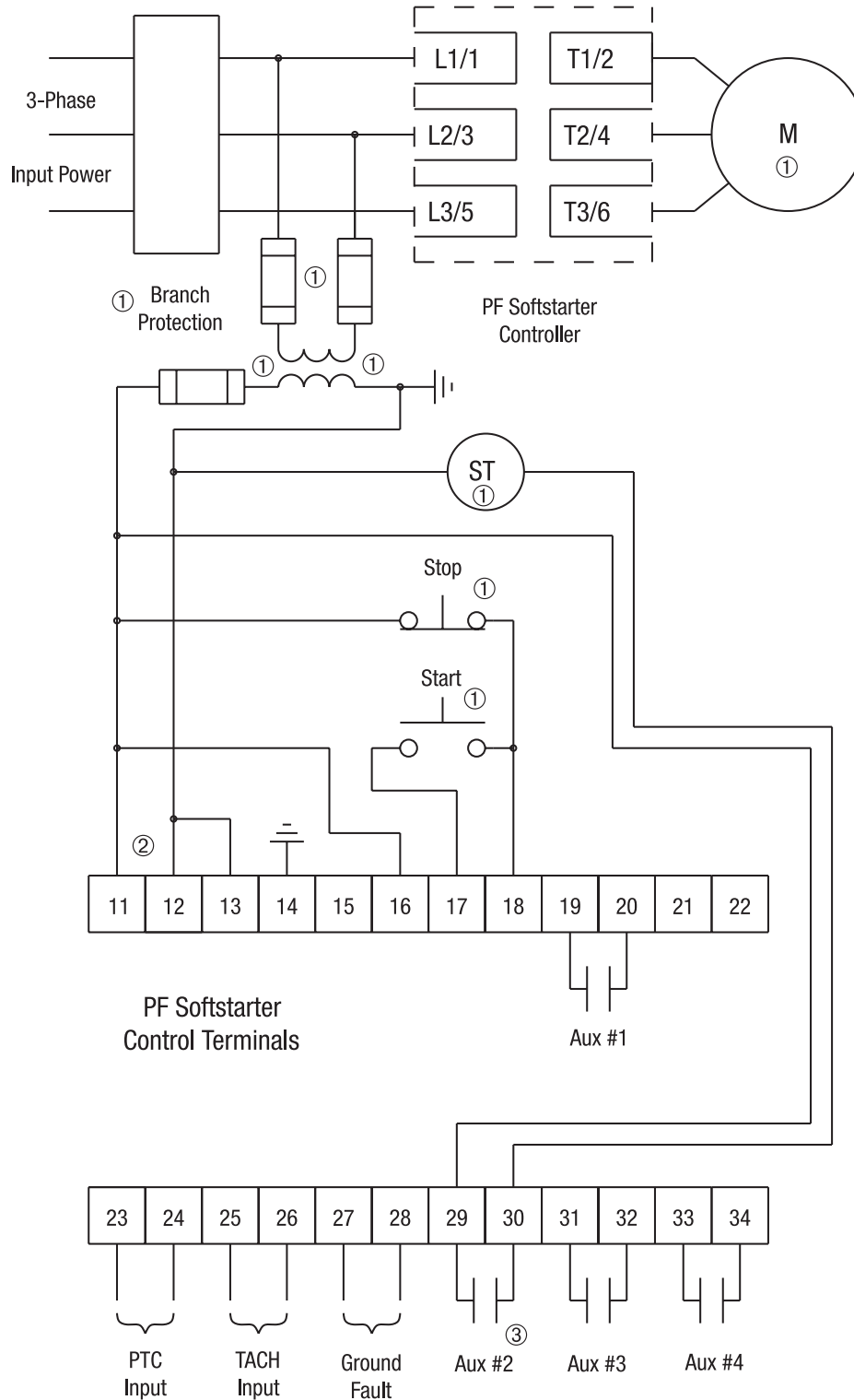
① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.
③ Aux #2 should be set to fault operation.

Figure 3.17 Typical Wiring Diagram for Single-Speed Reversing Applications

① Customer supplied.

② Refer to the controller nameplate to verify the rating of the control power input rating.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block
   CP1 - terminals 1 & 4.

③ No braking maneuver allowed in wiring diagram.
④ Maintained pushbutton.

Notes: (1) Minimum transition time for reversing direction is 1/2 second.
(2) Phase Reversal protection **must** be disabled in reversing applications.

Figure 3.18 Typical Wiring Diagram for Two-speed Applications

① Customer supplied.
② Two-speed, consequent pole installations.
③ Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.
④ Overload must be disabled in PF Softstarter.

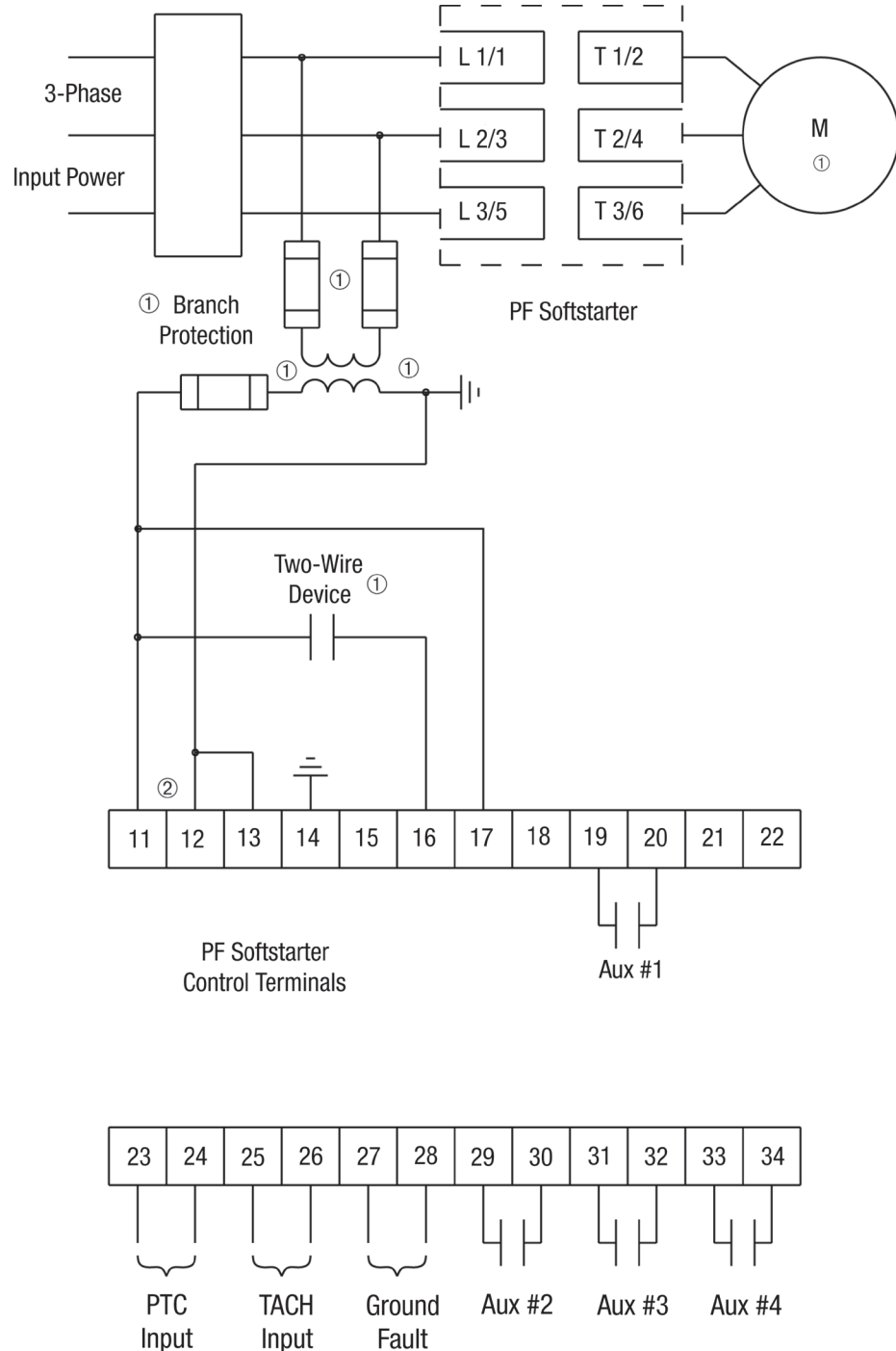## Figure 3.19 Typical Wiring Diagram for PF-Off-Bypass Control
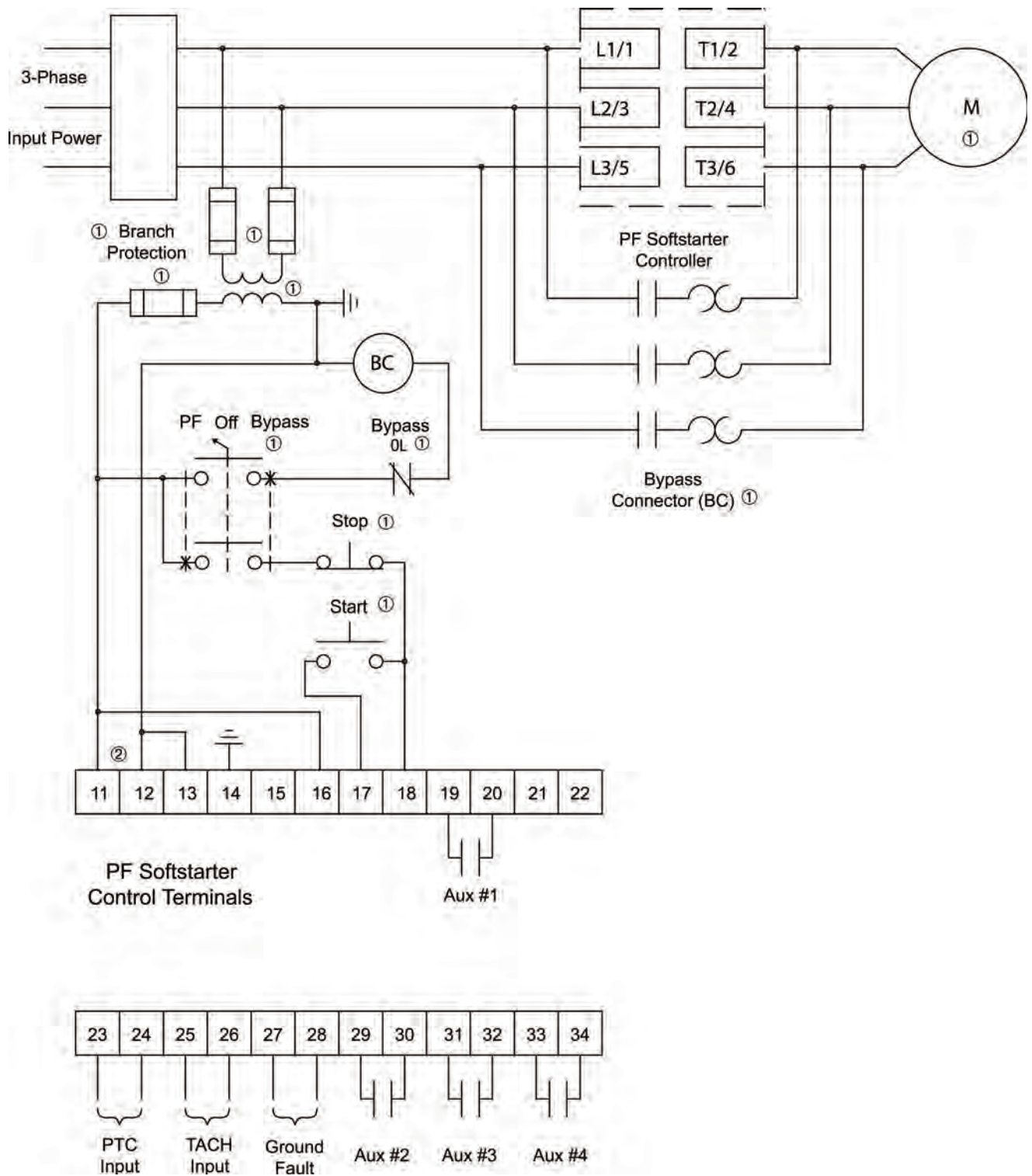
① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.

Figure 3.20 Typical Wiring Diagram for Hand-Off-Auto Control with Stop Option and Start/Stop Buttons
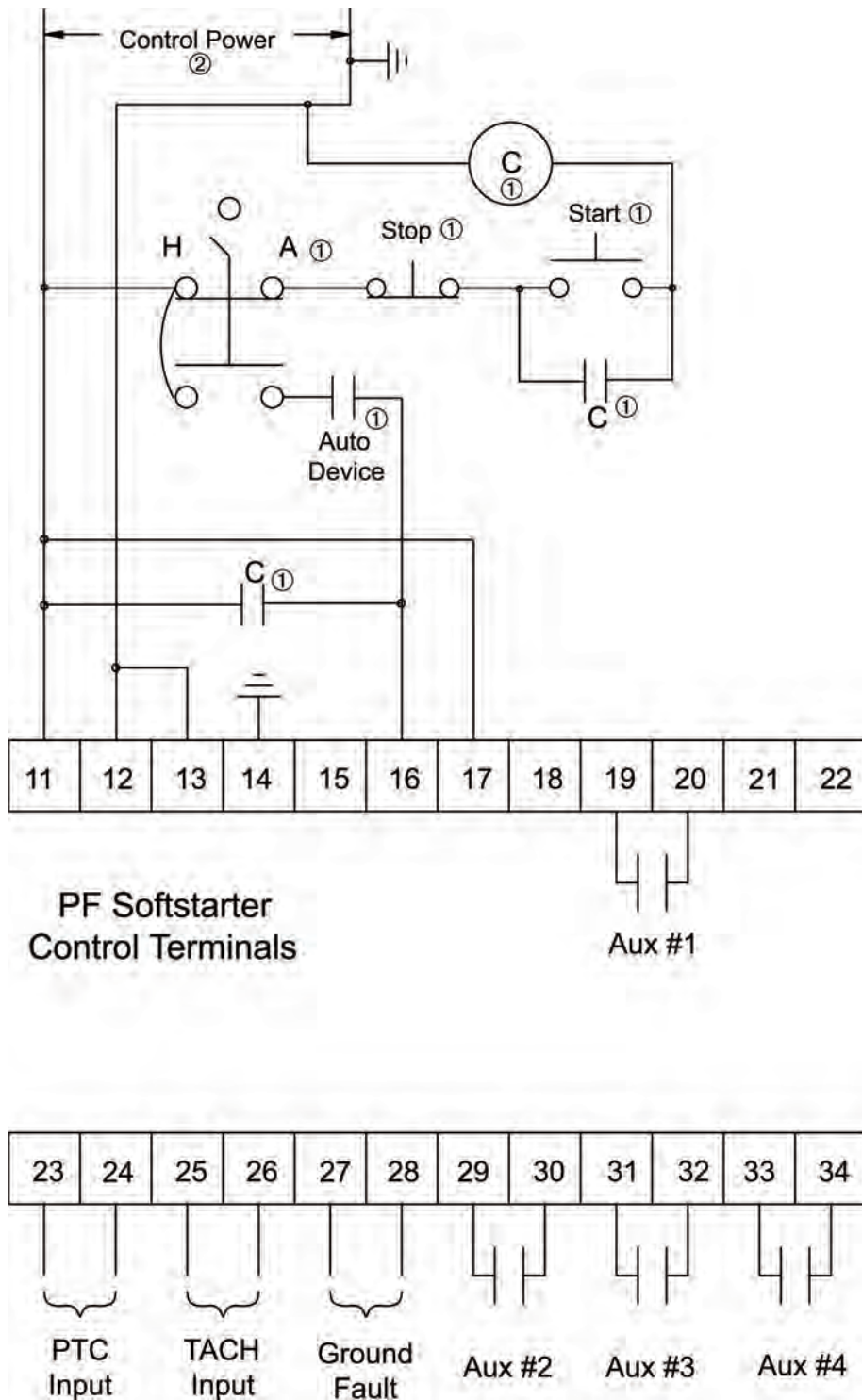
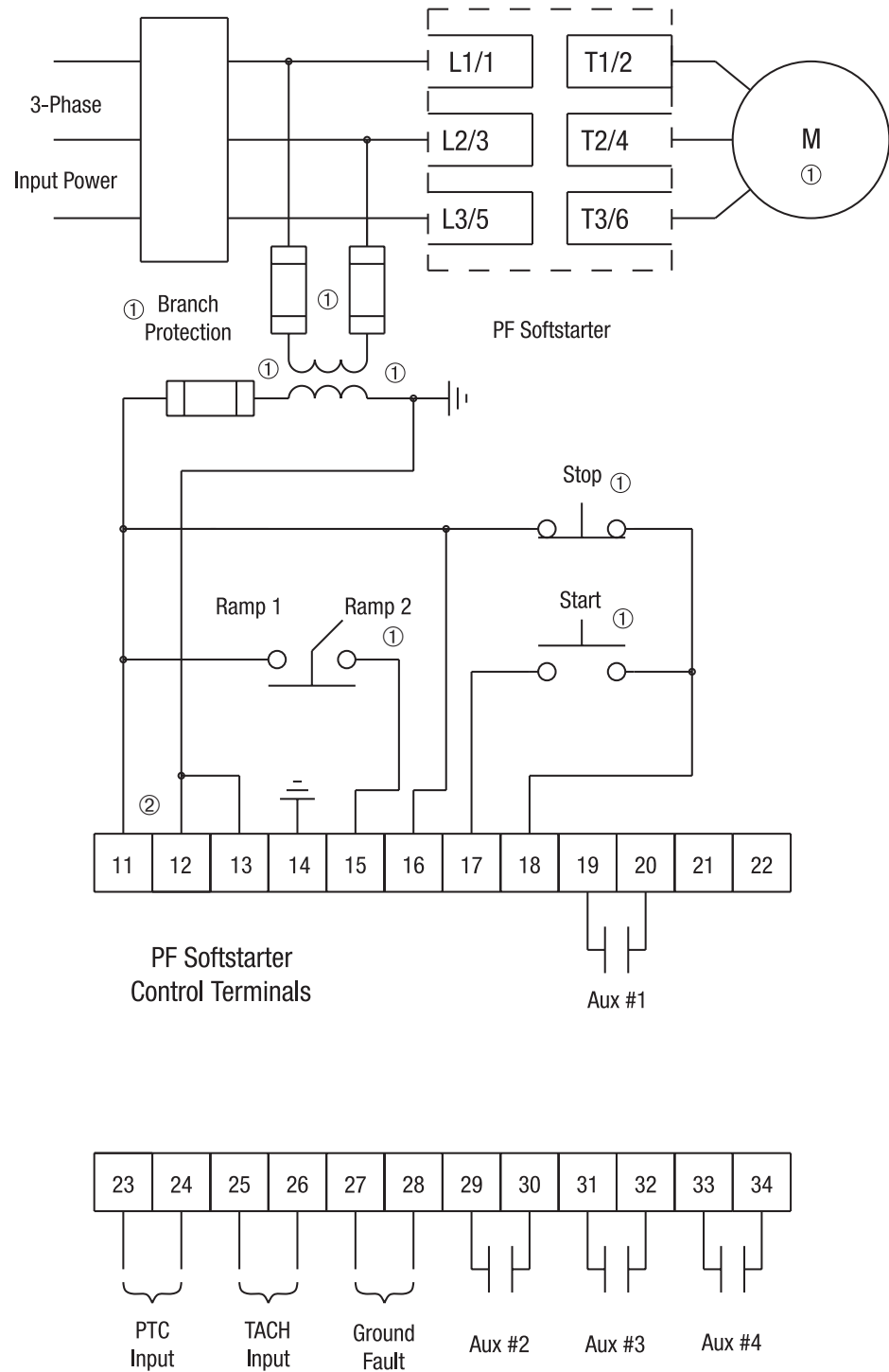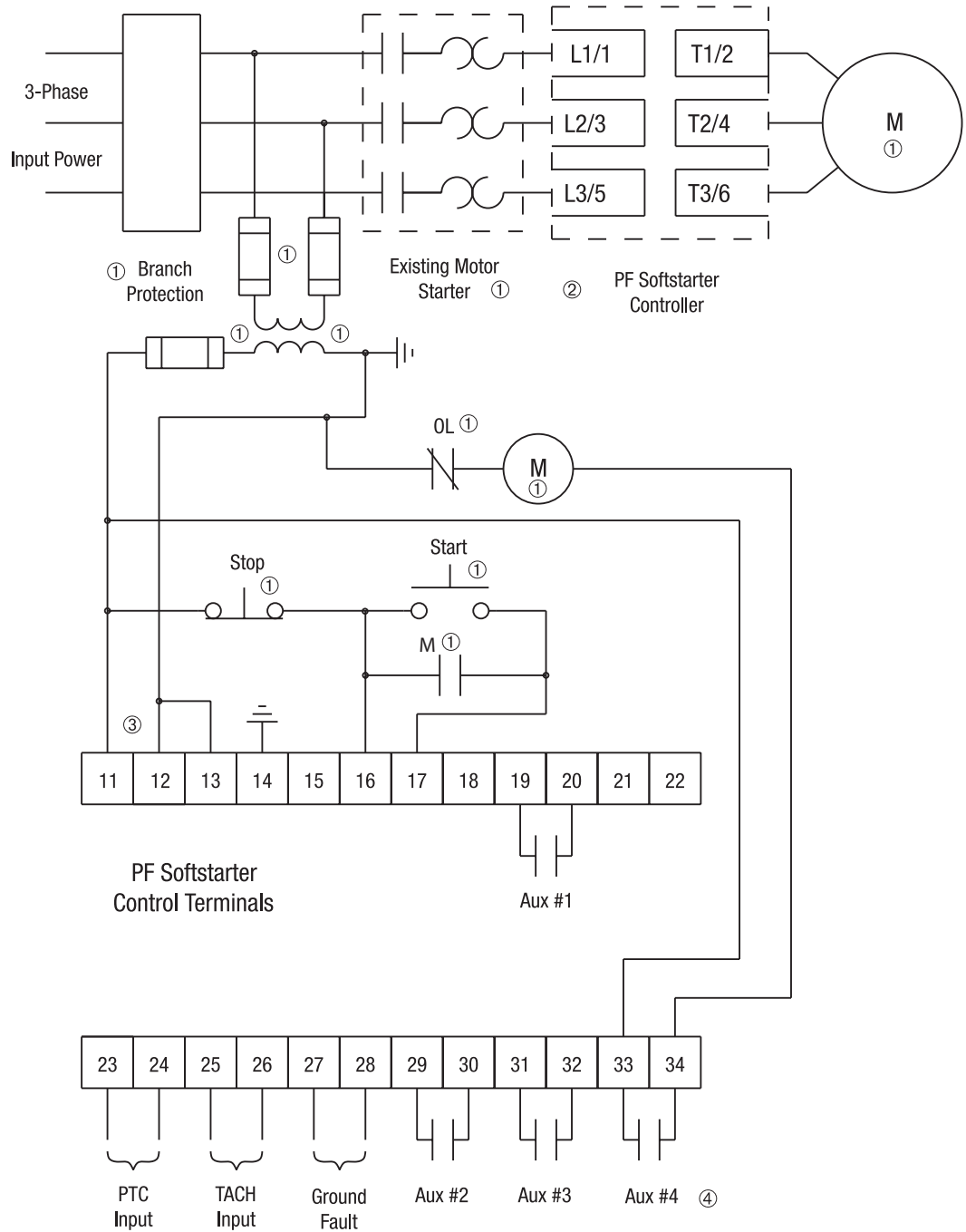PF Softstarter
Control Terminals

① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.

Soft Stop, Pump Control, and SMB Smart Motor Braking

Figure 3.21 through Figure 3.23 show the different wiring for the Soft Stop, Pump Control, and SMB Smart Motor Braking options.

Figure 3.21 Typical Wiring Diagram
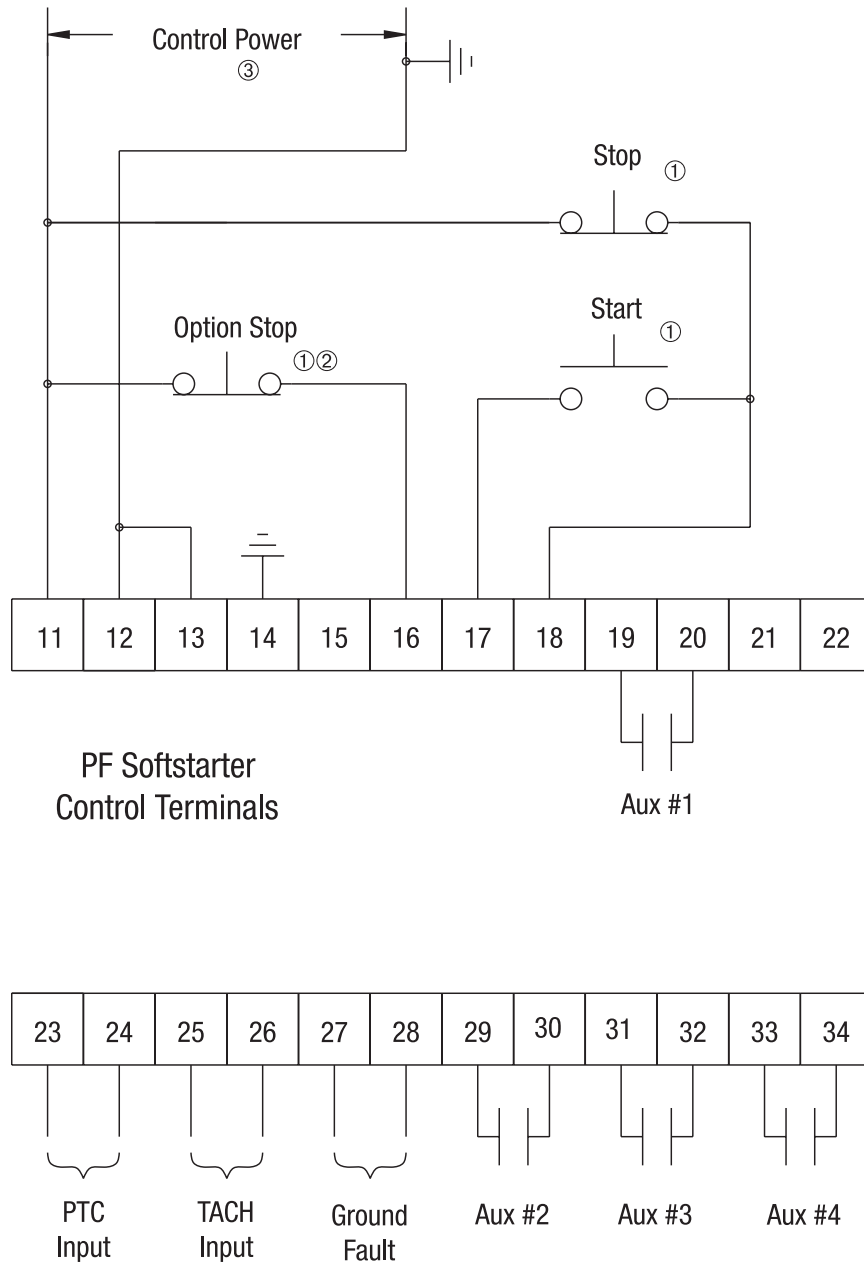
① Customer supplied.
② Soft Stop, Pump Stop, or Brake.
③ Refer to the controller nameplate to verify the rating of the control power input voltage.
    For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.

Note: Refer to Chapter 3 for typical power circuits.

Figure 3.22 Typical Retrofit Wiring Diagram
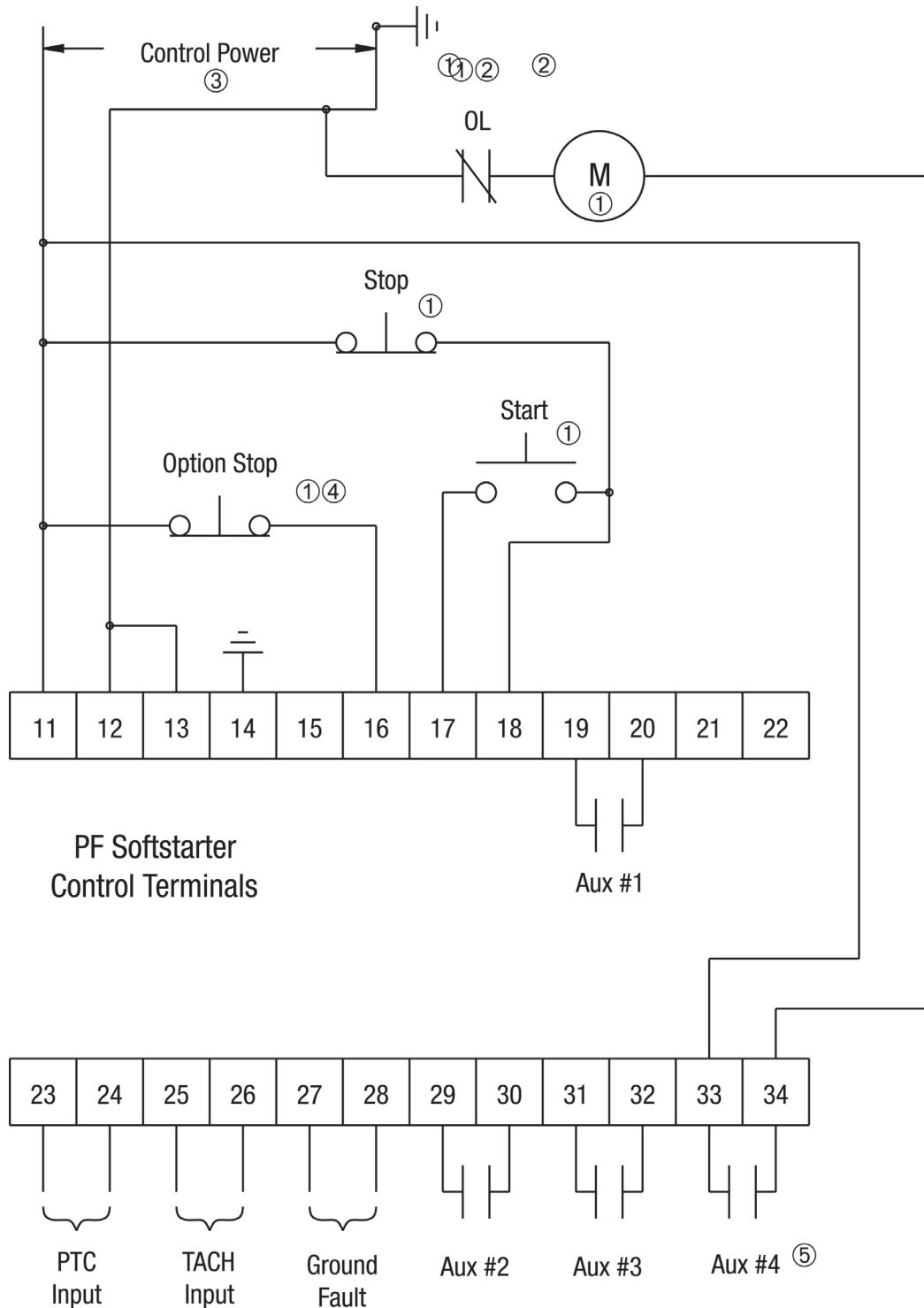
PF Softstarter
Control Terminals

PTC
Input

TACH
Input

Ground
Fault

Aux #2

Aux #3

Aux #4 ⑤

① Customer supplied.
② Overload protection should be disabled in the PF Softstarter.
③ Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.
④ Soft Stop, Pump Stop, or Brake.
⑤ Aux #4 should be set to normal operation.

Note: Refer to Chapter 3 for typical power circuits.

Figure 3.23 Typical Wiring Diagram for Applications Requiring an Isolation Contactor
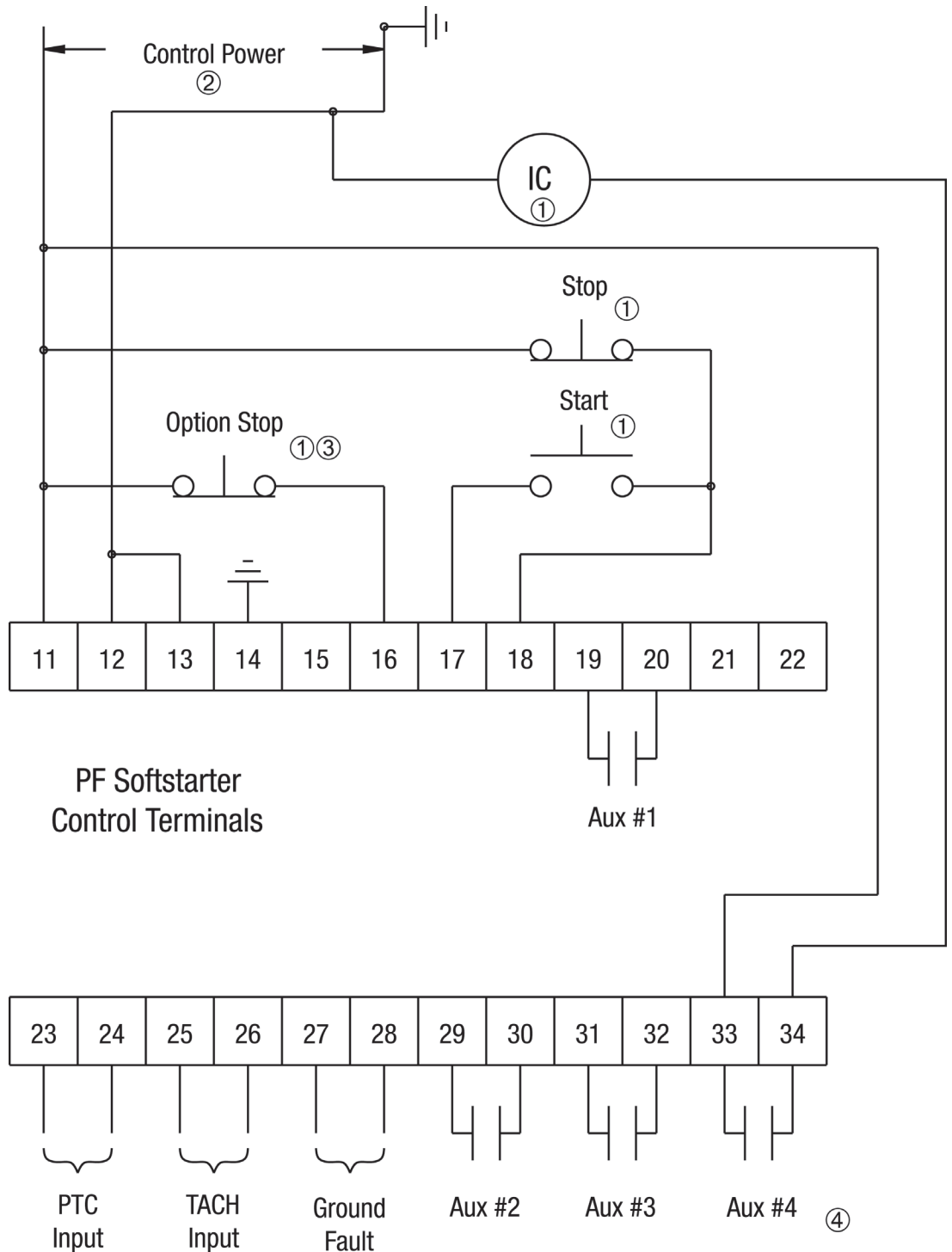
Control Power
②

IC
①

Stop ①

Start ①

Option Stop ①③

11	12	13	14	15	16	17	18	19	20	21	22

PF Softstarter
Control Terminals

Aux #1

23	24	25	26	27	28	29	30	31	32	33	34

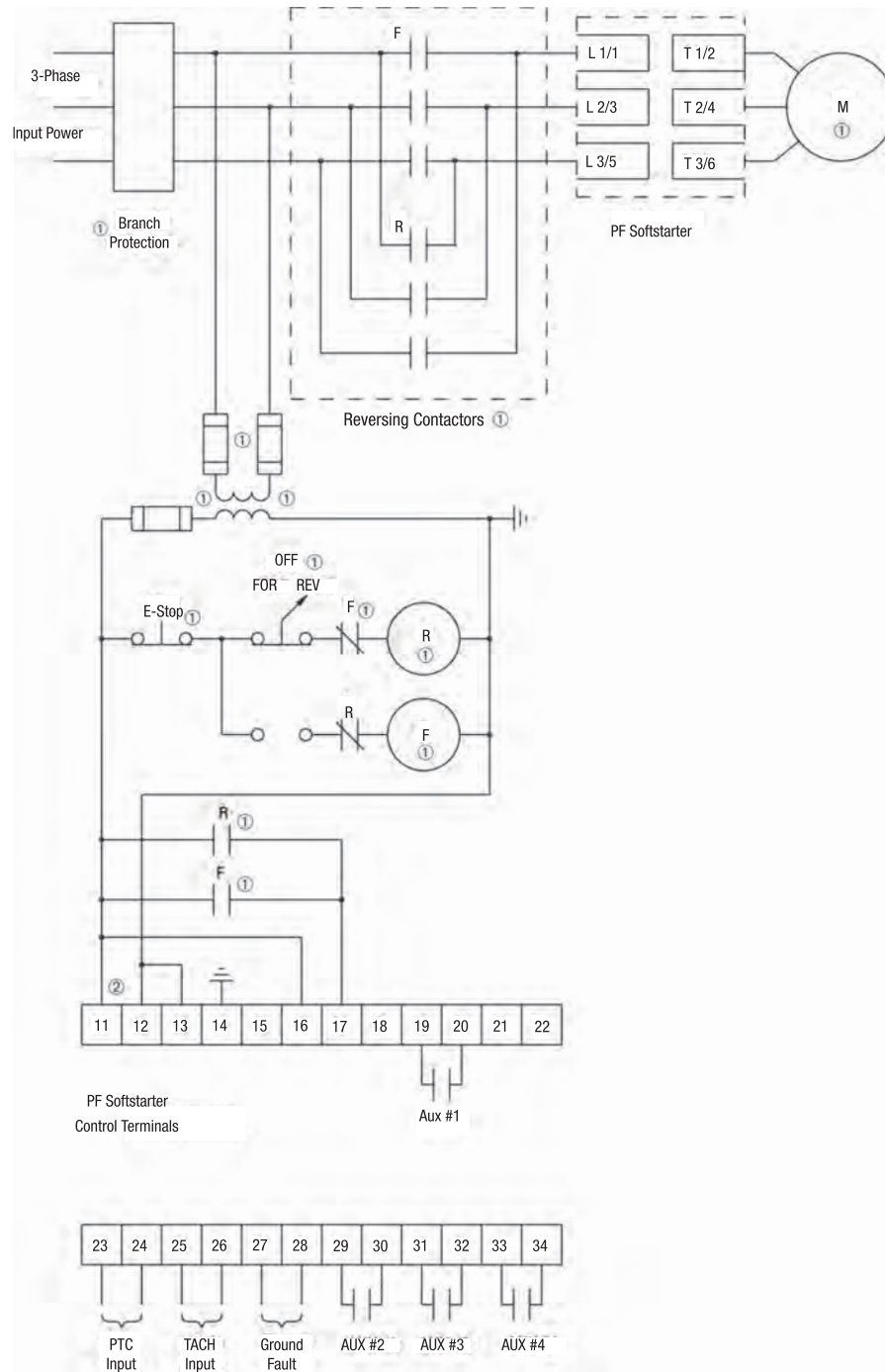PTC
Input

TACH
Input

Ground
Fault

Aux #2

Aux #3

Aux #4 ④

① Customer supplied.

② Refer to the controller nameplate to verify the rating of the control power input voltage. For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.

③ Soft Stop, Pump Stop, or Brake.

④ Aux #4 should be set to normal operation.

Note: Refer to Chapter 3 for typical power circuits.

Preset Slow Speed   Figure 3.24 show the different wiring for the Preset Slow Speed.

Figure 3.24 Typical Wiring Diagram for the Preset Slow Speed
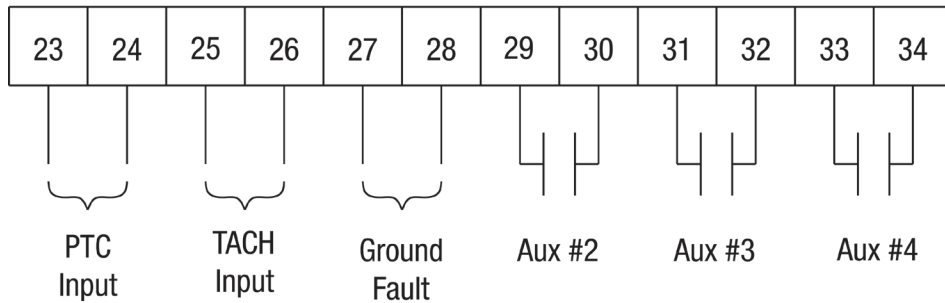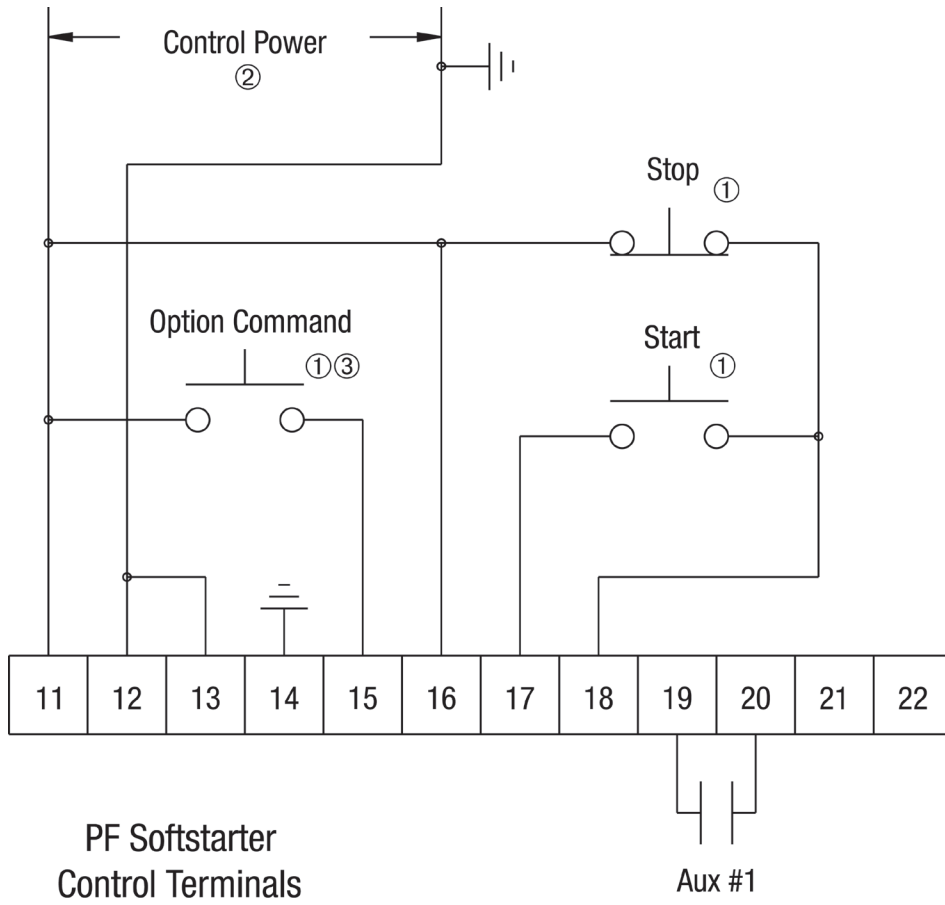
① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block CP1 - terminals 1 & 4.
③ Slow Speed.

Note: Refer to Chapter 3 for typical power circuits.

Slow Speed with Braking

Figure 3.25 Typical Wiring Diagram for the Slow Speed with Braking with an Isolation Contactor
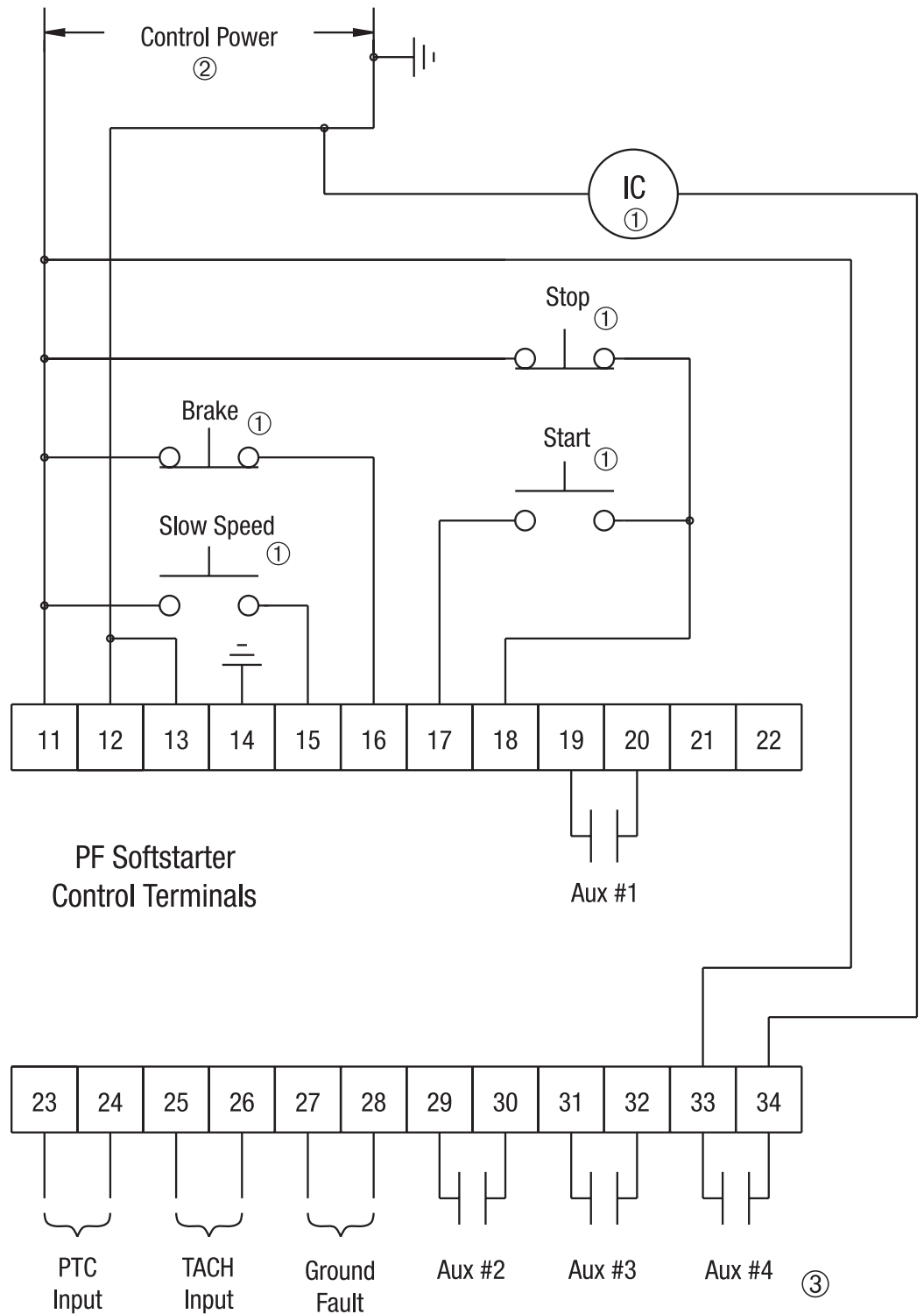
PF Softstarter
Control Terminals

Aux #1

PTC Input   TACH Input   Ground Fault   Aux #2   Aux #3   Aux #4   ③
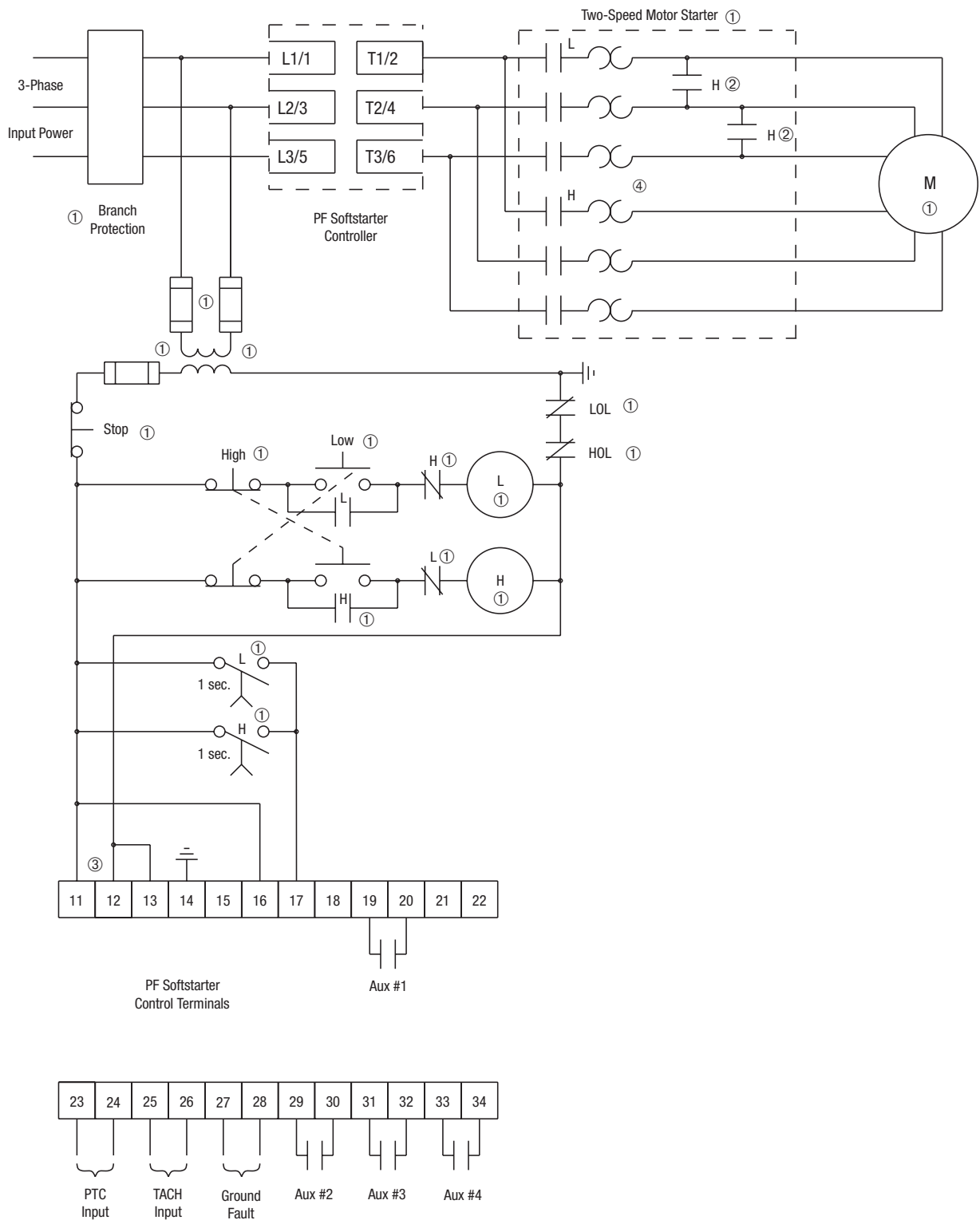
① Customer supplied.
② Refer to the controller nameplate to verify the rating of the control power input voltage.
   For units rated 625...1250 A, terminals 11 & 12 are factory pre-wired from terminal block
   CP1 - terminals 1 & 4.
③ Aux #4 should be set to normal operation.

Note: Refer to Chapter 3 for typical power circuits.

Figure 3.26 Inside-the-Delta Power and Motor Connections For 6 and 12 Lead Wye-Delta Motors

INCOMING POWER

L1   L2   L3

L1/1   L2/3   L3/5

PF/PCS SERIES
CONTROLLER

T6/12   T4/8   T5/10

T1/2   T2/4   T3/6

TO WYE-DELTA MOTOR
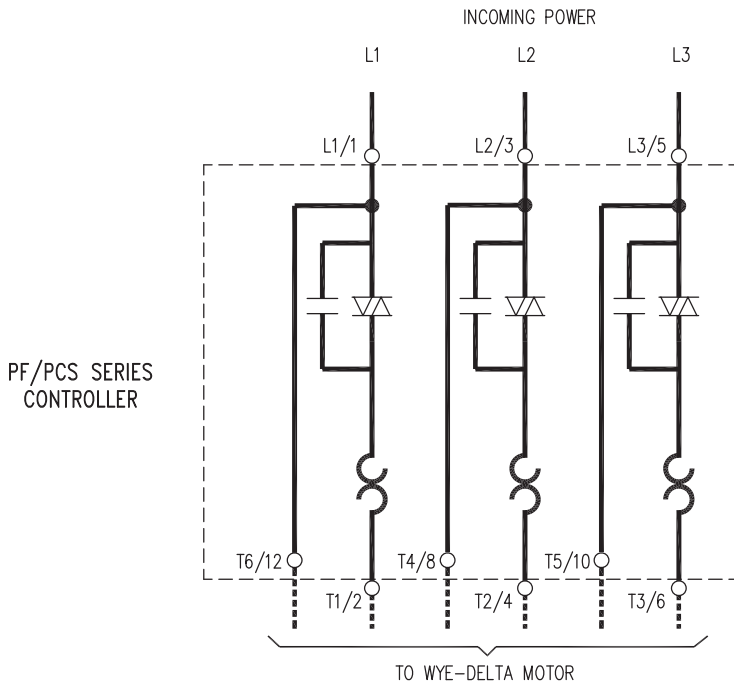
WARNING
WHEN NOT USING AN ISOLATION CONTACTOR, HAZARDOUS
VOLTAGES ARE PRESENT AT THE LOAD TERMINALS OF THE
CONTROLLER, EVEN WHEN THE CONTROLLER IS TURNED OFF.

12-LEAD DUAL VOLTAGE MOTOR CONNECTIONS							
STARTER TERMINALS	T1/2	T2/4	T3/6	T6/12	T4/8	T5/10	JOIN
MOTOR TERMINAL LOW VOLTAGE	1 & 7	2 & 8	3 & 9	6 & 12	4 & 10	5 & 11	–
MOTOR TERMINAL HIGH VOLTAGE	1	2	3	12	10	11	4 & 7 5 & 8 6 & 9

T6/12   T1/2

6   1

3   4
5   2
T3/6   T4/8
T5/10   T2/4
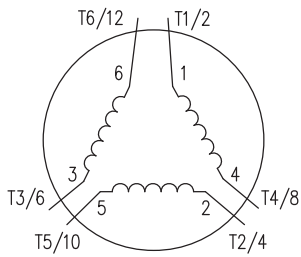
MOTOR TERMINAL
6-LEAD WYE-DELTA MOTOR

T6/12   T1/2

12   1
9   4
6   7
3   10
11 8 5 2
T3/6   T4/8
T5/10   T2/4

MOTOR TERMINAL
HIGH VOLTAGE

T6/12   T1/2

12   1
9   4
6   7
3   10
11 8 5 2
T3/6   T4/8
T5/10   T2/4
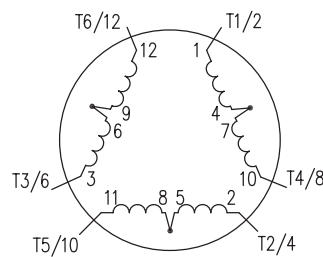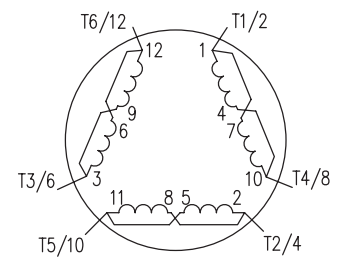
MOTOR TERMINAL
LOW VOLTAGE

12-LEAD DUAL VOLTAGE WYE-DELTA MOTOR

Sequence of Operation

Figure 3.27 through Figure 3.32 show the different operation sequences for the Soft Stop, Preset Slow Speed, Pump Control, SMB Smart Motor Braking, Accu-Stop, and Slow Speed with Braking options.

Figure 3.27 Soft Stop Sequence of Operation
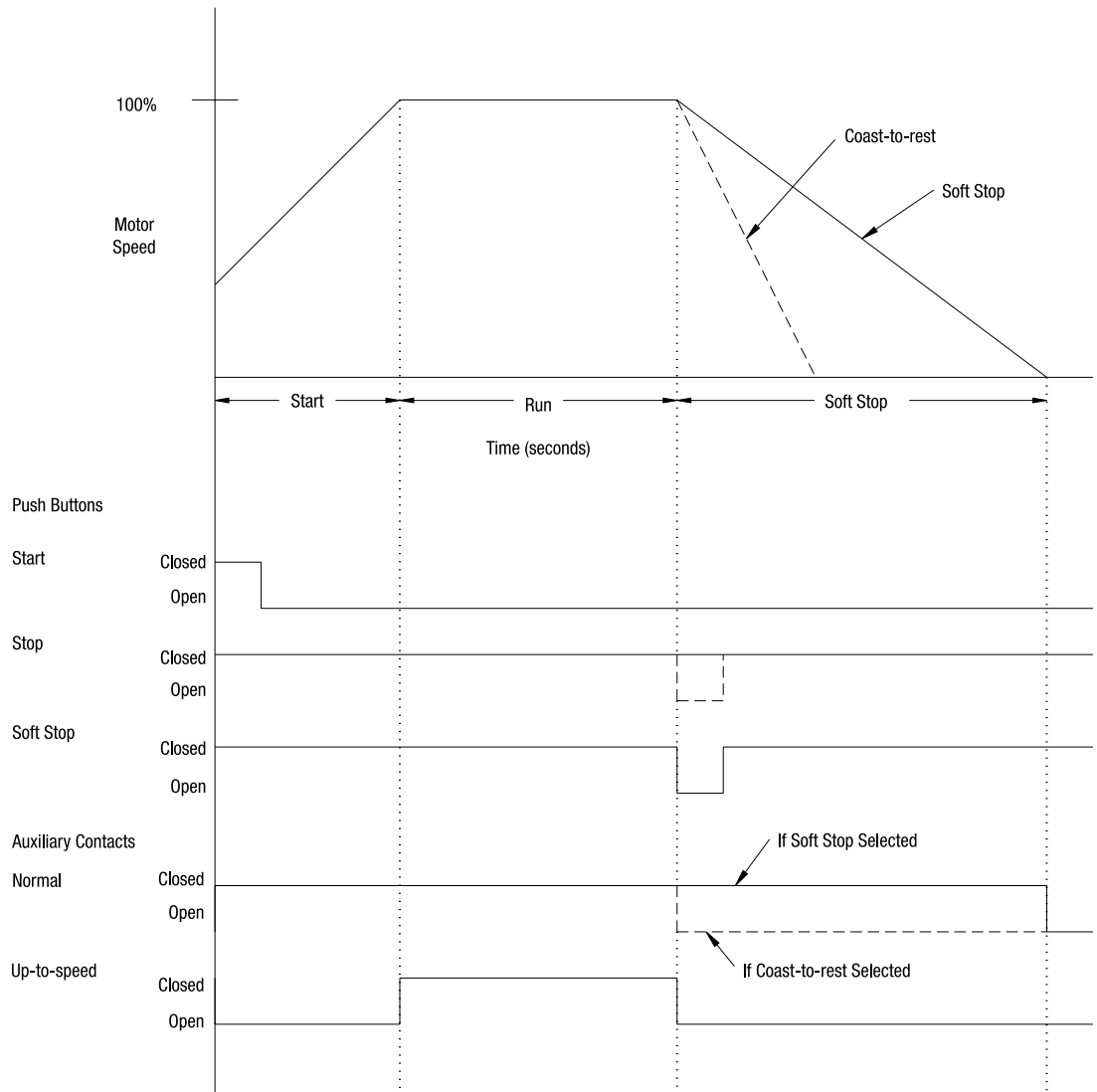
Attention

The user is responsible for determining which stopping mode is best suited to the application and will meet applicable standards for operator safety on a particular machine.

Figure 3.28   Preset Slow Speed Sequence of Operation
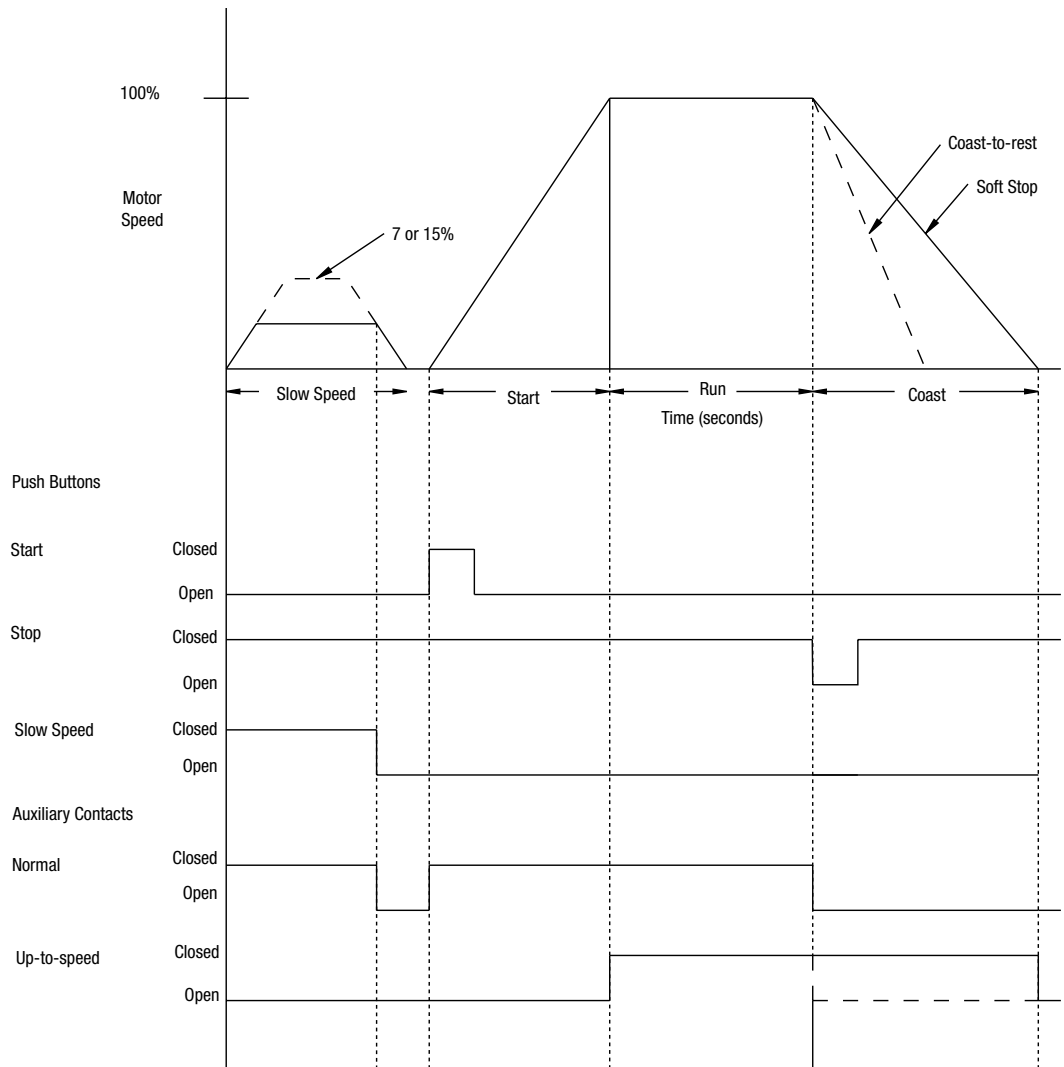
Figure 3.29 Pump Control Sequence of Operation
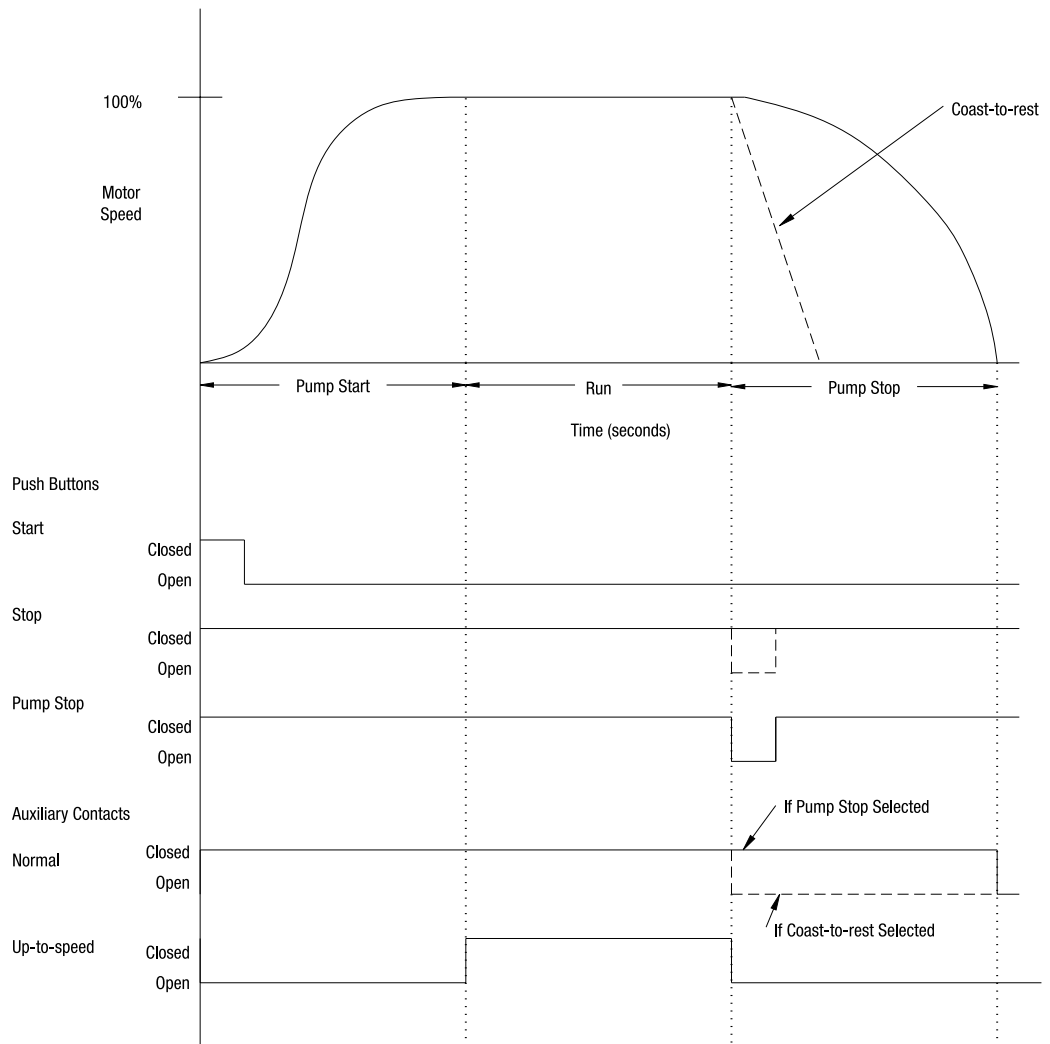
> **ATTENTION**
>
> The user is responsible for determining which stopping mode is best suited to the application and will meet applicable standards for operator safety on a particular machine.

Figure 3.30 SMB Smart Motor Brake Sequence of Operation
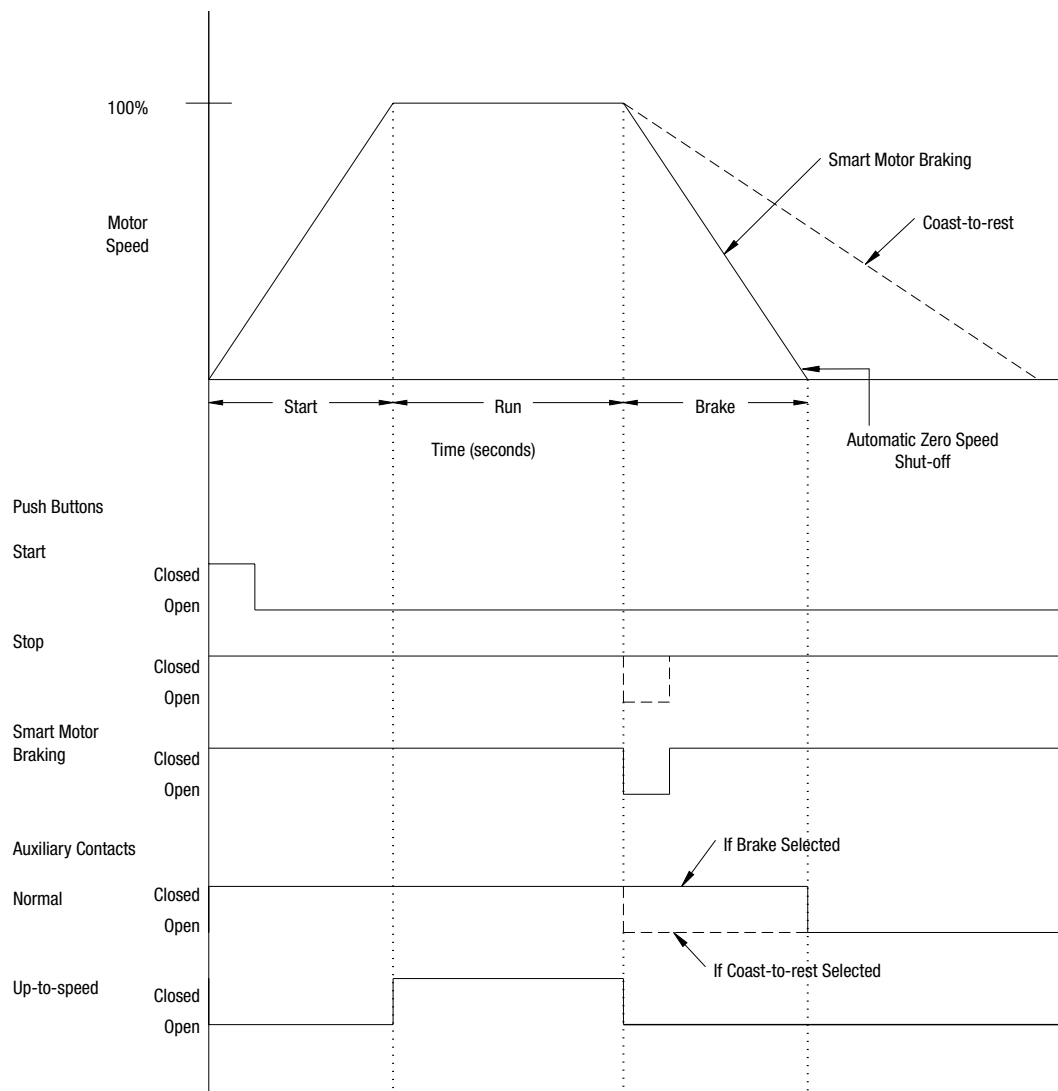
Attention	The user is responsible for determining which stopping mode is best suited to the application and will meet applicable standards for operator safety on a particular machine.

Figure 3.31 Accu-Stop Sequence of Operation
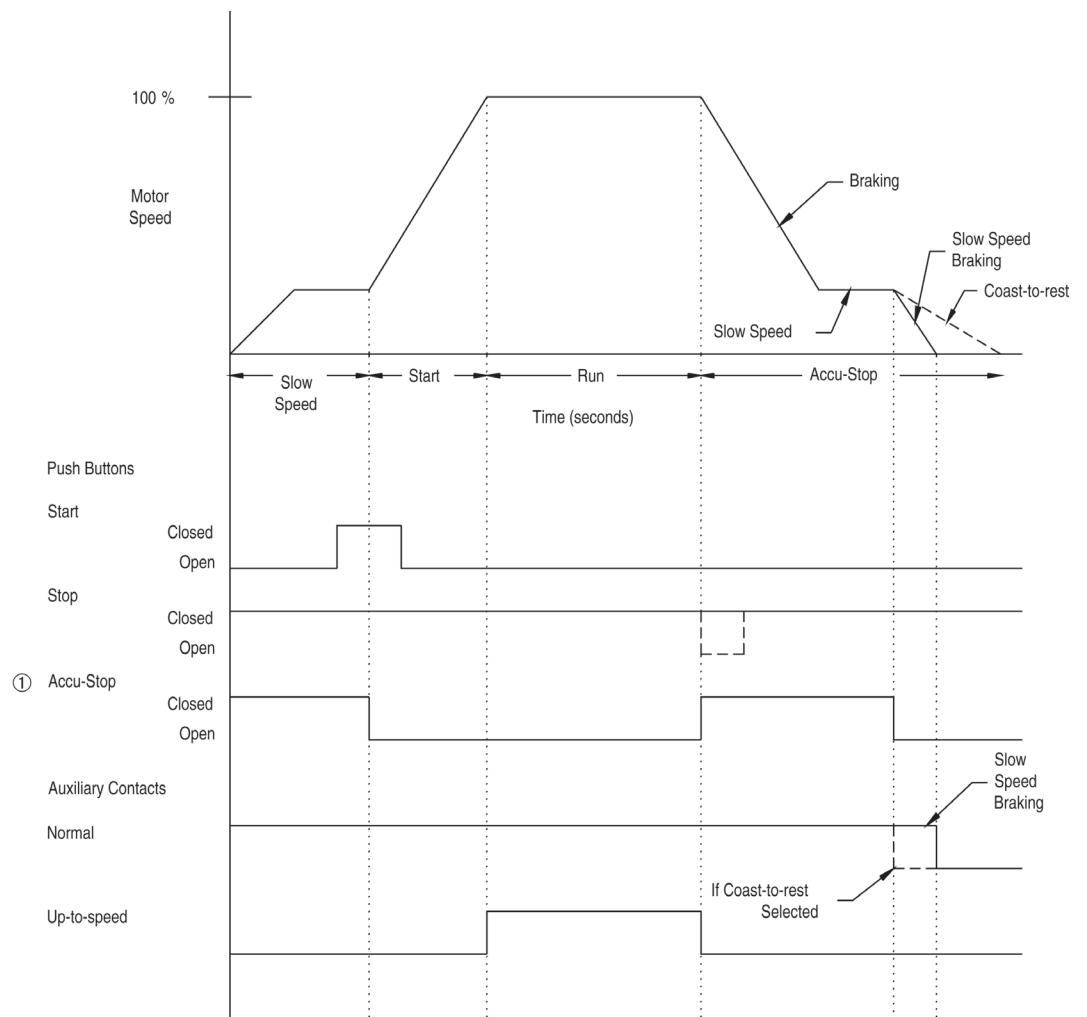
① When Accu-Stop push button is closed, start/stop function is disabled.

| **Attention** | The user is responsible for determining which stopping mode is best suited to the application and will meet applicable standards for operator safety on a particular machine. |

Figure 3.32 Slow Speed with Braking Sequence of Operation
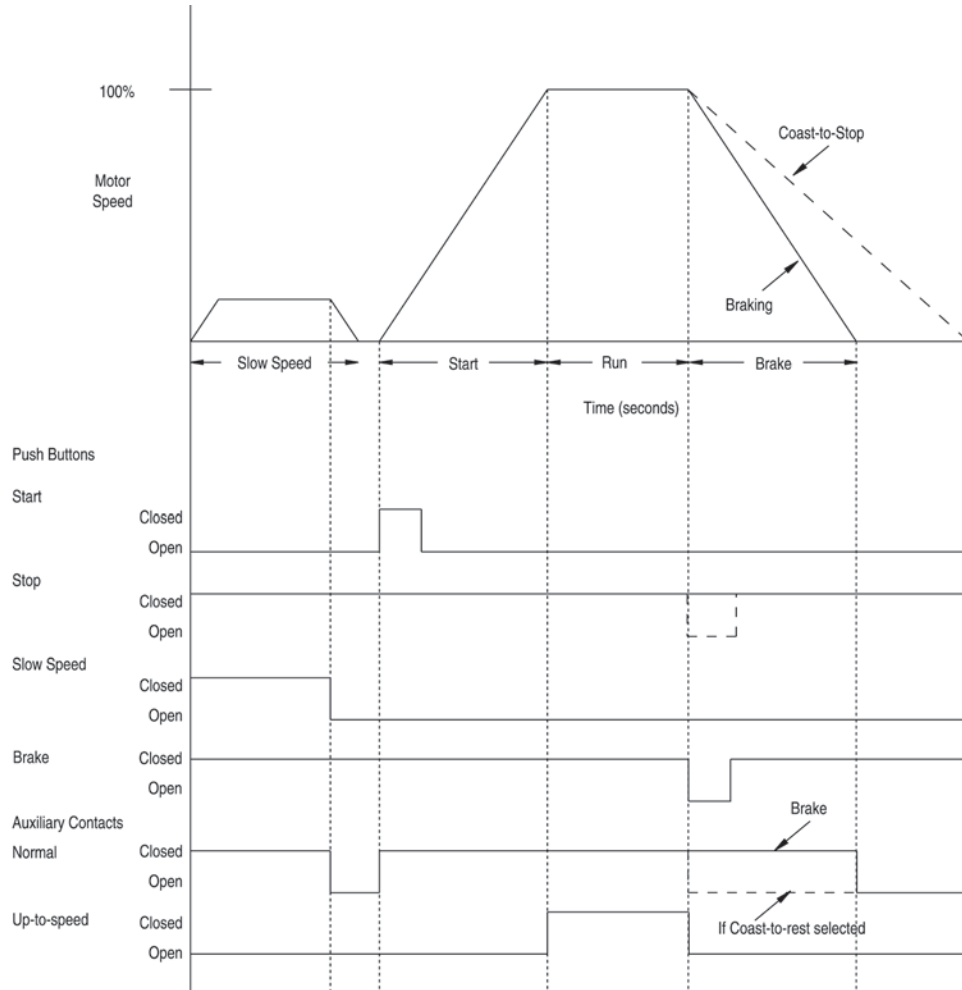
Attention	The user is responsible for determining which stopping mode is best suited to the application and will meet applicable standards for operator safety on a particular machine.

Special Application Considerations

Use of Protective Modules

A protective module (see Figure 3.35) containing metal oxide varistors (MOVs) can be installed to protect the power components from electrical transients and/or electrical noise. The protective modules clip transients generated on the lines and prevent such surges from damaging the SCRs.

Figure 3.35 Protective Module
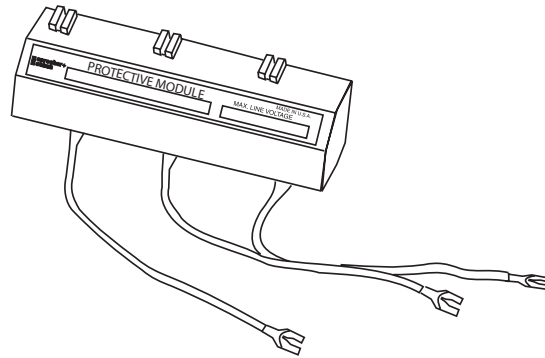
There are two general situations that may occur which would indicate the need for using the protective modules.

1. Transient spikes may occur on the lines feeding the PF Softstarter controller (or feeding the load from the PF Softstarter controller). Spikes are created on the line when devices are attached with current-carrying inductances that are open-circuited. The energy stored in the magnetic field is released when the contacts open the circuit. Examples of these are lightly loaded motors, transformers, solenoids, and electromechanical brakes. Lightning can also cause spikes.

2. The second situation arises when the PF Softstarter controller is installed on a system that has fast-rising wavefronts present, although not necessarily high peak voltages. Lightning strikes can cause this type of response. Additionally, if the PF Softstarter controller is on the same bus as other SCR devices, (AC/DC drives, induction heating equipment, or welding equipment) the firing of the SCRs in those devices can cause noise.

Note: protective modules may be placed on the line, load, or both sides of the softstarter. However, protective modules must NOT be placed on the load side of the softstarter when using inside-the-delta motor connections or with pump, linear speed, or braking control.

Multi-motor Applications

The PF Softstarter controller will operate with more than one motor connected to it. To size the controller, add the total nameplate amperes of all of the connected loads. The stall and jam features should be turned off. Separate overloads are still required to meet the National Electric Code (NEC) requirements.

Note: The PF Softstarter controller's built-in overload protection cannot be used in multi-motor applications.

Figure 3.36 Multi-Motor Application

① Customer Supplied
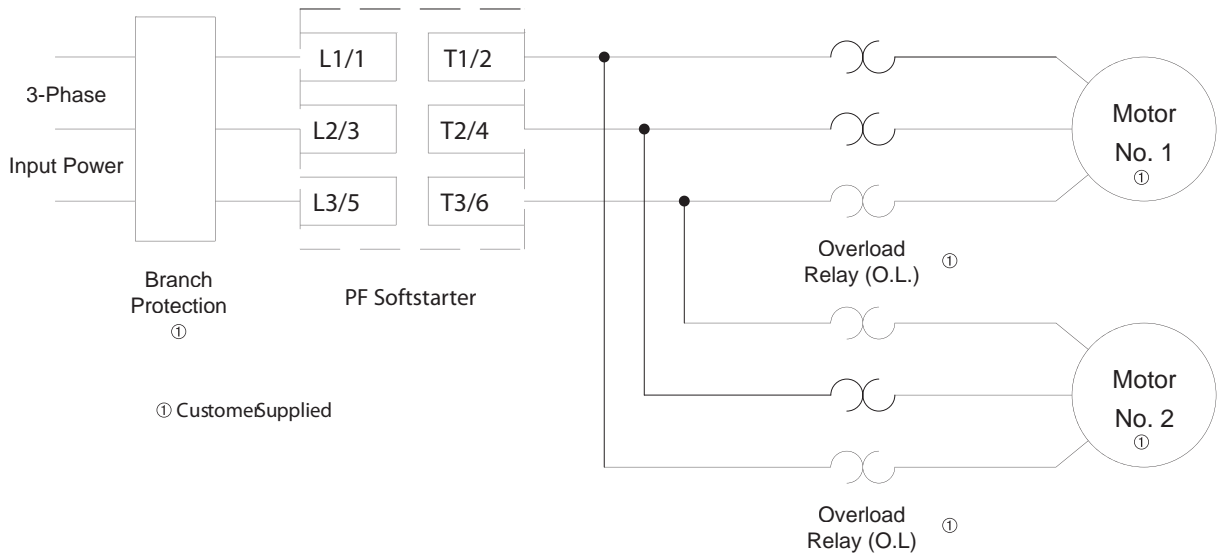
PF Softstarter as a Bypass to an AC Drive

By using the controller as shown in Figure 3.37, a soft start characteristic can be provided in the event that an AC drive is nonoperational.

Note: A controlled acceleration can be achieved with this scheme, but speed control is not available in the bypass mode.

Figure 3.37 Typical Application Diagram of a Bypass Contactor for an AC Drive
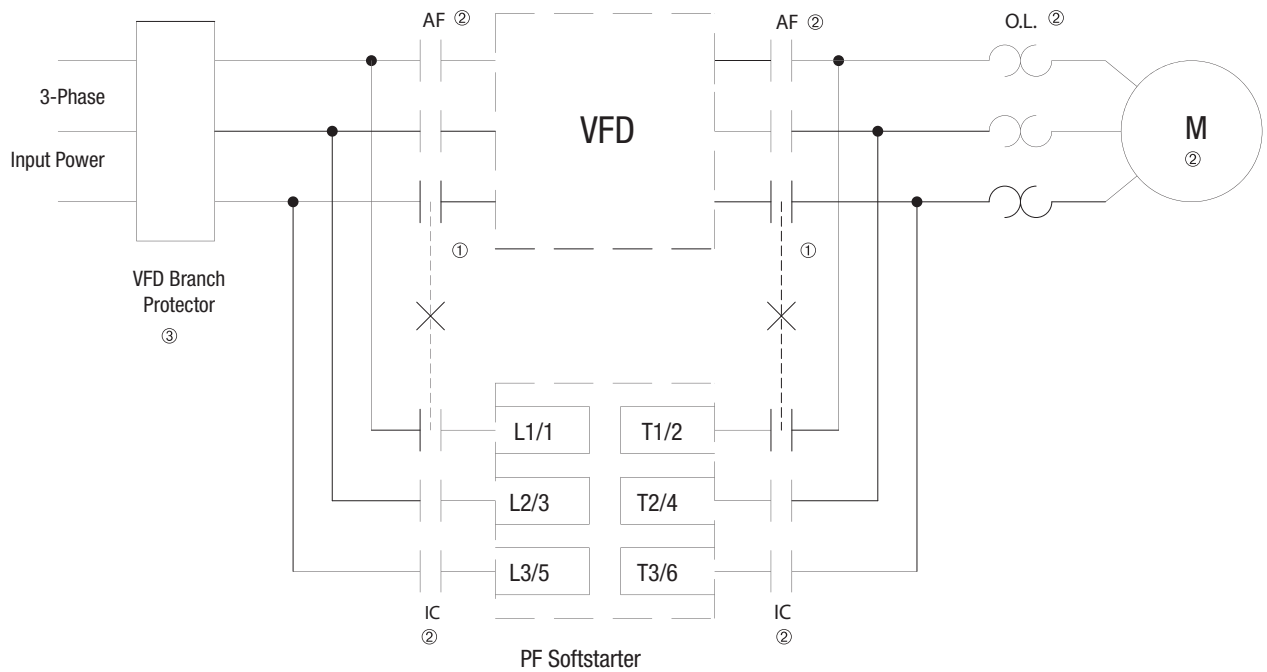
① Mechanical interlock required
② Customer supplied
③ Many VF drives are rated 150% FLA. Because the PF Softstarters can be used for a 600% FLA starting, separate branch circuit protection may be required.
④ Overload protection is included as a standard feature of the PF Softstarter

PF Softstarter with a Motor Winding Heater

Figure 3.38   Typical Application Diagram of a PF Softstarter with a Motor Winding Heater
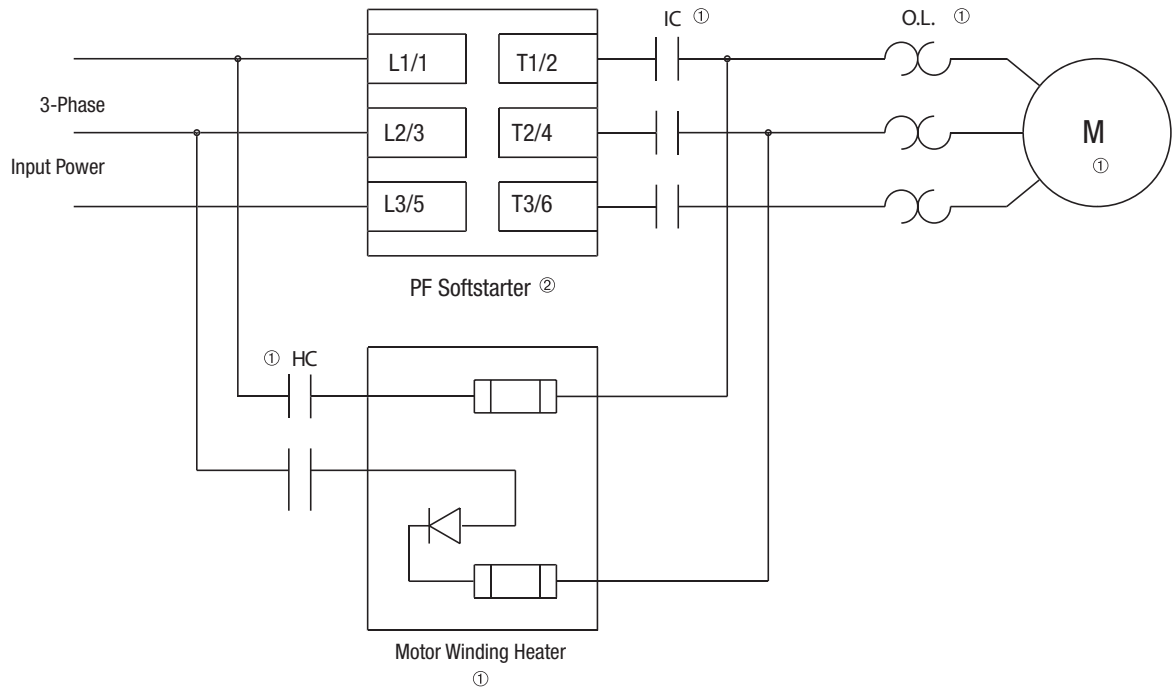
① Customer supplied
② Overload protection is included as a standard feature of the PF Softstarter

Overview

This chapter provides a basic understanding of the programming keypad built into the PF Softstarter. This chapter also describes programming the controller by modifying the parameters.

Keypad Description

The keys found on the front of the PF Softstarter are described below.

Esc	Escape	Exit a menu, cancel a change to a parameter value, or acknowledge a fault/alarm.	
Lang **Sel**	Select	Select a digit, select a bit, or enter edit mode in a parameter screen. Will get to menu to change the language being displayed.	
△ ▽	Up/Down Arrows	Scroll through options increase/decrease a value, or toggle a bit.	
⏎	Enter	Enter a menu, enter edit mode in a parameter screen, or save a change to a parameter value.	

Note: For ease of programming values, after using the Enter key to edit, use the Sel key to jump to the digit that needs to be modified, then use the arrow keys to scroll through the digits.

Programming Menu

Parameters are organized in a three-level menu structure for straightforward programming. Figure 4.1 details the programming menu structure and the three-level hierarchy.

In order to change parameters, the controller must be in the STOP mode, and the control voltage must be present.

Figure 4.1   Menu Structure Hierarchy

Power-up and
Status Display

Lang

Esc   or   **Sel**   or   ▲   or   ▼   or   ↵

Select language
being displayed

Choose Mode

OPERATION LEVEL

MAIN MENU

▲   or   ▼

Esc

Parameter ↔ Memory Storage ↔ Preferences ↔ Log-In ↔ Diagnostics

Monitoring
Set-up
Motor Protection
Utility
Linear List

Reset to Defaults

Change Password
User Dspl Line
User Dspl Time
User Dspl Video
Reset User Display

Enter Password

Alarms
Faults
Device Revision

Esc

GROUP MENU

*Parameter menu
continued in Figure 4.2*

① The PF Softstarter does not support EEPROM, Link, Process, or Start-up modes.
② Steps back one level.
③ Only displayed if password other than "0" is entered.

Figure 4.2 Parameter Menu Structure

```
                                    Parameter ①③
            ↑ ②
           Esc

Monitoring ↔ Set Up ↔ Motor Protection ↔ Utility ↔ Linear List
```

Metering
Volts Phase A-B
Volts Phase B-C
Volts Phase C-A
Current Phase A
Current Phase B
Current Phase C
Watt Meter
Kilowatt Hours
Elapsed Time
Meter Reset
Power Factor
Mtr Therm Usage
Motor Speed

Basic
SMC Option
Motor Connection
Line Voltage
Starting Mode
Ramp Time
Initial Torque
Cur Limit Lvl
Kickstart Time
Kickstart Lvl
Stop Input
Option 1 Input
Option 2 Input
Stop Mode
Stop Time
Braking Current
Overload Class
Service Factor
Motor FLC
Overload Reset
Aux1 Config
Aux2 Config
Aux3 Config
Aux4 Config
Backspin Timer
Parameter Mgt ④

Dual Ramp (Option 2 Input = Dual Ramp)
Starting Mode 2
Ramp Time 2
Initial Torque 2
Cur Limit Lvl 2
Kickstart Time 2
Kickstart Lvl 2
Parameter Mgt ④

Preset SS (Option 2 Input = Preset SS)
Slow Speed Sel
Slow Speed Dir
Slow Accel Cur
Slow Running Cur
Parameter Mgt ④

(Option 2 Input = Accu-Stop)
Slow Speed Sel
Slow Accel Cur
Slow Running Cur
Braking Current
Stopping Current
Parameter Mgt ④

Overload
Overload Class
Service Factor
Motor FLC
Overload Reset
Overload A Lvl
Parameter Mgt ④

Underload
Underload F Lvl
Underload F Dly
Underload A Lvl
Underload A Dly
Parameter Mgt ④

Undervoltage
Undervolt F Lvl
Undervolt F Dly
Undervolt A Lvl
Undervolt A Dly
Parameter Mgt ④

Overvoltage
Overvolt F Lvl
Overvolt F Dly
Overvolt A Lvl
Overvolt A Dly
Parameter Mgt ④

Unbalance
Unbalance F Lvl
Unbalance F Dly
Unbalance A Lvl
Unbalance A Dly
Parameter Mgt ④

Jam
Jam F Lvl
Jam F Dly
Jam A Lvl
Jam A Dly
Parameter Mgt ④

Stall
Stall Dly
Parameter Mgt ④

Ground Fault
Gnd Flt Enable
Gnd Flt Lvl
Gnd Flt Dly
Gnd Flt Inh Time
Gnd Flt A Enable
Gnd Flt A Lvl
Gnd Flt A Dly
Parameter Mgt ④

PTC
PTC Enable
Parameter Mgt ④

Phase Reversal
Phase Reversal
Parameter Mtg ④

Restart
Starts Per Hour
Restart Attempts
Restart Dly
Parameter Mtg ④

Language
Language
Parameter Mgt ④

Motor Data
MotorFLC
Motor ID
Parameter Mgt ④

Linear List
All parameters
Parameter Mgt ④

① Depending upon PF option selected, some parameters may not appear in product display.
② Steps back one level.
③ For further information on parameters, see Appendix B
④ For further information on parameter management, see page 4-7

Table 4.A Parameter Linear List

Parameter No.	Description	Parameter No.	Description	Parameter No.	Description
1	Volts Phase A-B	49	OL Trip Enable/Disable	97	Data Out A2
2	Volts Phase B-C	50	Overload A Lvl	98	Data Out B1
3	Volts Phase C-A	51	Underload F Lvl	99	Data Out B2
4	Current Phase A	52	Underload F Dly	100	Data Out C1
5	Current Phase B	53	Underload A Lvl	101	Data Out C2
6	Current Phase C	54	Underload A Dly	102	Data Out D1
7	Watt Meter	55	Undervolt F Lvl	103	Data Out D2
8	Kilowatt Hours	56	Undervolt F Dly	104	Motor ID
9	Elapsed Time	57	Undervolt A Lvl	105	CT Ratio
10	Meter Reset	58	Undervolt A Dly	106	MV Ratio
11	Power Factor	59	Overvolt F Lvl	107	Aux1 Config
12	Mtr Therm Usage	60	Overvolt F Dly	108	Aux3 Config
13	Motor Speed	61	Overvolt A Lvl	109	Aux4 Config
14	PF Option	62	Overvolt A Dly	110	Aux2 Config
15	Motor Connection	63	Unbalance F Lvl	111	Language
16	Line Voltage	64	Unbalance F Dly	112	Timed Start
17	Starting Mode	65	Unbalance A Lvl	113	I Shut Off Level
18	Ramp Time	66	Unbalance A Dly	114	UTS Level
19	Initial Torque	67	Jam F Lvl	115	Parameter Mgmt
20	Cur Limit Start	68	Jam F Dly	116	Backspin Timer
21	Reserved	69	Jam A Lvl	117	VShut Off Level
22	Kickstart Time	70	Jam A Dly	118	OL Reset Level
23	Kickstart Level	71	Stall Delay	119	Ambient Temp
24	Option Input 2	72	Gnd Flt Enable	120	Notch Position
25	Starting Mode 2	73	Gnd Flt Level	121	Notch Maximum
26	Ramp Time 2	74	Gnd Flt Delay	122	Start Delay
27	Initial Torque 2	75	Gnd Flt Inh time	123	By-pass Delay
28	Cur Limit Level 2	76	Gnd Flt A Enable	124	Fault 1
29	Reserved	77	Gnd Flt A Level	125	Fault 2
30	Kickstart Time 2	78	Gnd Flt A Delay	126	Fault 3
31	Kickstart Level 2	79	PTC Enable	127	Fault 4
32	Stop Mode	80	Phase Reversal	128	Fault 5
33	Stop Time	81	Start Per Hour	129	Ramp Time E
34	Pump Pedestal	82	Restart Attempts	130	Ramp Time 2E
35	Braking Current	83	Restart Delay	131	Stop Time E
36	Braking Time	84	Line Fault Disable	132	Option Input 1
37	Load Type	85	Emergency Run	133	Stop Input
38	High Eff Brake	86	Current Loss	134	Elapsed Time 2
39	Slow Speed Sel	87	Logic Mask		
40	Slow Speed Dir	88	Data In A1		
41	Slow Accel Cur	89	Data In A2		
42	Slow Running Cur	90	Data In B1		
43	Stopping Current	91	Data In B2		
44	Overload Class	92	Data In C1		
45	Service Factor	93	Data In C2		
46	Motor FLC	94	Data In D1		
47	Overload Reset	95	Data In D2		
48	OL Shunt Time	96	Data Out A1		

Password

The PF Softstarter allows the user to limit access to the programming system through password protection. This feature is disabled with a factory-set default of 0. To modify the password, complete the procedure below.

Description	Action	Display
—	—	0.0 Amps 0 Volt 0 %MTU
1. Press the ESC key to go from the status display to the Main menu.	Esc	Main Menu Diagnostics Parameter
2. Scroll with Up/Down keys until the Preferences option is highlighted.	▲ ▼	Main Menu Preferences Diagnostics
3. Press the Enter key to access the Preferences menu.	↵	Preferences: Change Password User Dspy lines
4. Scroll with Up/Down keys until the Change Password option is highlighted.	▲ ▼	Preferences: Change Password User Dspy lines
5. Press the Enter key.	↵	—
6. Scroll with Up/Down keys to enter the desired number. If you are modifying the password, make a note of it as displayed. Use the Sel key to highlight a single digit.	▲ ▼	Prefs: Password New Code: 83 Verify: 83
7. Verification of the new password is required. Press the enter key.	↵	—
8. Press the Enter key after you have completed modifying the password. ①	↵	Preferences: Change Password User Dspy lines

① To complete the programming process, re-enter the Main Menu mode to log out. This will eliminate unauthorized access to the programming system.

Note: If you lose or forget the password, contact your local Sprecher + Schuh representative.

Parameter Management

Before you begin programming, it's important to understand how the controller memory is:

- structured within the PF Softstarter
- used on power-up and during normal operation

Refer to Figure 4.3 and the explanations below.

Figure 4.3 Memory Block Diagram
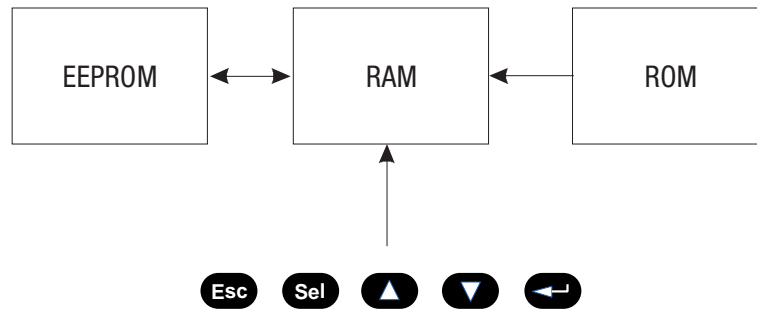
Random Access Memory (RAM)

This is the work area of the controller after it is powered up. The PF Softstarter uses an Auto Store feature when programming parameters. When parameters are modified in the program mode, the new values are stored immediately in RAM and then in EEPROM, once the enter key has been pressed, these values will be lost. When the device first powers up, the values from the EEPROM area of memory are copied into RAM.

Read-only Memory (ROM)

The PF Softstarter comes with factory default parameter values. These settings are stored in non-volatile ROM and are displayed the first time you enter the Program mode. At any time you can restore defaults by accessing the memory storage menu.

Description	Action	Display

Recalling Defaults
   After parameter values have been modified,
   factory default settings can still be re-initialized.
	⏎	Memory Storage:
		Reset to Defaults

Electrically Erasable Programmable Read-only Memory (EEPROM)

The PF Softstarter provides a non-volatile area for storing user-modified parameter values in the EEPROM.

Parameter Modification

All parameters are modified using the same method. The basic steps to performing parameter modification are described below.

Notes: (1) Parameter values modified while the motor is operating are not valid until the next time that operation occurs.
(2) If the password is set, parameters cannot be adjusted without logging in.
(3) Use the Sel key to highlight a single digit.

Description	Action	Display ②
—	—	0.0 Amps / 0 Volt / 0 %MTU
1. Press the ESC key to go from the status display to the Main menu.	Esc	—
2. Scroll with the Up/Down keys until the Parameter option is highlighted.	▲ ▼	Main Menu / Parameter / Memory Storage
3. Press the Enter key to access the Parameter menu.	↵	F G P : File / Monitoring / Set Up
4. Scroll with the Up/Down keys until the option you want to use (Monitoring, Motor Protection, etc.) is highlighted. For this example, Set Up will be used.	▲ ▼	F G P : File / Set Up / Motor Protection
5. Press Enter to select the Set Up group.	↵	—
6. Scroll to Basic Set Up and press Enter. ①	▲ ▼ ↵	F G P : Group / Basic Set Up
7. Scroll to the Starting Mode parameter by using the Up/Down keys, and press Enter.	▲ ▼ ↵	F G P : Parameter / Starting Mode / Ramp Time
8. Press Enter to select the option. Scroll to the option of your choice by using the Up/Down keys. For this example, we will choose Current Limit.	▲ ▼ ↵	F G P : P# 17 / Starting Mode / Current Lim
9. Press the Enter key to accept the new setting.	↵	—
10. Scroll to the next parameter by using the Down key. Continue the process until all desired settings are entered.	▼	F G P : P# 18 / Ramp Time / 10 Secs

① The PF Option advises the user if any control option (i.e., Pump Control) is resident. This parameter is factory set and cannot be modified by the user.
② The display will indicate that the second line is now active by highlighting the first character. If the LCD display does not provide a highlighted cursor, then the controller is in the display mode.

Soft Start

The following parameters are specifically used to adjust the voltage ramp supplied to the motor:

Parameter	Option
Starting Mode This must be programmed for Soft Start.	Soft Start
Ramp Time ① This programs the time period that the controller will ramp the output voltage up to full voltage from the Initial Torque level programmed.	0...30 s
Initial Torque The initial reduced output voltage level for the voltage ramp to the motor is established and adjusted with this parameter.	0...90% locked rotor torque
Kickstart Time A boost of current is provided to the motor of the programmed time period.	0.0...2.0 s
Kickstart Level Adjusts the amount of current applied to the motor during the kickstart time.	0...90% locked rotor torque

① If the controller senses that the motor has reached full speed before completing the Soft Start, it will automatically switch to providing full voltage to the motor.

Current Limit Start

To apply a current limit start to the motor, the following parameters are provided for user adjustment:

Parameter	Option
Starting Mode This must be programmed for Current Limit.	Current Limit
Ramp Time ① This programs the time period that the controller will hold the fixed, reduced output voltage before switching to full voltage.	0...30 s
Current Limit Level This parameter provides adjustability for the reduced output voltage level provided to the motor.	50...600% full load current
Kickstart Time A boost of current is provided to the motor for the programmed time period.	0.0...2.0 s
Kickstart Level Adjusts the amount of current applied to the motor during the kickstart time.	0...90% locked rotor torque

① If the controller senses that the motor has reached full speed before completing the current limit start, it will automatically switch to providing full voltage to the motor.

Dual Ramp Start

The PF Softstarter provides the user with the ability to select between two Start settings. The parameters below are available in the Set Up programming mode. To obtain Dual Ramp control, Ramp #1 is located in the Basic Set Up and Ramp #2 is located in the Option 2 Input (Dual Ramp).

Parameter	Option
Set Up The user must select the Set Up programming mode to obtain access to the Dual Ramp parameters.	~
Basic Set Up/Starting Mode Set Up as stated in previous pages.	~

Option 2 Input (Dual Ramp) ①
This allows the user the option to choose between two Soft Start profiles defined by:
    1. Start Mode/Ramp Time/Initial Torque and
    2. Start Mode 2/Ramp Time 2/Initial Torque 2.
When this feature is turned on, the ramp time/initial torque combination is determined by a hard contact input to terminal 15. When this input signal is low, ramp time/initial torque are selected. When this input is high, ramp time 2/initial torque 2 are selected. Once the Option 2 Input has been set to Dual Ramp, you must ESC back to the Parameter (File) menu. Re-enter into the Set Up menu to show both Basic Set Up and Dual Ramp.
	~

Basic Set Up/Start Mode ② This selects the start mode for option #1.	~
Basic Set Up/Ramp Time This programs the time period during which the controller will ramp the output voltage up to full voltage for the first Start setup.	0...30 s
Basic Set Up/Initial Torque This parameter establishes and adjusts the initial reduced output voltage level for the first Soft Start setup.	0..90% locked rotor torque
Dual Ramp/Start Mode 2 ② This selects the start mode for option #2.	~
Dual Ramp/Ramp Time 2 This programs the time period during which the controller will ramp the output voltage up to full voltage for the second Start setup.	0...30 s
Dual Ramp/Initial Torque 2 The initial reduced output voltage level for the second Start setup is established and adjusted with this parameter..	0...90% locked rotor torque

① The Dual Ramp feature is available on the standard controller.
② Kickstart can be programmed for both start modes.

Full Voltage Start

The PF Softstarter may be programmed to provide a full voltage start (output voltage to the motor reaches full voltage within 1/4 second) with the following programming:

Parameter	Option
Starting Mode	Full Voltage

Linear Speed

The PF Softstarter provides the user the ability to control the motor speed during starting and stopping maneuvers. A tach input is required as specified in *Linear Speed Acceleration* on page 1-6.

Parameter	Option
Starting Mode	Linear Speed
Ramp Time This programs the time period that the controller will ramp from 0 speed to full speed.	0...30 s
Kickstart Time A boost of current is provided to the motor of the pro-grammed time period.	0.0...2.2 s
Kickstart Level Adjusts the amount of current applied to the motor during the kickstart time.	0...90% locked rotor torque

Programming Parameters

The following table provides the option-specific parameters that are provided with each control option. These parameters are in addition to those already discussed in the Basic Set Up and Metering groups. Diagrams supporting the options described below are shown later in this chapter.

Option	Parameter	Range
Standard		
Soft Stop	**PF Option** This parameter identifies the type of control present and is not user programmable.	Standard
	Soft Stop Time Allows the user to set the time period for the Soft Stopping function.	0...120 s
Preset Slow Speed	**PF Option** This parameter identifies the type of control present and is not user programmable.	Standard
	Slow Speed Select Allows the user to program the slow speed that best fits the application.	Low: 7% – forward, 10% – reverse High: 15% – forward, 20% – reverse
	Slow Speed Direction This parameter programs the slow speed motor rotational direction.	Forward, Reverse
	Slow Accel Current Allows the user to program the required current to accelerate the motor to slow speed operation.	0…450% of full load current
	Slow Running Current Allows the user to program the required current to operate the motor at the slow speed setting.	0…450% of full load current

Option	Parameter	Range
Pump Control		
Pump Control	**PF Option** This parameter identifies the type of control present and is not user programmable.	Pump Control
	Pump Stop Time Allows the user to set the time period for the pump stopping function.	0...120 s
	Starting Mode Allows the user to program the PF Softstarter for the type of starting that best fits the application.	Pump Start, Soft Start, Current Limit Start
Braking Control		
SMB Smart Motor Braking	**PF Option** This parameter identifies the type of control present and is not user programmable.	Braking Control
	Braking Current ① Allows the user to program the intensity of the braking current applied to the motor.	0...400% of full load current
Accu-Stop	**PF Option** This parameter identifies the type of control present and is not user programmable.	Braking Control
	Slow Speed Select Allows the user to program the slow speed that best fits the application.	Low: 7% High: 15%
	Slow Accel Current Allows the user to program the required current to accelerate the motor to slow speed operation.	0...450% of full load current
	Slow Running Current Allows the user to program the required current to operate the motor at the slow speed setting.	0...450% of full load current
	Braking Current ① Allows the user to program the intensity of the braking current applied to the motor.	0...400% of full load current
	Stopping Current ① Allows the user to program the intensity of the braking current applied to the motor form slow speed operation.	0...400% of full load current

① All braking/stopping current settings in the range of 1...100% will provide 100% braking current to the motor.

Option	Parameter	Range
Slow Speed with Braking	**PF Option** This parameter identifies the type of control present and is not user programmable.	Braking Control
	Slow Speed Select Allows the user to program the slow speed that best fits the application.	Low: 7% High: 15%
	Slow Accel Current Allows the user to program the required current to accelerate the motor to slow speed operation.	0...450% of full load current
	Slow Running Current Allows the user to program the required current to operate the motor at the slow speed setting.	0...450% of full load current
	Braking Current [1] Allows the user to program the intensity of the braking current applied to the motor.	0...400% of full load current

[1] All braking/stopping current settings in the range of 1...100% will provide 100% braking current to the motor.

Basic Set Up

The Basic Set Up programming group provides a limited parameter set, allowing quick start-up with minimal adjustment. If the user is planning to implement some of the advanced features (e.g., Dual Ramp, or Preset Slow Speed), then the Setup programming group should be selected. It provides all the Basic Set Up parameter set plus the advanced set.

Parameter	Option
PF Option Displays the type of controller. This is factory set and not adjustable.	Standard
Motor Connection Displays the motor type to which the device is being connected..	Line or Delta
Line Voltage Displays the system line voltage to which the unit is connected.	
Starting Mode Allows the user to program the PF Softstarter for the type of starting that best fits the application.	Soft Start, Current Limit, Full Voltage, Linear Speed
Ramp Time This sets the time period during which the controller will ramp the output voltage.	0...30 s
Initial Torque ① The initial reduced voltage output level for the voltage ramp is established and adjusted with this parameter.	0...90% locked rotor torque
Current Limit Level ② The current limit level that is applied for the Ramp Time selected.	50...600% FLC
Kickstart Time A boost current is provided to the motor for the programmed time period.	0.0...2.0 s
Kickstart Level Adjusts the amount of current applied to the motor during kickstart.	0...90% locked rotor torque
Stop Input Allows the user to select the operation of terminal 18, Stop Input.	Coast, Stop Option
Option 1 Input Allows the user to select the operation of terminal 16, Option Input #1.	Disable, Coast, Stop Option, Fault, Fault NC, Network
Option 2 Input Allows the user to select the operation of terminal 15, Option Input #2.	Disable, Slow Speed, Dual Ramp, Fault, Fault NC, Network, Clear Fault
Stop Mode Allows the user to program the PF Softstarter for the type of stopping that best fits the application.	Disable, Soft Stop, Linear Speed
Stop Time This sets the time period which the controller will ramp the voltage during a stopping maneuver.	0.0...120 s
Overload Class	Disable, 10, 15, 20, 30
Service Factor	0.01...1.99 s
Motor FLC	1.0...2200
OL Reset	Auto, Manual
Aux1 Config Contact is provided as standard with the PF Softstarter. This contact is located at terminals 19 and 20. Aux Contacts 1 allows the user to configure the operation of the contacts.	Normal, Up-to-speed, Fault Alarm, Network Control, External Bypass: (N.O./N.C.)
Aux2 Config Contact is provided as standard with the PF Softstarter. This contact is located at terminals 29 and 30. Aux Contacts 2 allows the user to configure the operation of the contacts.	Normal, Up-to-speed, Fault Alarm, Network Control, External Bypass: (N.O./N.C.)
Aux3 Config Contact is provided as standard with the PF Softstarter. This contact is located at terminals 31 and 32. Aux Contacts 3 allows the user to configure the operation of the contacts.	Normal, Up-to-speed, Fault Alarm, Network Control, External Bypass: (N.O./N.C.)
Aux4 Config Contact is provided as standard with the PF Softstarter. This contact is located at terminals 33 and 34. Aux Contacts 4 allows the user to configure the operation of the contacts.	Normal, Up-to-speed, Fault Alarm, Network Control, External Bypass: (N.O./N.C.)
Parameter Mgmt Recall of factory default parameter values.	Ready, Load Default

① Starting Mode must be programmed to Soft Start to obtain access to the Initial Torque parameter.
② Starting Mode must be programmed to Current Limit to obtain access to the Current Limit Level parameter.

Attention	For overload protection, it is critical that the data be entered as it appears on the motor nameplate.

Motor Protection

While the Basic Set Up group allows the user to get started with a minimum number of parameters to modify, the Motor Protection group allows full access to the PF Softstarter's powerful parameter set. Following is a listing of the additional setup parameters provided.

Note: The majority of parameters have a Fault and an Alarm setting.

Parameter	Option
Overload Allows the user to select the operation of the overload:	Trip Class, Service Factor, Motor FLC, Overload Reset, Overload Alarm Level
Underload ② Determines the trip level as a percentage of the motor's FLA, and the delay period.	Underload Fault Level, Underload Fault Delay, Underload Alarm Level, Underload Alarm Delay
Undervoltage ① Determines the trip level as a percentage of the line voltage and the delay period.	Undervoltage Fault Level, Undervoltage Fault Delay, Undervoltage Alarm Level, Undervoltage Alarm Delay
Overvoltage ① Determines the trip level as a percentage of line voltage and delay period.	Overvoltage Fault Level, Overvoltage Fault Delay, Overvoltage Alarm Level, Overvoltage Alarm Delay
Unbalance ① Allows the user to set the current unbalance trip level and delay period.	Unbalance Fault Level, Unbalance Fault Delay, Unbalance Alarm Level, Unbalance Alarm Delay
Jam ② Determines the trip level as a percentage of motor full load current and delay period.	Jam Fault Level, Jam Fault Delay, Jam Alarm Level, Jam Alarm Delay
Stall Allows the user to set the stall delay time.	Stall Delay
Ground Fault ③ Allows the user to enable the ground fault level in amps, delay time, and inhibit time.	Ground Fault Enable, Ground Fault Level, Ground Fault Delay, Ground Fault Inhibit Time, Ground Fault Alarm Enable, Ground Fault Alarm Level, Ground Fault Alarm Delay
Motor PTC ④ Allows the user to connect a PTC to the PF and enable a fault when it becomes active.	PTC Enable
Phase Reversal Determines the proper orientation of line connections to the PF. If Enabled and phases are out of sequence, a fault will be indicated.	Phase Reversal
Restarts Allows the user to determine the maximum number of restarts per hour the unit can experience, and delay time between consecutive starts.	Restarts Per Hour, Restart Attempts, Restart Delay

① The delay time must be set to a value greater than zero when Undervoltage, Overvoltage, and Unbalance are enabled.
② For Jam and Underload detection to function, the Motor FLC must be programmed in the Motor Protection group. See Chapter 5 for instructions.
③ See details in *Ground Fault* on page 1-15.
④ See details in *Thermistor/PTC Protection* on page 1-16.

Example Settings

Undervoltage [1]

With Line Voltage programmed for 480V and the Undervoltage level programmed for 80%, the trip value is 384V.

Overvoltage [1]

With Line Voltage programmed for 240V and the Overvoltage level programmed for 115%, the trip value is 276V.

Jam [2][3]

With Motor FLC programmed for 150 A and the Jam level programmed for 400%, the trip value is 600 A.

Underload [2]

With Motor FLC programmed for 90 A and the Underload level programmed for 60%, the trip value is 54 A.

[1] The average value of the three phase-to-phase voltages is utilized.
[2] The largest value of the three phase currents is utilized.
[3] The PF Softstarter will self-protect.

Overview

The Basic Set Up and Overload programming group allows the user to set parameters indicating to the controller the motor that is connected. It is important to correctly input the data to achieve the best performance from your controller.

| Attention | For overload protection, it is critical that the data be entered as it appears on the motor nameplate. |

Motor Data Entry

In the Program mode, enter the correct values into the Overload group:

Parameter	Option	Display
Overload Class The Factory default setting is 10.	Disable, 10, 15, 20, 30	F G P : P# 44 Overload Class Class ##
Service Factor Enter the value from the motor's nameplate.	0.01...1.99	F G P : P# 45 Service Factor #.##
Motor FLC Enter the value for the motor's nameplate.	1.0...2200 A	F G P : P# 46 Motor FLC ###.# Amps
Overload Reset Allow's the user to select either a manual or auto reset after an overload fault.	Manual, Auto	F G P : P# 47 Overload Reset Manual
Motor Connection Enter the type of motor being connected to PF Softstarter; Line or Delta.	Line, Delta	F G P : P# 15 Motor Connection Line
Line Voltage Enter the system voltage in this parameter. This must be done to ensure optimum motor performance and correct operation of undervoltage and overvoltage protection.	1...10,000V	F G P : P# 16 Line Voltage ### Volt
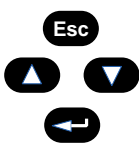
① Refer to the PF Softstarter nameplate for maximum ratings. Exceeding these could result in damage to the controller.
② Found in Overload programming group. Only one location needs to be programmed.
③ Found in Basic Set Up programming group

Overview

While the PF Softstarter operates your motor, it also monitors several different parameters, providing a full function metering package.①

Viewing Metering Data

To access the metering information, follow the procedure below.

Description	Action	Display
—	—	##.# Amps ### Volt ## %MTU
1. Press any of the following keys to access the Main Menu.	Esc ▲ ▼ ↵	Main Menu Parameter Memory Storage
2. Scroll with the Up/Down keys until the Parameter option is shown.	▲ ▼	Main Menu Parameter Memory Storage
3. Press the Enter key to select the Parameter option.	↵	—
4. Scroll with the Up/Down keys until the Monitoring option is displayed.	▲ ▼	F G P : File Monitoring Set Up
5. Press the Enter key to access the Monitoring group.	↵	—
6. Press the Enter key to access the Metering group.	↵	F G P : Group Metering

① Refer to Metering on page 1-19 or Figure 4.2 on page 4-3 for details on the metering functions.

Description	Action	Display
7. Scroll through the Metering parameters with the Up/Down keys to access the desired information. Press the Enter key to view that parameter.	▲ ▼ ↵	F G P : P# 1 Volts Phase A-B ### Volt F G P : P# 2 Volts Phase B-C ### Volt F G P : P# 3 Volts Phase C-A ### Volt F G P : P# 4 Current Phase A ##.# Amps F G P : P# 5 Current Phase B ##.# Amps F G P : P# 6 Current Phase C ##.# Amps F G P : P# 7 Watt Meter ##.# KW F G P : P# 8 Kilowatt Hours ##.# KWH F G P : P# 9 Elapsed Time ##.# Hour F G P : P# 10 Meter Reset No F G P : P# 11 Power Factor ##.# F G P : P# 12 Mtr Therm Usage ## %MTU

The metering values that are displayed on the PF Softstarter can be modified to show your desired values by accessing Main Menu / Preferences.

Overview

This chapter describes the fault diagnostics of the PF Softstarter. Further, this section describes the conditions that cause various faults to occur.

Protection Programming

Many of the protective features available with the PF Softstarter can be enabled and adjusted through the programming parameters provided. For further details on programming, refer to the Motor Protection section in Chapter 4, *Programming*.

The PF Softstarter comes equipped with a built-in three-line, 16-character LCD. The LCD displays the unit has faulted on the first line, the fault number on the second line, and the fault code on the third line.

Fault Display

Figure 7.1 Fault Display

```
              Faulted
 ┌─────────────────────────────────┐
 │ Fault # 1                       │
 │              Line Loss A        │
 └─────────────────────────────────┘
```
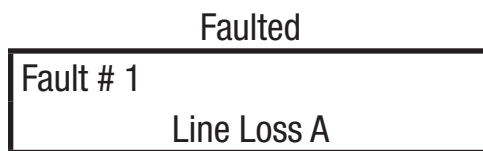
Note: The fault display will remain active as long as control power is applied. If control power is cycled, the fault will be cleared, the controller will re-initialize, and the display will show a status of "Stopped."

Note: You can hit Esc to get to another programming/diagnostic list, but the PF Softstarter will still be in a faulted state.

Important: Resetting a fault will not correct the cause of the fault condition. Corrective action must be taken before resetting the fault.

Clear Fault

You can clear a fault using any of several methods:

• Program the PF Softstarter for a Clear Fault, which can be found in Main Menu/Diagnostics/Faults.

• If a RESET push button is present, the N.O. push button auxiliary contact can be connected to Option Input #2 (terminal 15). Option Input #2 must be programmed for Clear Fault.

• Cycle control power to the PF Softstarter.

Important: An overload fault cannot be reset until the Motor Thermal Usage, parameter 12, value is below 75%. See *Protection and Diagnostics* on page 1-11 for further details.

Fault Buffer

The PF Softstarter stores in memory the five most recent faults. Display the fault buffer by selecting the View Faults Queue and scrolling through the fault buffer parameters. The information is stored as fault codes and fault descriptions. A fault code cross-reference is provided in Table 7.A.

Fault Codes

Table 7.A provides a complete cross-reference of the available fault codes and corresponding fault descriptions.

Table 7.A Fault Code Cross-reference

Fault	Code		Fault	Code
Line Loss A	1		Stall	25
Line Loss B	2		Phase Reversal	26
Line Loss C	3		Coms Loss P2	27
Shorted SCR A	4		Coms Loss P3	28
Shorted SCR B	5		Coms Loss P5	29
Shorted SCR C	6		Network P2	30
Open Gate A	7		Network P3	31
Open Gate B	8		Network P5	32
Open Gate C	9		Ground Fault	33
PTC Pwr Pole	10		Excess Starts	34
SCR Overtemp	11		Power Loss A	35
Motor PTC	12		Power Loss B	36
Open Bypass A	13		Power Loss C	37
Open Bypass B	14		Hall ID	38
Open Bypass C	15		NVS Error	39
No Load A	16		No Load	40
No Load B	17		Line Loss A	41 ①
No Load C	18		Line Loss B	42 ①
Line Imbalance	19		Line Loss C	43 ①
Overvoltage	20		V24 Loss	45
Undervoltage	21		V Control Loss	46
Overload	22		Input 1	48
Underload	23		Input 2	49
Jam	24		System Faults	128...209

① See Table 7.B for definition.

Fault and Alarm Auxiliary Indication for Fault or Alarm

Auxiliary contacts can be programmed for Fault or Alarm, N.O. or N.C. indication. Parameter setup can be found in the Parameter/Motor Protection group when modifying parameters in the Program Mode.

Fault Definitions Table 7.B shows the fault definitions for the PF Softstarter.

Table 7.B Fault Definitions

Fault	Description
Line Loss F1, F2, F3	The PF Softstarter can determine if a line connection has been lost, and will indicate this accordingly.
Shorted SCR	Shorted SCRs will be detected and starting will be prohibited by the PF Softstarter.
Open Gate	Open gate indicates that an abnormal condition that causes faulty firing (e.g., open SCR gate) has been sensed during the start sequence. The PF Softstarter will attempt to start the motor a total of three times before the controller shuts down.
Power Pole PTC and SCR Overtemperature	The power pole temperature in each phase is monitored. If the temperature rises above the predetermined level, the unit will fault to protect the power pole. A reset can be performed once the temperature falls below this level.
Motor PTC	A motor PTC can be connected to terminals 23 and 24. If the PTC parameter is enabled and the PTC trips, the PF Softstarter will trip and indicate a Motor PTC fault.
Open Bypass	Power pole bypass contacts are monitored for proper operation. In the event that a contact closure is not sensed, the PF Softstarter will indicate an Open Bypass fault.
No Load	The PF Softstarter can determine if a load connection has been lost, and No Load fault will be indicated.
Line Unbalance ①	Voltage unbalance is detected by monitoring the three phase supply voltages. The formula used to calculate the percentage voltage unbalance is as follows: $Vu = 100 (V_d / V_a)$ Vu: Percent voltage unbalance V_d: Maximum voltage deviation from the average voltage V_a: Average voltage The controller will shut down when the calculated voltage unbalance reaches the user-programmed trip percentages.
Overvoltage and Under voltage Protection ①	Overvoltage and undervoltage protection are user-defined as a percentage of the programmed line voltage. The PF Softstarter continuously monitors the three supply phases. The calculated average is then compared to the programmed trip level.
Underload ②	Underload protection is available for undercurrent monitoring. The controller will shut down when the motor current drops below the trip level. This trip level, a percentage of the motor's full load current rating, can be programmed.
Overload Protection	Overload protection is enabled in the Motor Protection group by programming the: • Overload class • Overload reset • Motor FLC • Service factor • Refer to Chapter 5 for more information on Motor Protection.
Phase Reversal	Phase reversal is indicated when the incoming power to the PF Softstarter is in any sequence other than ABC. This pre-start protective feature can be disabled.
Network	Network faults are faults generated on the network external to the PF Softstarter, and are annunciated on the LCD display.
Ground Fault	Ground faults are based on feedback from the user supplied 825 CT (5...480A devices only) detecting ground fault currents. Ground fault parameters of level and time delay must be programmed for proper operation.
Excess Starts/Hour	Excess starts/hour is displayed when the number of starts in a one hour period exceeds the value programmed.
Power Loss	Power loss indicates that an input power phase is not present. The controller's LCD display will identify the missing phase. If all three phases are absent when a start command is issued, the LCD will display "Starting" without motor rotation.
Line Loss F41, F42, F43	During expected SCR gate periods, the power pole voltage and currents are monitored. If the SCR conduction is discontinuous, a fault is indicated.

① Phase loss, overvoltage, and undervoltage protection are disabled during braking operation.
② Jam detection and underload protection are disabled during slow speed and braking operation.

Introduction

For safety of maintenance personnel as well as others who might be exposed to electrical hazards associated with maintenance activities, follow the local safety related work practices (for example, the NFPA 70E, Part II in the United States). Maintenance personnel must be trained in the safety practices, procedures, and requirements that pertain to their respective job assignments.

Attention

Hazardous voltage is present in the motor circuit even when the PF Softstarter is off. To avoid shock hazard, disconnect main power before working on the controller, motor, and control devices such as Start-Stop push buttons. Procedures that require parts of the equipment to be energized during troubleshooting, testing, etc., must be performed by properly qualified personnel, using appropriate local safety work practices and precautionary measures.

Attention

Disconnect the controller from the motor before measuring insulation resistance (IR) of the motor windings. Voltages used for insulation resistance testing can cause SCR failure. Do not make any measurements on the controller with an IR tester (megger).

Note: The time it takes for the motor to come up to speed may be more or less than the time programmed, depending on the frictional and inertial characteristics of the connected load.

Note: Depending on the application, the Braking options (SMB Smart Motor Braking, Accu-Stop, and Slow Speed) may cause some vibration or noise during the stopping cycle. This may be minimized by lowering the braking current adjustment. If this is a concern in your application, please consult the factory before implementing these options.

The following flowchart is provided to aid in quick troubleshooting.

Figure 8.1 Troubleshooting Flowchart
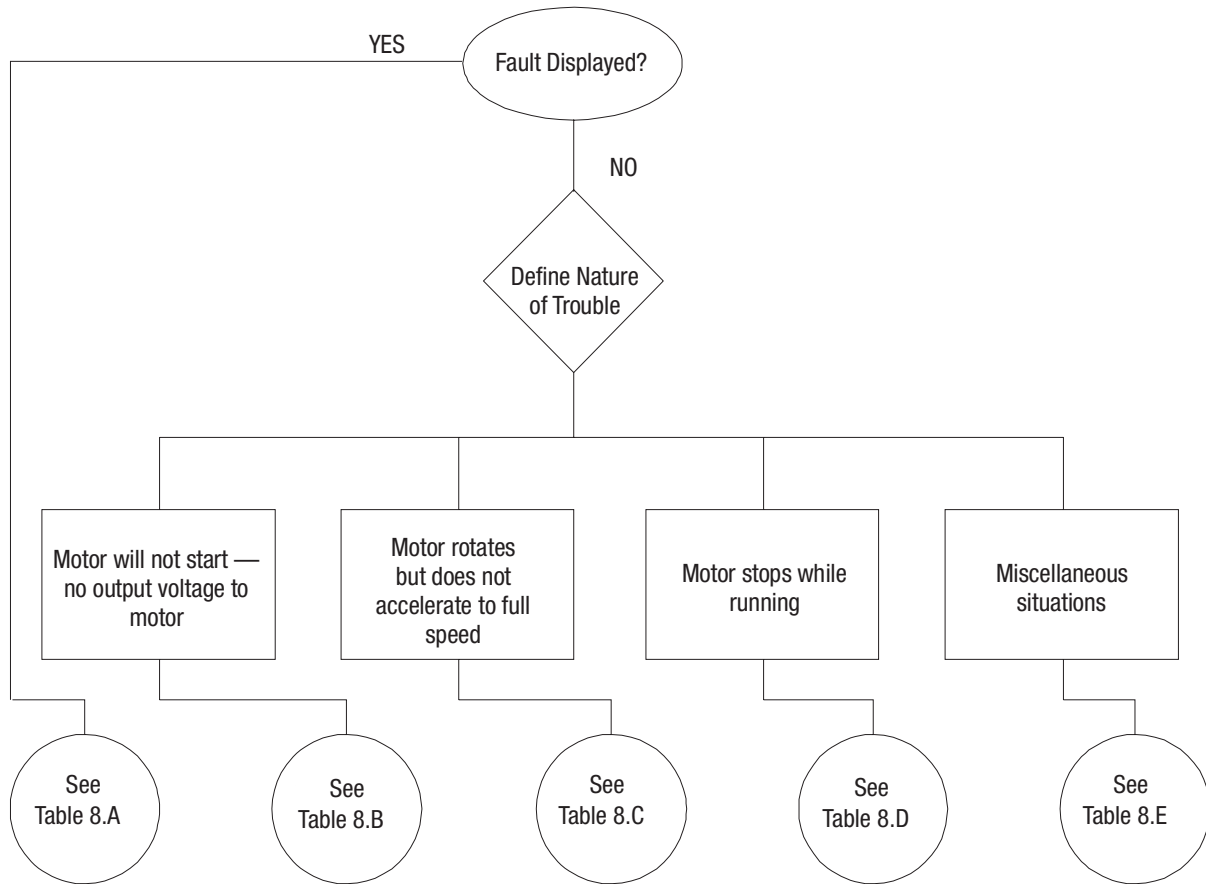
Table 8.A PF Fault Display Explanation

Display	Fault Code	Possible Causes	Possible Solutions
Line Loss ① (with phase indication)	1, 2, 3	• Missing supply phase • Motor not connected properly	• Check for open line (i.e., blown fuse) • Check for open load lead • Consult the factory
Shorted SCR	4, 5, & 6	• Shorted Power Module	• Check for shorted SCR, replace power module if necessary
Open Gate (with phase indication)	7, 8, & 9	• Open gate circuitry • Loose gate lead	• Perform resistance check; replace power module if necessary • Check gate lead connections to the control module
PTC Power Pole SCR Overtemp	10 & 11	• Controller ventilation blocked • Controller duty cycle exceeded • Fan failure • Ambient temperature limit exceeded • Failed thermistor • Failed control module	• Check for proper ventilation • Check application duty cycle • Replace fan • Wait for controller to cool or provide external cooling • Replace power module • Replace control module
Motor PTC	12	• Motor ventilation blocked • Motor duty cycle exceeded • PTC open or shorted	• Check for proper ventilation • Check application duty cycle • Wait for motor to cool or provide external cooling • Check resistance of PTC

Table 8.A PF Fault Display Explanation (Continued)

Display	Fault Code	Possible Causes	Possible Solutions
Open Bypass	13, 14, & 15	• Control voltage is low • Inoperable power module bypass	• Check control voltage power supply • Replace power module • Check control module TB2…TB4 and TB5…TB7 for secureness • Check Aux 1, 2, 3, 4 configurations are not set to External Bypass
No Load	16, 17, 18, & 40	• Loss of load side power wiring	• Check all load side power connections and motor windings
Line Unbalance	19	• Supply unbalance is greater than the user-programmed value • The delay time is too short for the application	• Check power system and correct if necessary • Extend the delay time to match the application requirements
Overvoltage	20	• Supply voltage is greater than user-programmed value	• Check power system and correct if necessary • Correct the user-programmed value
Undervoltage	21	• Supply voltage is less than user-programmed value • The delay time is too short for the application	• Check power system and correct if necessary • Correct the user-programmed value • Extend the delay time to match the application requirements
Overload	22	• Motor overloaded • Overload parameters are not matched to the motor	• Check motor overload condition • Check programmed values for overload class and motor FLC
Underload	23	• Broken motor shaft • Broken belts, toolbits, etc. • Pump cavitation	• Repair or replace motor • Check machine • Check pump system
Jam	24	• Motor current has exceeded the user programmed jam level.	• Correct source of jam • Check programmed time value
Stall	25	• Motor has not reached full speed by the end of the programmed ramp time	• Correct source of stall
Phase Reversal	26	• Incoming supply voltage is not in the expected ABC sequence	• Check power wiring
Ground Fault	33	• Ground fault current level has exceeded programmed value	• Check power system and motor; correct if necessary • Check programmed ground fault levels to match application requirements
Excess Starts/Hr.	34	• Number of starts in a one hour period has exceeded the value programmed	• Wait an appropriate amount of time to restart • Turn off the Starts/Hr. feature
Power Loss (with phase indication) [1]	35, 36, & 37	• Missing supply phase (as indicated)	• Check for open line (i.e., blown line fuse)
Hall ID	38	• Incorrect power module has been installed	• Check power module and replace
NVS Error	39	• Data entry error	• Check user data and perform a User Store function • Replace control module • Reset default values
Line Loss	41, 42, 43	• Line distortion • High impedance connection	• Check supply voltage for capability to start/stop motor • Check for loose connections on line side or motor side of power wires

[1] Prestart fault indication.

Table 8.B Motor Will Not Start — No Output Voltage to the Motor

Display	Possible Causes	Possible Solutions
Fault displayed	• See fault description	• See Table 9.A addressing fault conditions
Display is blank	• Control voltage is absent • Failed control module	• Check control wiring and correct if necessary • Replace control module • Cycle control power
Stopped 0.0 Amps	• Pilot devices • PF Enable input is open at terminal 13 • Input terminals are not wired correctly • Start-Stop control has not been enabled for the human interface module. • Control voltage • Failed control module	• Check wiring • Check wiring • Check wiring • Follow the instructions on pg 7-4...7-6 to enable control capability • Check control voltage • Replace control module
Starting	• Two or three power phases are missing	• Check power system

Table 8.C Motor Rotates (but does not accelerate to full speed)

Display	Possible Causes	Possible Solutions
Fault displayed	• See fault description	• See Table 8.A addressing fault conditions
Starting	• Mechanical problems • Inadequate Current Limit setting • Failed control module	• Check for binding or external loading and correct • Check motor • Adjust the Current Limit Level to a higher setting • Replace control module

Table 8.D Motor Stops While Running

Display	Possible Causes	Possible Solutions
Fault displayed	• See fault description	• See Table 9.A addressing fault conditions
Display is blank	• Control voltage is absent • Failed control module	• Check control wiring and correct if necessary • Replace control module
Stopped 0.0 Amps	• Pilot devices • Failed control module	• Check control wiring and correct if necessary • Replace control module
Starting	• Two or three power phases are missing • Failed control module	• Check power system • Replace control module

Table 8.E Miscellaneous Situations

Situation	Possible Causes	Possible Solutions
Motor current and voltage fluctuates with steady load	• Motor • Erratic Load	• Verify type of motor as a standard squirrel cage induction motor • Check load conditions
Erratic operation	• Loose connections	• Shut off **all** power to controller and check for loose connections
Accelerates too fast	• Starting time • Initial torque • Current limit setting • Kickstart	• Increase starting time • Lower initial torque setting • Decrease current limit setting • Lower kickstart time or turn off
Accelerates too slow	• Starting time • Initial torque • Current limit setting • Kickstart	• Decrease starting time • Increase initial torque setting • Increase current limit setting • Increase kickstart time or turn off
Fan does not operate	• Wiring • Failed fan(s)	• Check wiring and correct if necessary • Replace fan module
Motor stops too quickly with Soft Stop option	• Time setting	• Verify the programmed stopping time and correct if necessary
Motor stops too slowly with Soft Stop option	• Stopping time setting • Misapplication	• Verify the programmed stopping time and correct if necessary • The Soft Stop option is intended to **extend** the stopping time for loads that stop suddenly when power is removed from the motor.
Fluid surges with pumps still occur with the Soft Stop option	• Misapplication	• Soft Stop ramps voltage down over a set period of time. In the case of pumps, the voltage may drop too rapidly to prevent surges. A closed loop system such as Pump Control would be more appropriately suited.
Motor overheats	• Duty cycle	• Preset Slow Speed and Accu-Stop options: Extended operation at slow speeds reduces motor cooling efficiency. Consult motor manufacturer for motor limitations. • SMB Smart Motor Braking option: Check duty cycle. Consult motor manufacturer for motor limitations.
Motor short circuit	• Winding fault	• Identify fault and correct. • Check for shorted SCR; replace if necessary. • Ensure power terminals are secure.

Power Module Check

If a power module needs to be checked, use the applicable procedure that follows.

| **Attention** | To avoid shock hazard, disconnect main power before working on the controller, motor, or control devices such as Start/Stop push buttons. |

| **Attention** | Make sure that wires are properly marked and programmed parameter values are recorded. |

Shorted SCR Test

1. Using an ohmmeter, measure the resistance between the line and load terminals of each phase on the controller. (L1-T1, L2-T2, & L3-T3)

The resistance should be greater than 10,000 ohms.

Specifications

Functional Design Specifications

Standard Features

Installation	Power Wiring	Standard squirrel-cage induction motor or a Wye-Delta, six-lead motor.
	Control Wiring	2- and 3-wire control for a wide variety of applications.
Setup	Keypad	Front keypad and backlit LCD display.
Starting and Stopping Modes		● Soft Start ● Current Limit Start ● Dual Ramp ● Full Voltage ● Linear Speed Acceleration ● Preset Slow Speed ● Soft Stop
Protection and Diagnostics		Power loss, line fault, voltage unbalance, excessive start/hour, phase reversal, undervoltage, overvoltage, controller temp, stall, jam, open gate, overload, underload, communication fault.
Metering		A, V, kW, kWH, elapsed time, power factor, motor thermal capacity usage.
Alarm Contact		Overload, underload, undervoltage, overvoltage, unbalance, jam, stall, and ground fault
Status Indication		Stopped, starting, stopping, at speed, alarm, and fault.
Auxiliary Contacts		Four fully programmable contacts as normal/up-to-speed/external bypass/fault, alarm/network; (N.O./N.C.)

Optional Features

Pump Control		Helps reduce fluid surges in centrifugal pumping systems during starting and stopping period. Starting time is adjustable from 0...30 seconds. Stopping time is adjustable from 0...120 seconds.
Braking Control	SMB Smart Motor Braking option	Provides motor braking without additional equipment for applications that require the motor to stop quickly. Braking current is adjustable from 0...400% of the motor's full load current rating.
	Accu-Stop	Provides controlled position stopping. During stopping, braking torque is applied to the motor until it reaches preset slow speed (7% or 15% of rated speed) and holds the motor at this speed until a stop command is given. Braking torque is then applied until the motor reaches zero speed. Braking current is programmable from 0...450% of full load current.
	Slow Speed with Braking	Used on applications that require slow speed (in the forward direction) for positioning or alignment and also require braking control to stop.

Electrical Ratings

	Device Rating	UL/CSA/NEMA	IEC
Power Circuit			
Rated Operation Voltage	480V	200...480V AC (-15%, +10%)	200...415V
	600V	200...600V AC (-15%, +10%	200...500V
Rated Insulation Voltage	480V	N/A	500V
	600V		500V
Related Impulse Voltage	480V	N/A	6000V
	600V		
Dielectric Withstand	480V	2200V AC	2500V
	600V		
Repetitive Peak Inverse Voltage Rating	480V	1400V	1400V
	600V	1600V	1600V
Operating Frequency	All	47…63 Hz	47…63 Hz
Utilization Category	5...480 A	MG 1	AC-53B: 3.0-50: 1750
	625...1250A	MG 1	AC-53B: 3.0-50: 3550
Protection Against Electrical Shock	5...85 A	N/A	IP20
	108...480 A	N/A	IP2X (with terminal covers)
	625...1250 A	N/A	IP00 (open Device)
DV/DT Protection	480V & 600V	RC Snubber Network	
	690V	None	
Transistent Protection	480 V & 600V	Metal Oxide Varistors: 220 Joules	
Control Circuit			
Rated Operation Voltage	5..480 A	100..240V AC or 24V AC/DC	
	625...1250 A	110/120V AC or 230/240V AC	
Rated Insulation Voltage	All	N/A	240V
Rated Impulse Voltage	All	N/A	3000V
Dielectric Withstand	All	1600V AC	2000V
AC Operating Frequency	All	47…63 Hz	
Logic input on-state voltage-minimum		85V AC, 19.2V DC / 20.4V AC	
Logic input on-state current		20 mA @120V AC/ 40 mA @ 240V AC, 7.6 mA @ 24V AC/DC	
Logic input off-state voltage maximum		50V AC, 10V DC / 12V AC	
Logic input off-site current @ input off-state voltage		<10 mA AC, <3 mA DC	

Short Circuit Protection		Type 1					
SCCR Performance 200...600V		Non Time-Delay Fuse		Circuit Breaker		Time-Delay Fuse	
SCCR List ①		Max. Std. Available Fault	Max. Std. Fuse (A) ②	Max. Std. Available Fault	Max. Circuit Breaker (A)	Max. High Fault	Max.Fuse (A) ③
Line Device Operational Current Rating (A)	5	5 kA	20	5 kA	20	70 kA	10
	25	5 kA	100	5 kA	100	70 kA	50
	43	10 kA	150	10 kA	150	70 kA	90
	60	10 kA	225	10 kA	225	70 kA	125
	85	10 kA	300	10 kA	300	70 kA	175
	108	10 kA	400	10 kA	300	70 kA	200
	135	10 kA	500	10 kA	400	70 kA	225
	201	18 kA	600	18 kA	600	70 kA	350
	251	18 kA	700	18 kA	700	70 kA	400
	317	30 kA	800	30 kA	800	69 kA	500
	361	30 kA	1000	30 kA	1000	69 kA	600
	480	42 kA	1200	42 kA	1200	69 kA	800
	625	42 kA	1600	42 kA	1600	74 kA	1600
	780	42 kA	1600	42 kA	2000	74 kA	1600
	970	85 kA	2500	85 kA	2500	85 kA	2500
	1250	85 kA	3000	85 kA	3200	85 kA	3000
Delta Device Operational Current Rating (A)	8.7	5 kA	35	5 kA	35	70 kA	18.
	43	5 kA	150	5 kA	150	70 kA	90
	74	10 kA	300	10 kA	300	70 kA	150
	104	10 kA	400	10 kA	400	70 kA	200
	147	10 kA	400	10 kA	400	70 kA	200
	187	10 kA	600	10 kA	500	70 kA	300
	234	10 kA	700	10 kA	700	70 kA	400
	348	18 kA	1000	18 kA	1000	70 kA	600
	435	18 kA	1200	18 kA	1200	70 kA	800
	549	30 kA	1600	30 kA	1600	69 kA	1000
	625	30 kA	1600	30 kA	1600	69 kA	1200
	831	42 kA	1600	30 kA	1600	69 kA	1600
	850	42 kA	1600	42 kA	2000	74 kA	1600
	900	42kA	1600	42 kA	2000	74 kA	1600
	1200	85 kA	3000	85 kA	3200	85 kA	3000
	1600	85 kA	3000	85 kA	3200	85 kA	3000

SCCR Performance 690V		Type 1		
SCCR List ①		Max. Std. Available Fault	Max. Ampere Tested - North American Style	Max. Ampere Tested - European Style
Maximum FLC Device Rating (A)	108	70 kA	A070URD33xxx500	6,9 gRB 73xxx400 6,6URD33xxx500
	135	70 kA	A070URD33xxx500	6,9 gRB 73xxx400 6,6URD33xxx500
	201	70 kA	A070URD33xxx700	6,9 gRB 73xxx630 6,6URD33xxx700
	251	70 kA	A070URD33xxx700	6,9 gRB 73xxx630 6,6URD33xxx700
	317	70 kA	A070URD33xxx900	6,9 gRB 73xxx800 6,6URD33xxx900
	361	70 kA	A070URD33xxx900	6,9 gRB 73xxx800 6,6URD33xxx900
	480	70 kA	A070D33xxx1250 A100URD73xxx1250	9 URD 73xxx1250 6,6URD33xxx1250
	625	70 kA	A070URD33xxx1400	6,6URD33xxx1400
	780	70 kA	A070URD33xxx1400	6,6URD33xxx1400
	970	85 kA	2 fuses in parallel A070URD33xxx1250	2 fuses in parallel 6,6URD33xxx1250
	1250	85 kA	2 fuses in parallel A070URD33xxx1250	2 fuses in parallel 6,6URD33xxx1250

① Consult local codes for proper sizing of short circuit protection
② Non-time delay fuses: Class K5 - 5...480 (8.7...831) A devices,
   Class L - 625...1250 (850...1600) A devices.
③ High capacity fault rating when used with time delay class CC, J, or L fuses.

Power Requirements

Control Module, 1...480 A	120...240V AC	Transformer	75 VA
	24V AC	Transformer	130 VA
	24V DC	Inrush Current	5 A
		Inrush Time	250 ms
		Transistent Watts	60 W
		Transistent Time	500 ms
		Steady State Watts	24 W
		Minimum Allen-Bradley Power Supply	1606-XLP50E
Control Module, 625...1250 A	751 VA (recommended 800 VA)		
Heatsink Fan(s) A ①	5..135 A, 20 VA 201...251 A, 40 VA 317...480 A, 60 VA 625...1250 A, 150 VA		

Steady State Heat Dissipation with Control and Fan Power (W)

Controller Rating (A)	5	70
	25	70
	43	81
	60	97
	85	129
	108	91
	135	104
	201	180
	251	198
	317	225
	361	245
	480	290
	625	446
	780	590
	970	812
	1250	1222

Auxiliary Contacts
- 19/20 Aux #1
- 29/30 Aux #2
- 31/32 Aux #3
- 33/34 Aux #4

Type of Control Circuit	Electromagnetic relay
Number of Contacts	1
Type of Contacts	programmable N.O./N.C.
Type of Current	AC
Rated Operational Current	3A @ 120V AC, 1.5 A @240V AC
Conventional Thermal Current Ith	5 A
Make/Break VA	3600/360
Utilization Category	AC-15 / DC

PTC Input Ratings

Response Resistance	$3400\ \Omega \pm 150\ \Omega$
Reset Resistance	$1600\ \Omega \pm 100\ \Omega$
Short-Circuit Trip Resistance	$25\ \Omega \pm 10\ \Omega$
Max. Voltage at PTC Terminals (R_{PTC} = 4 k)	< 7.5V
Max. Voltage at PTC Terminals (R_{PTC} = open)	30V
Max. No. of Sensors	6
Max. Cold Resistance of PTC Sensor Chain	$1500\ \Omega$
Response Time	800 ms
Tach Input	0...5V DC, 4.5V DC = 100% Speed

① For devices rated 5...480 A, heatsink fans can be powered by either 110/120V AC or 220/240V AC.
 For devices rated 625...1250 A, heatsink fan power is sourced internally, based on supplied power.

Environmental

Operating Temperature Range	-5...50°C (23...122°F) (open) -5...40°C (23...104°F) (enclosed)
Storage and Transportation Temperature Range	-20...+75°C
Altitude	2000 m (6560 ft) ①
Humidity	5.95% (non-condensing)
Pollution Degree	2

① The product's allowable operational ambient temperature must be derated by -3 °C (-27°F) per 1000 m (3280 ft.). Maximum operating altitude is 7000 m (23,000 ft.). Current rating of the PF Softstarter does not change for altitudes that require a lower maximum ambient temperature.

Mechanical

Resistance to Vibration	Operational	All	1.0 G Peak, 0.15 mm (0.006 in.) displacement
	Non-Operational	5...480 A	2.5 G, 0.38 mm (0.015 in.) displacement
		625...1250 A	1.0 G, 0.15 mm (0.006 in.) displacement
Resistance to Shock	Operational	5...85 A	15 G
		108...480 A	5.5 G
		625...1250 A	4 G
	Non-Operational	5...85 A	30 G
		108...480 A	25 G
		625...1250 A	12 G
Construction	Power Poles	5…85	Heatsink thyristor modular design
		108…1250 A	Heatsink hockey puck thyristor modular design
	Control Modules		Thermoset and Thermoplastic Moldings
	Metal Parts		Plated Brass, Copper, or Painted Steel
Terminals	Power Terminals	5...85 A	Cable size ---- Line Upper — 2.5…95 mm^2 (14…3/0 AWG) Line Lower — 0.8…2.5 mm^2 (18…14 AWG) Load Upper — 2.5…50 mm^2 (14…1 AWG) Load Lower — 0.8…2.5 mm^2 (18…14 AWG) Tightening torque — 14.7 N•m (130 lb.-in.) Wire strip length — 18…20 mm (0.22...0.34 in.)
		108…135 A	One M10 x 1.5 diameter hole per power pole
		201…251 A	Two M10 x 1.5 diameter holes per power pole
		317…480 A	Two M12 x 1.75 diameter holes per power pole
		625...1250 A	Two 13.5 mm (0.53 in.) diameter holes per power pole
	Power Terminal Markings		NEMA, CENELEC EN50 012
	Control Terminals		M 3 screw clamp: clamping yoke connection

Other

EMC Emission Levels	Conducted Radio Frequency Emissions		Class A	
	Radiated Emissions		Class A	
EMC Immunity	Electromagnetic Discharge		8 kV Air Discharge	
Levels	Radio Frequency		Per EN/IEC 60947-4-2	
	Electrostatic Field			
	Fast Transient		Per EN/IEC 60947-4-2	
	Surge Transient		Per EN/IEC 60947-4-2	
Overload	Current Range		Line	Delta
Characteristics		5	1...5	1.7...9
		25	5...25	8.6...43
		43	8.6...43	14.8...75
		60	12...60	20.8...104
		85	17...85	29.4...147
		108	27...108	47...187
		135	34...135	59...234
		201	67...201	116...348
		251	84...251	145...435
		317	106...317	183...549
		361	120...361	208...625
		480	160...480	277...831
		625	208...625	283...850
		780	260...780	300...900
		970	323...970	400...1200
		1250	416...1250	533...1600
	Trip Classes		10, 15, 20, and 30	
	Trip Current Rating		117% of Motor FLC	
	Number of Poles		3	
Certifications	Open Type Controllers		CE Marked Per Low Voltage Directive	
			73/23/EEC, 93/68/EEC	
			UL Listed (File No. E195687)	

Approximate Dimensions and Shipping Weights

Open Type Controllers

Dimensions are in millimeters (inches). Dimensions are not intended for manufacturing purposes.

Controller Rating (A)	Height	Width	Depth	Approximate Shipping Weight
5…85	321 (12.6)	150 (5.9)	203 (8.0)	5.7 kg (12.6 lb.)
108…135	443.7 (17.47)	196.4 (7.74)	205.2 (8.08)	15.0 kg (33 lb.)
201…251	560 (22.05)	225 (8.86)	253.8 (9.99)	30.4 kg (67 lb.)
317…480	600 (23.62)	290 (11.42)	276.5 (10.89)	45.8 kg (101 lb.)
625...780	1041.1 (41.0)	596.9 (23.5)	346.2 (13.63)	179 kg (395 lb.)
970...1250	1041.1 (41.0)	596.9 (23.5)	346.2 (13.63)	224 kg (495 lb.)

Enclosed Type Line-Connected Controllers

Factory-installed options may affect enclosure size requirements. Exact dimensions can be obtained after order entry. Consult your local Sprecher + Schuh representative.

Controller Rating (A)	Disconnect Rating (A)	IP65 (Type 4/12)		
		B Height	A Width	C Depth
Non-Combination Controller				
5	—	610 (24)	508 (20)	254 (10)
25	—	610 (24)	508 (20)	254 (10)
43	—	610 (24)	508 (20)	254 (10)
60	—	610 (24)	508 (20)	254 (10)
85	—	610 (24)	508 (20)	254 (10)
108	—	762 (30)	610 (24)	305 (12)
135	—	762 (30)	610 (24)	305 (12)
201	—	914 (36)	762 (30)	406 (16)
251	—	914 (36)	762 (30)	406 (16)
317	—	1524 (60)	914 (36)	406 (16)
361	—	1524 (60)	914 (36)	406 (16)
480	—	1524 (60)	914 (36)	406 (16)
625	—	2286 (90)	1829 (72)	508 (20)
780	—	2286 (90)	1829 (72)	508 (20)
970 ①	—	2286 (90)	1829 (72)	508 (20)
1250 ①	—	2286 (90)	1829 (72)	508 (20)

① 970...1250 rated devices are only available as Type 1 and require a door-mounted fan, capable of delivering 240 cfm.

Enclosed Type Line-Connected Controllers, Continued

Approximate Dimensions ④

Controller Rating (A)	Disconnect Rating (A)	IP65 (Type 4/12)		
		B Height	A Width	C Depth
Combination Controllers with Fusible Disconnect				
5	30 A/J	610 (24)	508 (20)	254 (10)
25	30 A/J	610 (24)	508 (20)	254 (10)
43	60 A/J	610 (24)	508 (20)	254 (10)
60	100 A/J	610 (24)	508 (20)	254 (10)
85	100 A/J	610 (24)	508 (20)	254 (10)
108	200 A/J	914 (36)	762 (30)	406 (16)
135	200 A/J	914 (36)	762 (30)	406 (16)
201	400 A/J	1219 (48)	914 (36)	406 (16)
251	400 A/J	1219 (48)	914 (36)	406 (16)
317	600 A/J	1524 (60)	914 (36)	406 (16)
361	600 A/J	1524 (60)	914 (36)	406 (16)
480 ①	600 A/J	1524 (60)	914 (36)	406 (16)
480 ②	800 A/L	2286 (90)	508 (20)	508 (20)
625	—	2286 (90)	1829 (72)	508 (20)
780	—	2286 (90)	1829 (72)	508 (20)
970 ③	—	2286 (90)	1829 (72)	508 (20)
1250 ③	—	2286 (90)	1829 (72)	508 (20)
Combination Controllers with Circuit Breaker				
5	15 A	610 (24)	508 (20)	254 (10)
25	30 A	610 (24)	508 (20)	254 (10)
43	80 A	610 (24)	508 (20)	254 (10)
60	100 A	610 (24)	508 (20)	254 (10)
85	125 A	610 (24)	508 (20)	254 (10)
108	175 A/175 A Plug	914 (36)	762 (30)	406 (16)
135	225 A/225 A Plug	914 (36)	762 (30)	406 (16)
201	300 A/300 A Plug	1219 (48)	914 (36)	406 (16)
251	400 A/400 A Plug	1219 (48)	914 (36)	406 (16)
317	600 A/500 A Plug	1524 (60)	914 (36)	406 (16)
361	600 A/600 A Plug	1524 (60)	914 (36)	406 (16)
480	800 A/800 A Plug	1524 (60)	914 (36)	406 (16)
625	—	2286 (90)	1829 (72)	508 (20)
780	—	2286 (90)	1829 (72)	508 (20)
970 ③	—	2286 (90)	1829 (72)	508 (20)
1250 ③	—	2286 (90)	1829 (72)	508 (20)

① Use this row for 460V -58 and 575V -59.

② Use this row for 460V -59 and 575 -60 and -61.

③ 970...1250 rated devices are only available as Type 1 and require a door-mounted fan, capable of delivering 240 cfm.

④ These dimensions are to be considered the recommended minimal enclosure dimensions and do not represent actual Sprecher + Schuh assembled product dimensions. Consult your local Sprecher + Schuh representative for details.

Parameter Information

Table B.1 Parameter List

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Metering	Volts Phase A-B	1	Volt			Provides the three phase-to-phase supply voltage measurements at all times, including bypass operation.	
Metering	Volts Phase B-C	2	Volt			Provides the three phase-to-phase supply voltage measurements at all times, including bypass operation.	
Metering	Volts Phase C-A	3	Volt			Provides the three phase-to-phase supply voltage measurements at all times, including bypass operation.	
Metering	Current Phase A	4	Amps			Provides the three phase motor current measurement. This measurement is always line current regardless of the motor connection (Wye or Delta).	
Metering	Current Phase B	5	Amps			Provides the three phase motor current measurement. This measurement is always line current regardless of the motor connection (Wye or Delta).	
Metering	Current Phase C	6	Amps			Provides the three phase motor current measurement. This measurement is always line current regardless of the motor connection (Wye or Delta).	
Metering	Watt Meter	7	KW/MW			Provides the power usage of the connected motor. This value is calculated from the voltage, current and power factor measurements.	
Metering	Kilowatt Hours	8	KWH/MWH			Provides the power usage over time of the connected motor.	
Metering	Elapsed Time	9	Hours			Indicates the total time of motor operation in hours. The accumulated time is updated continuously during run time.	
Metering	Meter Reset	10		NO ETM Reset KWH Reset	NO	Provides the user the capability to reset the value stored in the elapsed time (9) and kilowatt hours (8) meters to zero.	
Metering	Power Factor	11		0.00…0.99		Provides the operational displacement power factor measurement of the connected motor.	
Metering	Mtr Therm Usage	12	%MTU	0…100		Provides the theoretical model of motor heating as a percentage value. At 100% MTU, the controller will fault on overload. This model is based on the motor thermal overload calculation.	
Metering	Motor Speed	13	%	0…100		Indicates the operating percentage of motor base speed when linear ramp is selected and an external tachometer is used.	

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Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Basic Set Up	PF Option	14		Standard Brake Pump Control		This a "read-only" parameter that identifies to the user the type of control module installed.	
Basic Set Up	Motor Connection	15		Line/Delta	Line	This parameter allows the user the ability to select the power wiring configuration of the attached motor (WYE or DELTA). A fault controlled means of disconnecting the line should always be use in the DELTA mode.	
Basic Set Up	Line Voltage	16	Volt	0…10000	480	This parameter sets the base voltage for the under / over voltage protective features. For medium voltage applications the controller has internal capabilities set of multipliers that correspond to the line voltage dividers.	
Basic Set Up	Starting Mode	17		Full Voltage Current Limit Soft Start Linear Speed Pump Start	Soft Start	Allows the user to select the type of start provided with controller configuration.	
Basic Set Up	Ramp Time	18	Secs	0…30	10	Allows the user to program the time (0…30 s) that the controller performs the starting maneuver. The starting maneuver will automatically transition to bypass and full voltage if the controller senses that the motor has reached full speed prior to the ramp time completion. Also refer to Parameter 129.	
Basic Set Up	Initial Torque	19	%LRT	0…90	70	When using the soft start mode, this parameter allows the user to adjust the initial torque level applied to the motor at the beginning of the start maneuver.	
Basic Set Up	Cur Limit Start Level	20	%FLC	50…600	350	When using the current limit starting mode, this parameter allows the user to adjust the current level applied to the motor during the start maneuver.	
Basic Set Up	Reserved	21				Reserved	
Basic Set Up	Kickstart Time	22	Secs	0.0…2.0	0.0	When programmed with a non-zero value, this parameter provides a torque pulse for the programmed time period at the beginning of the starting maneuver (0.0…2.0 s).	
Basic Set Up	Kickstart Level	23	%LRT	0…90	0	When the Kickstart Time is programmed, this parameter provides the user with the ability to set the level of the torque pulse applied to the motor (approx. 0…90%).	
Basic Set Up	Option Input 2	24		Disable Preset Slow Speed Dual Ramp Fault Fault NC Network Clear Fault	Disable	Provides the user with the ability to define the function of option Input #2 (disable, coast, stop option, fault, fault N.C., network).	

Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Dual Ramp	Starting Mode 2	25		Full Voltage Current Limit Soft Start Linear Speed Pump Start	Soft Start	When the dual ramp mode is selected, this parameter allows the user to select the type of ramp mode used for the second ramp profile.	
Dual Ramp	Ramp Time 2	26	Secs	0…30	10	When the dual ramp mode is selected, this parameter allows the user to program the time (0…30 s) that the controller performs the starting maneuver for profile #2. Also refer to Parameter 130.	
Dual Ramp	Initial Torque 2	27	%LRT	0…90	70	When using the soft start mode for profile #2, this parameter allows the user to adjust the initial torque level applied to the motor at the beginning of the start maneuver.	
Dual Ramp	Cur Limit Level 2	28	%FLC	50…600	350	When using the current limit starting mode for profile #2, this parameter allows the user to adjust the current level applied to the motor during the start maneuver.	
Dual Ramp	Reserved	29				Reserved	
Dual Ramp	Kickstart Time 2	30	Secs	0.0…2.0	0.0	This parameter provides a torque pulse for the programmed time period at the beginning of the starting maneuver for ramp profile #2.	
Dual Ramp	Kickstart Level2	31	%LRT	0…90	0	This parameter provides the user with the ability to set the level of the torque pulse applied to the motor (approx. 0 to 90%) for ramp profile #2	
Basic Set Up	Stop Mode	32		Soft Stop Linear Speed Smart Brake Accu-Stop	Soft Stop	Allows the user to select the type of stop provided with the installed controller.	
Basic Set Up	Stop Time	33	Secs	0…120	0	Allows the user to select the length of stopping time when a stopping mode is selected.	
Linear List	Pump Pedestal	34				(Only available with Pump Control option) Allows the ability to manually adjust the pump algorithm slightly for different applications. The purpose of this parameter is to allow the pump stop algorithm to be more aggressive earlier in the ramp. If experiencing overload trips during stopping, either reduce the stopping time or try increasing this by units of 5. Try not to exceed a value of 40.	

.Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Basic Set Up/ Accu-Stop	Braking Current	35	%FLC	0…400	0	When the Smart Motor Braking option is installed, this parameter allows the user the ability to adjust the braking current level applied to the motor. Smart Motor Braking and Accu-Stop has the capability to apply braking current to the motor from the "at speed" condition. With Smart Motor Braking, the braking maneuver continues until the motor comes to rest, at which point the controller automatically ceases braking action. Note that high braking currents can introduce excessive vibration to the motor couplings and/or gearing and additional heating in the motor.	
Linear List	Braking Time (SMB)	36 ③	Sec	0…999	0	This parameter provides the ability to over-ride the SMB function (zero-speed detection) and set an exact time in which the braking current is applied to the motor. This can be used for applications where detecting zero speed is difficult or when the purpose is to reduce the number of overload trips associated with driving the motor to a complete stop. Setting this to a specific value will turn off the braking at a set time, each time a stopping maneuver is performed. An ideal setting can be accomplished through trial and error and should always allow for some small coast time. Setting this value to long will cause braking current to be applied to a stopped motor and likely result in overload trips.	
Linear List	Load Type (SMB)	37 ③		0 - Standard 1 - Hi Inertia 2 - Hi Friction 3 - Ramp 89	0 - Standard	Allows the user the ability to modify the braking profile to match a particular load type. This parameter is designed to only be used with the SMB algorithm and not with timed brake. For the majority of applications the standard profile will work sufficiently. Adjusting this parameter should really only be used when some type of problem during braking is being encountered.	
Linear List	High Eff Brake (SMB)	38 ③	% of Stopping Time	0…99	0	This parameter is used to extend the SMB braking time by a percentage of the typical stopping time. The need to adjust this parameter can occur when braking is applied to high efficiency motors and relates to the counter EMF produced by these motors. This setting should never really exceed 50%. Nuisance overload faults will likely occur is set incorrectly.	

③ This parameter is not viewable without entering a special password in Firmware versions 4.001 or earlier. Contact Sprecher + Schuh technical support if you have Version 4.001 firmware or earlier and need to access this parameter.

.Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Preset SS/ Accu-Stop	Slow Speed Sel	39		SS Low SS High	SS High	When this option is used, this parameter provides the user the ability to select between the "Low" and "High" settings for both the Preset Slow Speed and Accu-Stop control options.	
Preset SS/ Accu-Stop	Slow Speed Dir	40		SS FWD SS REV	SS FWD	Provides the user the ability to program the motor's direction of rotation. Note that with the Preset Slow Speed option, the controller has the capability to operate the motor in the reverse direction during slow speed operation without the use of a reversing contactor.	
Preset SS/ Accu-Stop	Slow Accel Cur	41	%FLC	0…450	0	Provides the user the ability to program the current to slow speed operation for both the Preset Slow Speed and Accu-Stop control options. This setting is typically load dependent.	
Preset SS/ Accu-Stop	Slow Running Cur	42	%FLC	0…450	0	Provides the user the ability to program the operating current of slow speed operation for both the Preset Slow Speed and Accu-Stop control options. This setting is typically load dependent.	
Accu-Stop	Stopping Current	43	%FLC	0…400	0	Provides adjustment capability for the braking intensity from slow speed operation to the "stopped" condition for the Accu-Stop control option.	
Basic Set Up/ Overload	Overload Class	44		Disable Class 10 Class 15 Class 20 Class 30	Class 10	Allows the user to select the time-to-trip for the built-in overload. This selection is based on the type of motor being used and the application it is being applied too.	
Basic Set Up/ Overload	Service Factor	45		0.01…1.99	1.15	This motor nameplate value is used to determine the ultimate overload trip current.	
Basic Set Up/ Overload	Motor FLC	46	Amps	1.0…2200.0 ①	1.0	Sets the base current for use with all the current based protection features (jam, over / under load, motor overload). The motor nameplate FLA is to be used regardless of the configuration WYE or DELTA.	
Basic Set Up/ Overload	Overload Reset	47		Manual Auto	Manual	Allows the user to select between an auto and manual reset mode for all Overload faults.	

① Devices rated 625…1250 Amps are only programmable to the whole digit ampere. There are no decimal points for any current based parameters.

.Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Linear List	OL Shunt Time	48 ③	Sec	0…999	0	This parameter prevents the overload from accumulating or incrementing the Motor Thermal Usage (%MTU) during the programmed "shunt" time. This function is allowable under some electrical codes for loads which have long acceleration times (i.e. High inertia). As a general rule of thumb, this time should never exceed the programmed start time. Setting this parameter longer than necessary can result in motor overheating that is not being accounted for in the thermal model.	
Linear List	OL Trip Enable/ Disable	49 ③		0= Disable 1= Enable	Enable	This parameter disables the overload from tripping during slow speed, pump stopping, and braking maneuvers. Motor Thermal Usage (%MTU) continues to increment during these maneuvers. Setting this parameter to disable can result in motor overheating or potential damage.	
Overload	Overload A Lvl	50	%MTU	0…100	0	Allows the user to set an overload level (% of motor thermal usage) that will cause an alarm when the level exceeds the setting.	
Underload	Underload F Lvl	51	%FLC	0…99	0	Allows the user to set a current (% of line FLC) that will cause a fault when the motor current falls below this value. A zero value is the "off" setting.	
Underload	Underload F Dly	52	Secs	0…99	0	Allows the user the ability to prevent some nuisance faults by entering a delay period that provides a window that the motor current condition must persist within for the controller to fault.	
Underload	Underload A Lvl	53	%FLC	0…99	0	Allows the user to set a current (% of line FLC) that will cause an Alarm when the motor current falls below this value. A zero value is the "off" setting.	
Underload	Underload A Dly	54	Secs	0…99	0	Allows the user the ability to prevent some nuisance Alarm conditions by entering a delay period that provides a window that the motor current condition must persist within for the controller to Alarm.	
Under-voltage	Undervolt F Lvl	55	%V	0…99	0	Allows the user to set a voltage (% of line Voltage) that will cause a fault when the voltage falls below this value. A zero value is the "off" setting.	
Under-voltage	Undervolt F Dly	56	Secs	0…99	0	Allows the user the ability to prevent some nuisance faults by entering a delay period that provides a window that the voltage condition must persist within for the controller to fault.	

③ This parameter is not viewable without entering a special password in Firmware versions 4.001 or earlier. Contact Sprecher + Schuh technical support if you have Version 4.001 firmware or earlier and need to access this parameter.

.Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Under-voltage	Undervolt A Lvl	57	%V	0…99	0	Allows the user to set a voltage (% of line Voltage) that will cause an Alarm when the voltage falls below this value. A zero value is the "off" setting.	
Under-voltage	Undervolt A Dly	58	Secs	0…99	0	Allows the user the ability to prevent some nuisance Alarms by entering a delay period that provides a window that the voltage condition must persist within for the controller to Alarm.	
Over-voltage	Overvolt F Lvl	59	%V	0…199	0	Allows the user to set a voltage (% of line Voltage) that will cause a fault when the voltage falls above this value. A zero value is the "off" setting.	
Over-voltage	Overvolt F Dly	60	Secs	0…99	0	Allows the user the ability to prevent some nuisance faults by entering a delay period that provides a window that the voltage condition must persist within for the controller to fault.	
Over-voltage	Overvolt A Lvl	61	%V	0…199	0	Allows the user to set a voltage (% of line Voltage) that will cause an Alarm when the voltage falls above this value. A zero value is the "off" setting.	
Over-voltage	Overvolt A Dly	62	Secs	0…99	0	Allows the user the ability to prevent some nuisance Alarms by entering a delay period that provides a window that the voltage condition must persist within for the controller to Alarm.	
Unbalance	Unbalance F Lvl	63	%V	0…25	0	Allows the user to set a percentage of line to line Voltages that will cause a fault when the voltage falls above this value. A zero value is the "off" setting.	
Unbalance	Unbalance F Dly	64	Secs	0…99	0	Allows the user the ability to prevent some nuisance faults by entering a delay period that provides a window that the voltage unbalance condition must persist within for the controller to fault.	
Unbalance	Unbalance A Lvl	65	%V	0…25	0	Allows the user to set a percentage of line to line Voltages that will cause an Alarm when the voltage falls above this value. A zero value is the "off" setting.	
Unbalance	Unbalance A Dly	66	Secs	0…99	0	Allows the user the ability to prevent some nuisance Alarms by entering a delay period that provides a window that the voltage unbalance condition must persist within for the controller to Alarm.	
Jam	Jam F Lvl	67	%FLC	0…1000	0	Allows the user to set an instantaneous over current level (% of line FLC) that will cause a fault. A zero value is the "off" setting.	
Jam	Jam F Dly	68	Secs	0…99	0	Allows the user the ability to prevent some nuisance faults by entering a delay period that provides a window that the motor over current condition must persist within for the controller to fault.	

.Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Jam	Jam A Lvl	69	%FLC	0…1000	0	Allows the user to set an instantaneous over current level (% of line FLC) that will cause an Alarm. A zero value is the "off" setting.	
Jam	Jam A Dly	70	Secs	0…99	0	Allows the user the ability to prevent some nuisance Alarms by entering a delay period that provides a window that the motor over current condition must persist within for the controller to Alarm.	
Stall	Stall Delay	71	Secs	0.0…10.0	0	This feature allows the user to program the amount of time beyond the initial start maneuver for the motor to be at speed. A setting of zero means that the stall detection feature is disabled.	
Ground Fault	Gnd Flt Enable	72		Disable Enable	Disable	Enables ground fault protection when used with an external core balanced ground fault sensor.	
Ground Fault ②	Gnd Flt Level	73	Amps	1.0…5.0 ②	2.5 ②	Allows the user to set a current (core balance current) that will cause a fault when the current is above this value.	
Ground Fault	Gnd Flt Delay	74	Secs	0.1…250.0	0.5	Allows the user the ability to prevent some nuisance faults by entering a delay period that provides a window that the ground fault condition must persist within for the controller to fault.	
Ground Fault	Gnd Flt Inh Time	75	Secs	0…250	10	Allow the user the ability to disable/inhibit ground fault protection for a selected time when starting.	
Ground Fault	Gnd Flt A Enable	76		Disable Enable	Disable	Enables a ground fault protection Alarm when used with an external core balanced ground fault sensor.	
Ground Fault ②	Gnd Flt A Lvl	77	Amps	1.0…5.0 ②	2.0 ②	Allows the user to set a current (core balance current) that will cause an Alarm when the current is above this value.	
Ground Fault	Gnd Flt A Dly	78	Secs	0…250	10	Allows the user the ability to prevent some nuisance Alarms by entering a delay period that provides a window that the ground fault condition must persist within for the controller to Alarm.	
PTC	PTC Enable	79		Disable Enable	Disable	Enables PTC based over-temperature protection when used with external PTC sensors.	
Phase Reversal	Phase Reversal	80		Disable Enable	Disable	Allows the user to prevent starting if the incoming line phase sequence is not correct. The incoming power lines are expected to be in an ABC sequence. The controller will fault if power lines are out of the ABC sequence.	
Restart	Starts Per Hour	81		0…99		Limits the number of starts that can occur in a one-hour period. This feature includes a "sliding window" for the one-hour time period.	

② The 625, 780, 970, and 1250 A units the min./max. is 5.0.…25 and the default value is 5.0 Amps.

.**Table B.1 Parameter List (Continued)**

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Restart	Restart Attempts	82		0…5	0	Allows the user to enable the PF Softstarter to auto-restart for up-to 5 attempts, other than an SCR overtemp or motor overload fault. The start signal must remain active for a restart to occur.	
Restart	Restart Delay	83	Secs	0…60	0	Provides a delay time between restart attempts to allow for the condition to be removed.	
Linear List	Line Fault Disable	84 ③		0 = Disable 1 = Disable F1 2 = Disable F41 3 = Enable	Enable	This parameter gives the user the ability to selectively disable specific fault codes such as F1, F2, F3 and F41, F42, F43. These faults are used to detect problems with incoming power and the detection of appropriate zero crosses (F1) or the firing of the SCRs based on the current and voltage characteristics associated with the SCR turning off (F41). These faults can only occur during starting or stopping and are usually related to the incoming power condition.	
Linear List	Emergency Run	85 ③		0 = Disable 1 = Enable	Disable	This parameter defeats all running faults and is only effective in the "run" mode. It will not override faults prior to starting (i.e. shorted SCR). This parameter is reset to "off/disable" when control power is recycled.	
Linear List	Current Loss	86 ③		0 = Disable 1 = Enable	Enable	This parameter allows the user to override a current loss fault. This is indicative of the typical failure mode of a damaged CT.	
Comm Masks	Logic Mask	87		8-bit binary	0	Allows the user to enable or disable control from various serial interface ports (DPI) with a "0" setting. If a port is set to "1", the port will be allowed to control the PF and will produce a comm. fault if disconnected.	
DataLinks	Data In A1	88			0	16 bit Datalink	
DataLinks	Data In A2	89			0	16 bit Datalink	
DataLinks	Data In B1	90			0	16 bit Datalink	
DataLinks	Data In B2	91			0	16 bit Datalink	
DataLinks	Data In C1	92			0	16 bit Datalink	
DataLinks	Data In C2	93			0	16 bit Datalink	
DataLinks	Data In D1	94			0	16 bit Datalink	
DataLinks	Data In D2	95			0	16 bit Datalink	
DataLinks	Data Out A1	96			0	16 bit Datalink	
DataLinks	Data Out A2	97			0	16 bit Datalink	
DataLinks	Data Out B1	98			0	16 bit Datalink	
DataLinks	Data Out B2	99			0	16 bit Datalink	
DataLinks	Data Out C1	100			0	16 bit Datalink	
DataLinks	Data Out C2	101			0	16 bit Datalink	
DataLinks	Data Out D1	102			0	16 bit Datalink	
DataLinks	Data Out D2	103			0	16 bit Datalink	

③ This parameter is not viewable without entering a special password in Firmware versions 4.001 or earlier. Contact Sprecher + Schuh technical support if you have Version 4.001 firmware or earlier and need to access this parameter.

.Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Motor Data	Motor ID	104		0…65535	0	Allows the user the ability to assign a specific identification number to a motor and controller combination. This can be useful for network applications where you may need to locate a specific motor/controller based on a network address.	
Motor Data	CT Ratio	105		1…1500		Sets the proper current ratio when an external current transformer is used for Medium Voltage applications.	
Motor Data	MV Ratio	106		1…10000		Sets the proper feedback scaling when used for Medium Voltage applications.	
Basic Set Up	Aux1 Config	107		Normal Normal NC Up To Speed Up To Speed NC Fault Fault NC Alarm Alarm NC Network Network NC External Bypass	Normal	Allows the user the ability to configure each Auxiliary relay contact for a specific operation Note: Normal = PF in RUN	
Basic Set Up	Aux3 Config	108		Normal Normal NC Up To Speed Up To Speed NC Fault Fault NC Alarm Alarm NC Network Network NC External Bypass	Alarm	Allows the user the ability to configure each Auxiliary relay contact for a specific operation Note: Normal = PF in RUN	
Basic Set Up	Aux4 Config	109		Normal Normal NC Up To Speed Up To Speed NC Fault Fault NC Alarm Alarm NC Network Network NC External Bypass	Normal	Allows the user the ability to configure each Auxiliary relay contact for a specific operation Note: Normal = PF in RUN	

Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Basic Set Up	Aux2 Config	110		Normal Normal NC Up To Speed Up To Speed NC Fault Fault NC Alarm Alarm NC Network Network NC External Bypass	Fault	Allows the user the ability to configure each Auxiliary relay contact for a specific operation Note: Normal = PF in RUN	
Language	Language	111		English French Spanish German Portuguese Mandarin	English	Allows the user to change the text display to one of the available options.	
Linear List	Timed Start	112 ③		0 = Disable 1 = Enable	Disable	This parameter can be used to force the starting profile to complete its entire time period and ignore an early up-to-speed detection. The default is set to "Disabled", so that the PF can determine when the motor is at speed.	
Linear List	I Shut Off	113 ③	% current	0…37	0	This parameter adjusts the level of current at which the PF determines that the SCR has turned off. Since this parameter has the potential to modify the SCR control scheme, it is important that adjustments be made with the help of Technical Support.	
Linear List	UTS Level	114 ③	% up to speed	0…100	75	The PF has the ability to automatically determine if the motor is up to speed. If there is a problem with detecting the up-to-speed condition, this parameter can be modified to compensate. Rule of thumb is this number should be increased on high efficiency motors experiencing problems. If the PF is detecting the up-to-speed condition too late (or not at all) this number should be decreased on very low efficiency motors. **Note:** Be careful when adjusting this level. Improper adjustment can cause the PF to start at full voltage	
All	Parameter Mgmt	115		Ready Load Default	Ready	Allows the user to load factory default values for all parameters.	
Basic Set Up	Backspin Timer	116	Secs	0…999	0	(Only available with the Pump Control option) Ensures that a specific amount of time passes between a stop and start sequence.	

③ This parameter is not viewable without entering a special password in Firmware versions 4.001 or earlier. Contact Sprecher + Schuh technical support if you have Version 4.001 firmware or earlier and need to access this parameter.

Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Linear List	V Shut Off Level	117 ③	% V	0…100	25	This parameter provides the user with the ability to manually adjust the level for the controller's voltage shut off detection. Since this parameter has the potential to modify the SCR control scheme, it is important that adjustments be made with the help of Technical Support. It is important that you do not disable both parameter 113 and this one at the same time, otherwise SCR firing instability can occur.	
Linear List	OL Reset Level	118 ③	%	0…99	75	Sets the level at which the motor overload is allowed to be reset. Once the TCU% has dropped below the program level, the device can be reset manually or will auto reset if programmed for auto-reset operation.	
Linear List	Ambient Temperature	119 ③		0…60	50	Provides the ability to compensate for a lower or higher ambient temperature condition. The ambient temperature programmed should be representative of the actual nominal temperature (or worst case condition) since improper programming can result in nuisance tripping or SCR damage due to true SCR overheating.	
Linear List	Notch Position	120 ③	%	40.0…100.0	87.5	This parameter allows for the starting control algorithm to be manually modified. It is recommended that you do not make changes to this parameter without specifically talking with Technical Support.	
Linear List	Notch Maximum (pump control)	121 ③		50…70	70	This parameter allows for the pump stopping control algorithm to be manually modified. It is recommended that you do not make changes to this parameter without specifically talking with Technical Support.	
Linear List	Start Delay	122 ③	Sec	0…30	0	An internal on-delay timer. Ensures that a subsequent start can not be initiated for a preset amount of time	
Linear List	By-pass Delay	123 ③	Sec	0…15	0	For applications that routinely see fast spikes of current or overload conditions (more than 125% of the PF's frame rating) this parameter can be used to reduce the cycling between SCR and by-pass. This time delay parameter will allow the PF to stay under SCR control for the duration of time programmed.	
Linear List	Fault 1	124		0…255		Fault buffer #1 allows display of the current fault. A value of 0 indicates that there is no current fault.	
Linear List	Fault 2	125		0…255		Fault buffer #2 represents fault history of the device with fault #1 being the current fault and fault #5 being the oldest fault kept in memory.	

③ This parameter is not viewable without entering a special password in Firmware versions 4.001 or earlier. Contact Sprecher + Schuh technical support if you have Version 4.001 firmware or earlier and need to access this parameter.

Table B.1 Parameter List (Continued)

Group	Parameter Name	Parameter Number	Units	Min./ Max.	Default Settings	Parameter Description	User Settings
Linear List	Fault 3	126		0…255		Fault buffer #3 represents fault history of the device with fault #1 being the current fault and fault #5 being the oldest fault kept in memory.	
Linear List	Fault 4	127		0…255		Fault buffer #4 represents fault history of the device with fault #1 being the current fault and fault #5 being the oldest fault kept in memory.	
Linear List	Fault 5	128		0…255		Fault buffer #5 represents fault history of the device with fault #1 being the current fault and fault #5 being the oldest fault kept in memory.	
Linear List	Ramp Time E	129 ③	Sec	0…999	0	This parameter provides the user with the ability to extend the ramp time beyond the initial range of 0-30 seconds. To use this parameter, parameter 18 must be set to 0.	
Linear List	Ramp Time 2E	130 ③	Sec	0…999	0	Allows for the second ramp time to also be extended. To use this parameter, parameter 26 must be set to 0.	
Linear List	Stop Time E	131 ③	Sec	0…999	0	Allows the stop time be extended beyond the limit of 120 seconds. Parameter 33 must be set to 0 for this parameter to be active.	
Basic Set Up	Option Input 1	132		Disable Coast Stop Option Fault Fault NC Network	Stop Option	Provides the user with the ability to define the function of option Input #1.	
Basic Set Up	Stop Input	133		Coast Stop Option	Coast	Provides the user with the ability to define the function of the stop input.	
Linear List	Elapsed Time 2	134 ③	Hours	0.0/3000.0		This is an additional Elapsed Time Meter that cannot be reset by the user. It increments exactly as the Elapsed Time but cannot be reset.	

③ This parameter is not viewable without entering a special password in Firmware versions 4.001 or earlier. Contact Sprecher + Schuh technical support if you have Version 4.001 firmware or earlier and need to access this parameter.

Renewal Parts

Description		PF Rating	Catalog Number ①	
			For units rated 200...600V AC	
			100...240V AC	**24V AC/DC**
Control Modules	Standard	All	PFS	PFS-024
	Pump	All	PFB	PFB-024
	Braking	5...85 A	PFD-0085	PFD-0085-024
		108...251 A	PFD-0251	PFD-0251-024
		317...480 A	PFD-0480	PFD-0480-024
		625...780 A	PFD-0780	N/A
		970...1250 A	PFD-1250	N/A

Description		PF Rating	Series	Catalog Number ①	
				Line Voltage	
				200...480V	**200...600V**
Power Poles		5 A	B	PFL-0005-480V ②	PFL-0005-600V ②
		25 A	B	PFL-0025-480V ②	PFL-0025-600V ②
		43 A	B	PFL-0043-480V ②	PFL-0043-600V ②
		60 A	B	PFL-0060-480V ②	PFL-0060-600V ②
		85 A	B	PFL-0085-480V ②	PFL-0085-600V ②
		108 A	B	PFL-0108-480V ②	PFL-0108-600V ②
		135 A	B	PFL-0135-480V ②	PFL-0135-600V ②
		201 A	B	PFL-0201-480V ②	PFL-0201-600V ②
		251 A	B	PFL-0251-480V ②	PFL-0251-600V ②
		317 A	B	PFL-0317-480V ②	PFL-0317-600V ②
		361 A	B	PFL-0361-480V ②	PFL-0361-600V ②
		480 A	B	PFL-0480-480V ②	PFL-0480-600V ②
		625 A	B	PFL-0625-480V ②	PFL-0625-600V ②
		780 A	B	PFL-0780-480V ②	PFL-0780-600V ②
		970 A	B	PFL-0970-480V ②	PFL-0970-600V ②
		1250 A	B	PFL-1250-480V ②	PFL-1250-600V ②
Heatsink Fans		5...85 A	B	PFV-0085	
		108...135 A	B	PFV-0085	
		201..251 A	B	PFV-0251	
		317...480 A	B	PFV-0480	
		625...1250 A	B	PFV-1250-120	
		625...1250 A	B	PFV-1250-230	
Base Plate		201...251 A	B	PFM-0251	
		317...480 A	B	PFM-0480	
By-Pass Contactor	110/120V AC Control Power	625...780 A	B	100-D180ED11 ③	
		970...1250 A	B	100-D420ED110 ③	
	230/240V AC Control Power	625...780 A	B	100-D180EA11 ③	
		970...1250 A	B	100-D420EA110 ③	

① One piece provided per part number.
② Three-phase power pole structure provided per part no.
③ See Appendix D for special installation instructions.

Control Type	Control Voltage	Line Voltage	Amperes	Originally Ordered as Catalog Number	Series	Control Module Catalog Number	Power Poles Catalog Number
Standard	100…240V	200…480V AC	5	PFS-0005-480V	B	PFS	PFL-0005-480V
			25	PFS-0025-480V	B	PFS	PFL-0025-480V
			43	PFS-0043-480V	B	PFS	PFL-0043-480V
			60	PFS-0060-480V	B	PFS	PFL-0060-480V
			85	PFS-0085-480V	B	PFS	PFL-0085-480V
			108	PFS-0108-480V	B	PFS	PFL-0108-480V
			135	PFS-0135-480V	B	PFS	PFL-0135-480V
		200…600V AC	5	PFS-0005-600V	B	PFS	PFL-0005-600V
			25	PFS-0025-600V	B	PFS	PFL-0025-600V
			43	PFS-0043-600V	B	PFS	PFL-0043-600V
			60	PFS-0060-600V	B	PFS	PFL-0060-600V
			85	PFS-0085-600V	B	PFS	PFL-0085-600V
			108	PFS-0108-600V	B	PFS	PFL-0108-600V
			135	PFS-0135-600V	B	PFS	PFL-0135-600V
	24V AC/DC	200…480V AC	5	PFS-0005-480V-024	B	PFS-024	PFL-0005-480V
			25	PFS-0025-480V-024	B	PFS-024	PFL-0025-480V
			43	PFS-0043-480V-024	B	PFS-024	PFL-0043-480V
			60	PFS-0060-480V-024	B	PFS-024	PFL-0060-480V
			85	PFS-0085-480V-024	B	PFS-024	PFL-0085-480V
			108	PFS-0108-480V-024	B	PFS-024	PFL-0108-480V
			135	PFS-0135-480V-024	B	PFS-024	PFL-0135-480V
		200…600V AC	5	PFS-0005-600V-024	B	PFS-024	PFL-0005-600V
			25	PFS-0025-600V-024	B	PFS-024	PFL-0025-600V
			43	PFS-0043-600V-024	B	PFS-024	PFL-0043-600V
			60	PFS-0060-600V-024	B	PFS-024	PFL-0060-600V
			85	PFS-0085-600V-024	B	PFS-024	PFL-0085-600V
			108	PFS-0108-600V-024	B	PFS-024	PFL-0108-600V
			135	PFS-0135-600V-024	B	PFS-024	PFL-0135-600V

Control Type	Control Voltage	Line Voltage	Amperes	Originally Ordered as Catalog Number	Series	Control Module Catalog Number	Power Poles Catalog Number
Pump Control	100…240V	200…480V AC	5	PFB-0005-480V	B	PFB	PFL-0005-480V
			25	PFB-0025-480V	B	PFB	PFL-0025-480V
			43	PFB-0043-480V	B	PFB	PFL-0043-480V
			60	PFB-0060-480V	B	PFB	PFL-0060-480V
			85	PFB-0085-480V	B	PFB	PFL-0085-480V
			108	PFB-0108-480V	B	PFB	PFL-0108-480V
			135	PFB-0135-480V	B	PFB	PFL-0135-480V
		200…600V AC	5	PFB-0005-600V	B	PFB	PFL-0005-600V
			25	PFB-0025-600V	B	PFB	PFL-0025-600V
			43	PFB-0043-600V	B	PFB	PFL-0043-600V
			60	PFB-0060-600V	B	PFB	PFL-0060-600V
			85	PFB-0085-600V	B	PFB	PFL-0085-600V
			108	PFB-0108-600V	B	PFB	PFL-0108-600V
			135	PFB-0135-600V	B	PFB	PFL-0135-600V
	24V AC/DC	200…480V AC	5	PFB-0005-480V-024	B	PFB-024	PFL-0005-480V
			25	PFB-0025-480V-024	B	PFB-024	PFL-0025-480V
			43	PFB-0043-480V-024	B	PFB-024	PFL-0043-480V
			60	PFB-0060-480V-024	B	PFB-024	PFL-0060-480V
			85	PFB-0085-480V-024	B	PFB-024	PFL-0085-480V
			108	PFB-0108-480V-024	B	PFB-024	PFL-0108-480V
			135	PFB-0135-480V-024	B	PFB-024	PFL-0135-480V
		200…600V AC	5	PFB-0005-600V-024	B	PFB-024	PFL-0005-600V
			25	PFB-0025-600V-024	B	PFB-024	PFL-0025-600V
			43	PFB-0043-600V-024	B	PFB-024	PFL-0043-600V
			60	PFB-0060-600V-024	B	PFB-024	PFL-0060-600V
			85	PFB-0085-600V-024	B	PFB-024	PFL-0085-600V
			108	PFB-0108-600V-024	B	PFB-024	PFL-0108-600V
			135	PFB-0135-600V-024	B	PFB-024	PFL-0135-600V

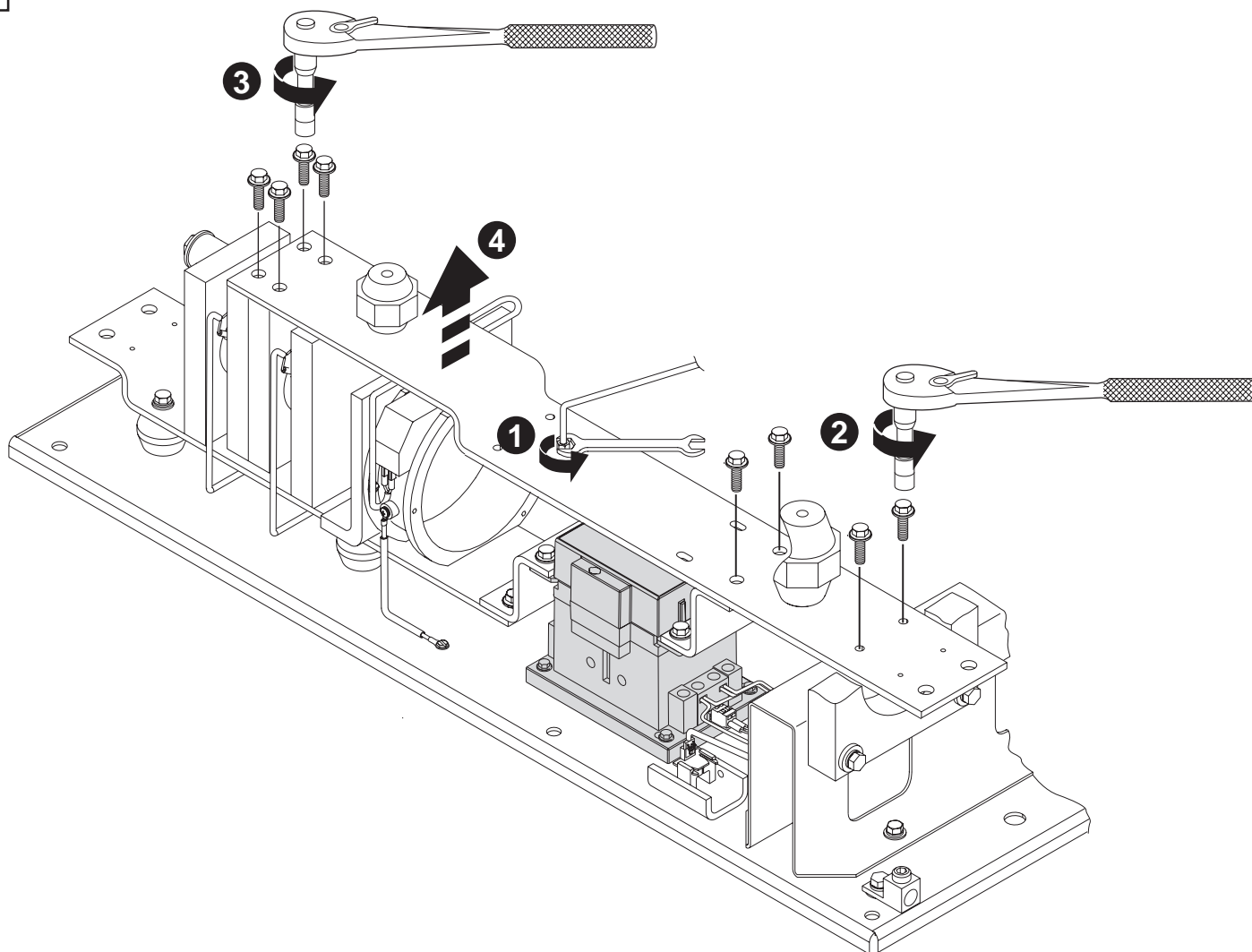| Control Type	Control Voltage	Line Voltage	Am-peres	Originally Ordered as Catalog Number	Series	Control Module Catalog Number	Power Poles Catalog Number
Braking Control	100…240V	200…480V AC	5	PFD-0005-480V	B	PFD-0085	PFL-0005-480V
			25	PFD-0025-480V	B	PFD-0085	PFL-0025-480V
			43	PFD-0043-480V	B	PFD-0085	PFL-0043-480V
			60	PFD-0060-480V	B	PFD-0085	PFL-0060-480V
			85	PFD-0085-480V	B	PFD-0085	PFL-0085-480V
			108	PFD-0108-480V	B	PFD-0251	PFL-0108-480V
			135	PFD-0135-480V	B	PFD-0251	PFL-0135-480V
		200…600V AC	5	PFD-0005-600V	B	PFD-0085	PFL-0005-600V
			25	PFD-0025-600V	B	PFD-0085	PFL-0025-600V
			43	PFD-0043-600V	B	PFD-0085	PFL-0043-600V
			60	PFD-0060-600V	B	PFD-0085	PFL-0060-600V
			85	PFD-0085-600V	B	PFD-0085	PFL-0085-600V
			108	PFD-0108-600V	B	PFD-0251	PFL-0108-600V
			135	PFD-0135-600V	B	PFD-0251	PFL-0135-600V
	24V AC/DC	200…480V AC	5	PFD-0005-480V-024	B	PFD-0085-024	PFL-0005-480V
			25	PFD-0025-480V-024	B	PFD-0085-024	PFL-0025-480V
			43	PFD-0043-480V-024	B	PFD-0085-024	PFL-0043-480V
			60	PFD-0060-480V-024	B	PFD-0085-024	PFL-0060-480V
			85	PFD-0085-480V-024	B	PFD-0085-024	PFL-0085-480V
			108	PFD-0108-480V-024	B	PFD-0251-024	PFL-0108-480V
			135	PFD-0135-480V-024	B	PFD-0251-024	PFL-0135-480V
		200…600V AC	5	PFD-0005-600V-024	B	PFD-0085-024	PFL-0005-600V
			25	PFD-0025-600V-024	B	PFD-0085-024	PFL-0025-600V
			43	PFD-0043-600V-024	B	PFD-0085-024	PFL-0043-600V
			60	PFD-0060-600V-024	B	PFD-0085-024	PFL-0060-600V
			85	PFD-0085-600V-024	B	PFD-0085-024	PFL-0085-600V
			108	PFD-0108-600V-024	B	PFD-0251-024	PFL-0108-600V
			135	PFD-0135-600V-024	B	PFD-0251-024	PFL-0135-600V

Contactor Replacement Installation Instructions for 625...1250 A units

Attention

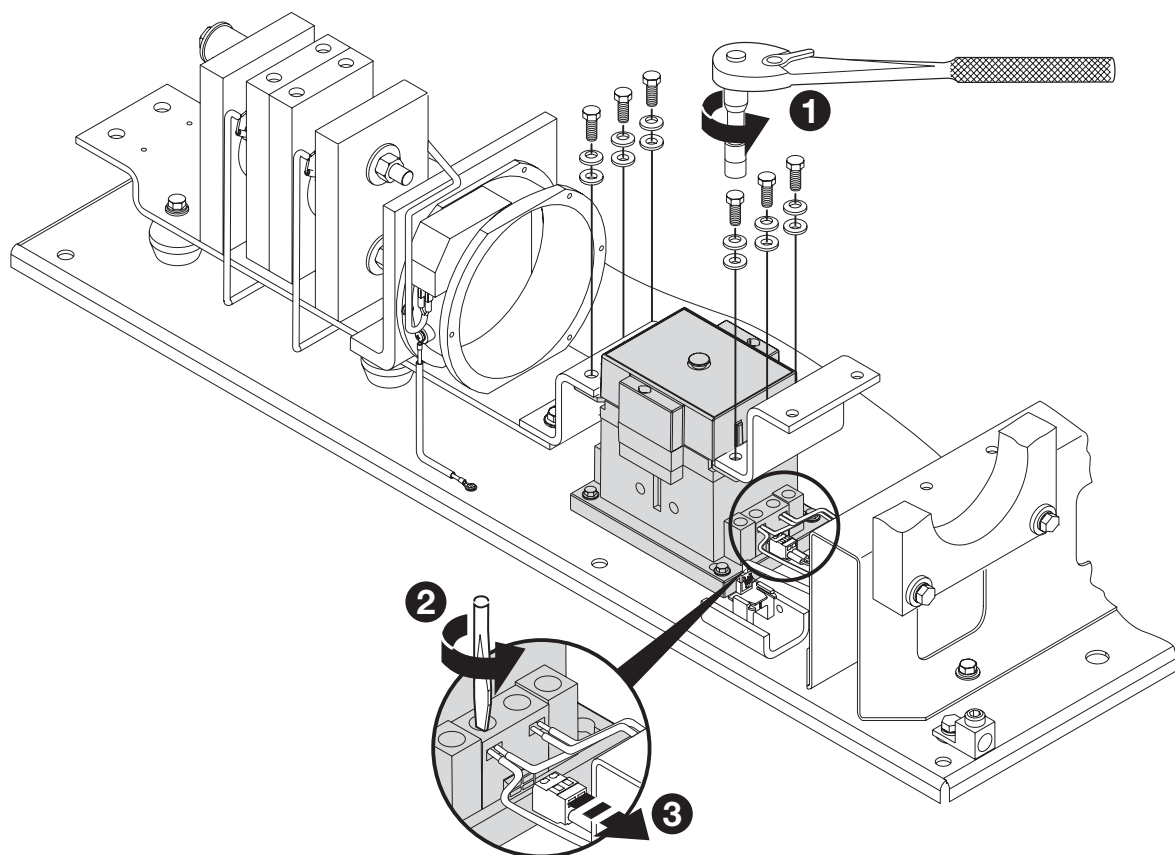Remove all power to the unit, before proceeding with replacement procedures.

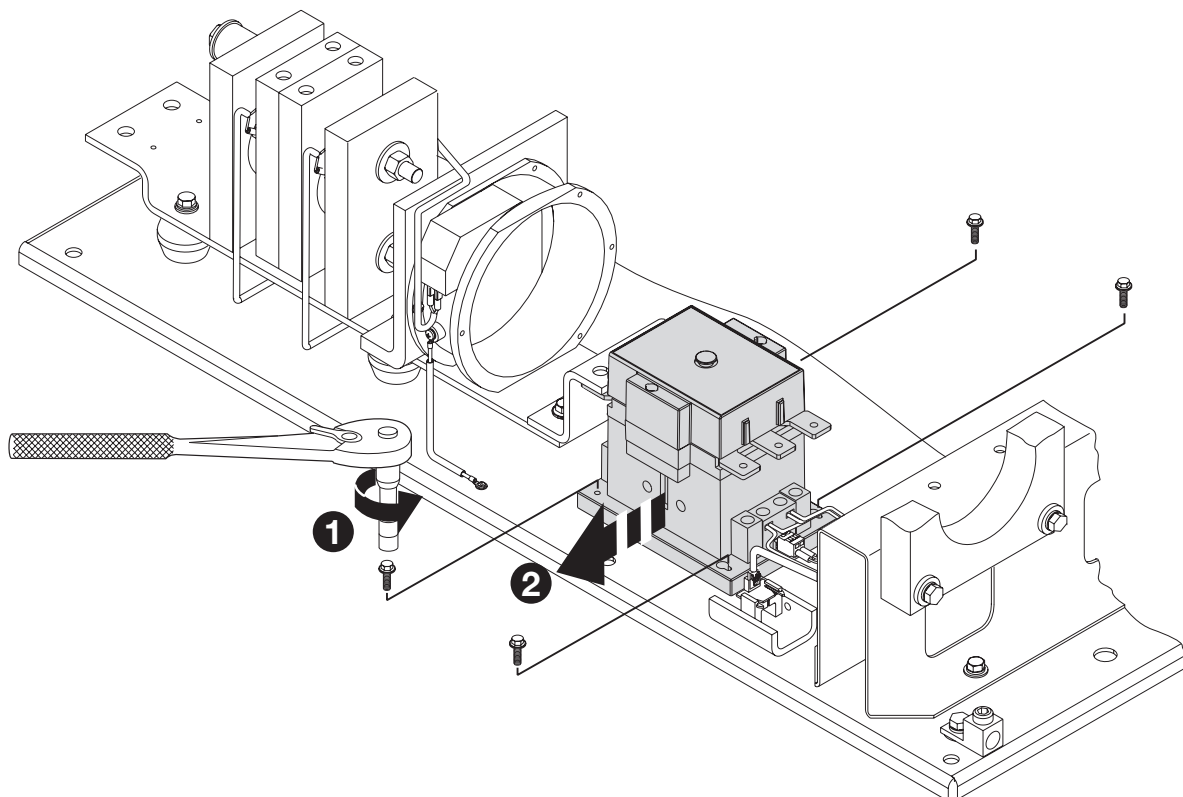Prior to beginning the following steps, the front cover must be removed.

1 **Note: Cover is removed**

2

3

5

100 lb-in
11.3 N•m   **625 / 780 A**

140 lb-in
15.8 N•m   **970 / 1250 A**

3
20 lb-in
2.3 Nm

625 / 780 A   **30 lb-in**
3.4 N•m

970 / 1250 A   **55 lb-in**
6.2 N•m

2

1

4

6

2   **100 lb-in**
11.3 N•m

1

100 lb-in
11.3 N•m   **3**

5   **140 lb-in**
15.8 N•m

18 lb-in
2.0 N•m   **4**
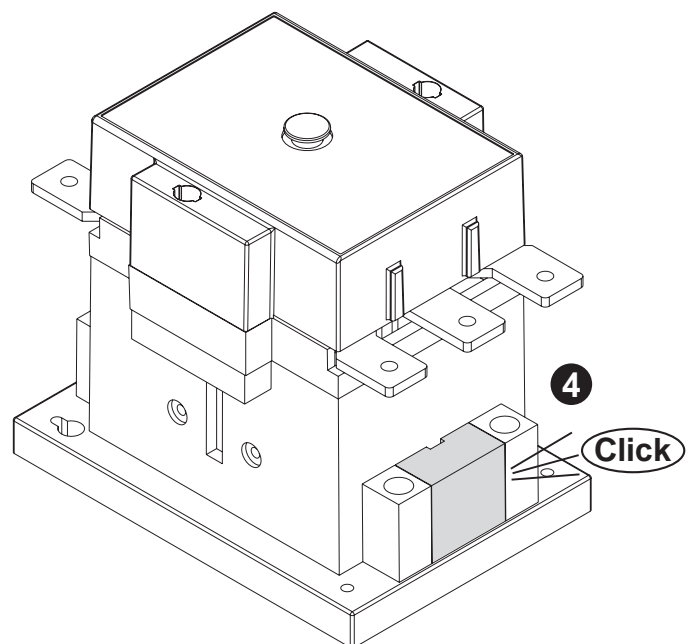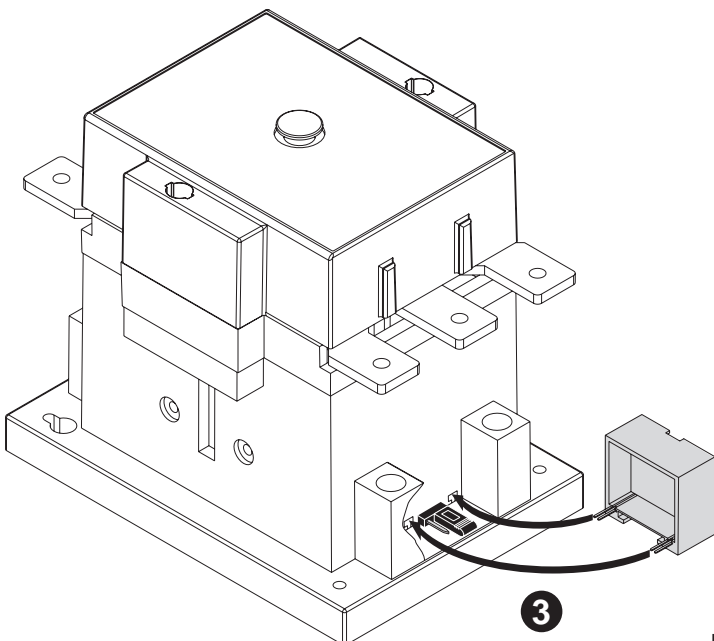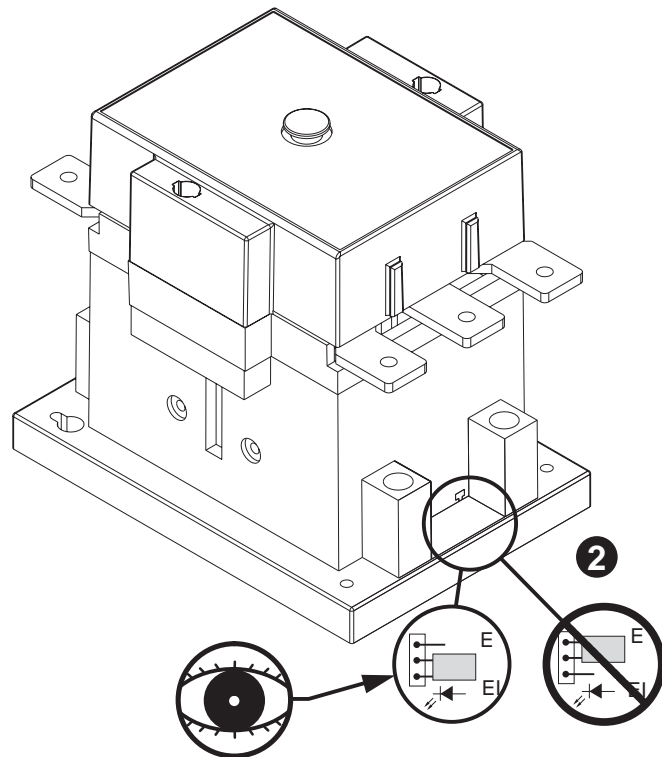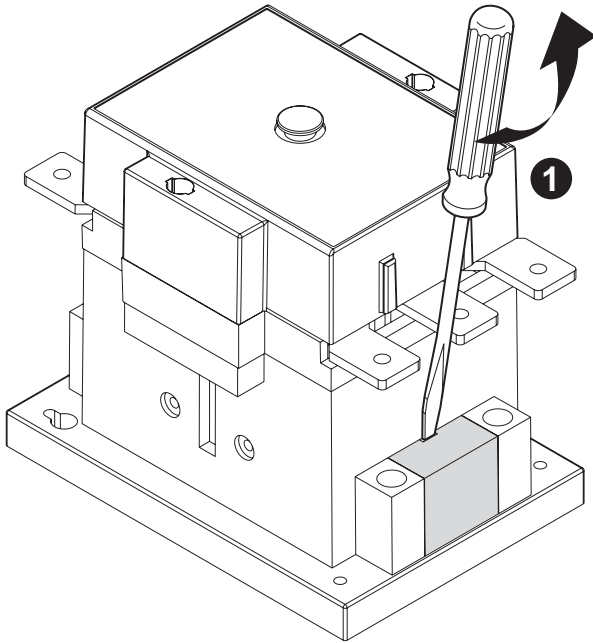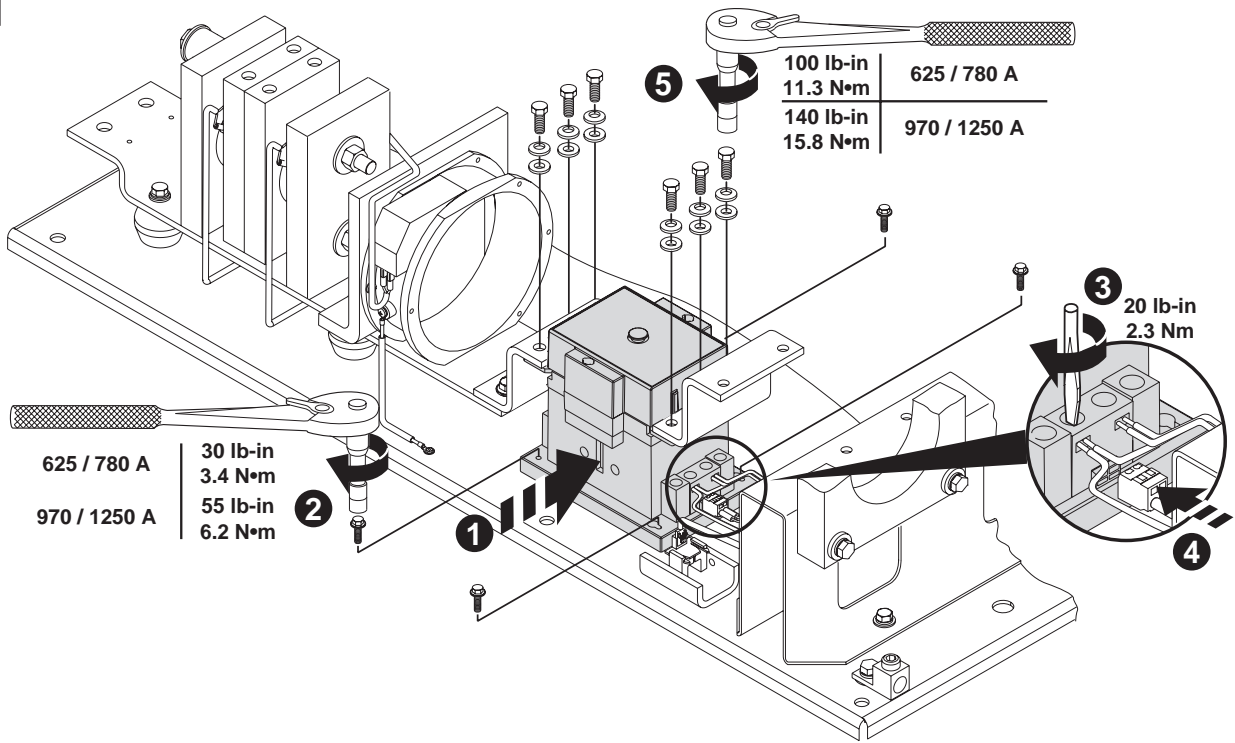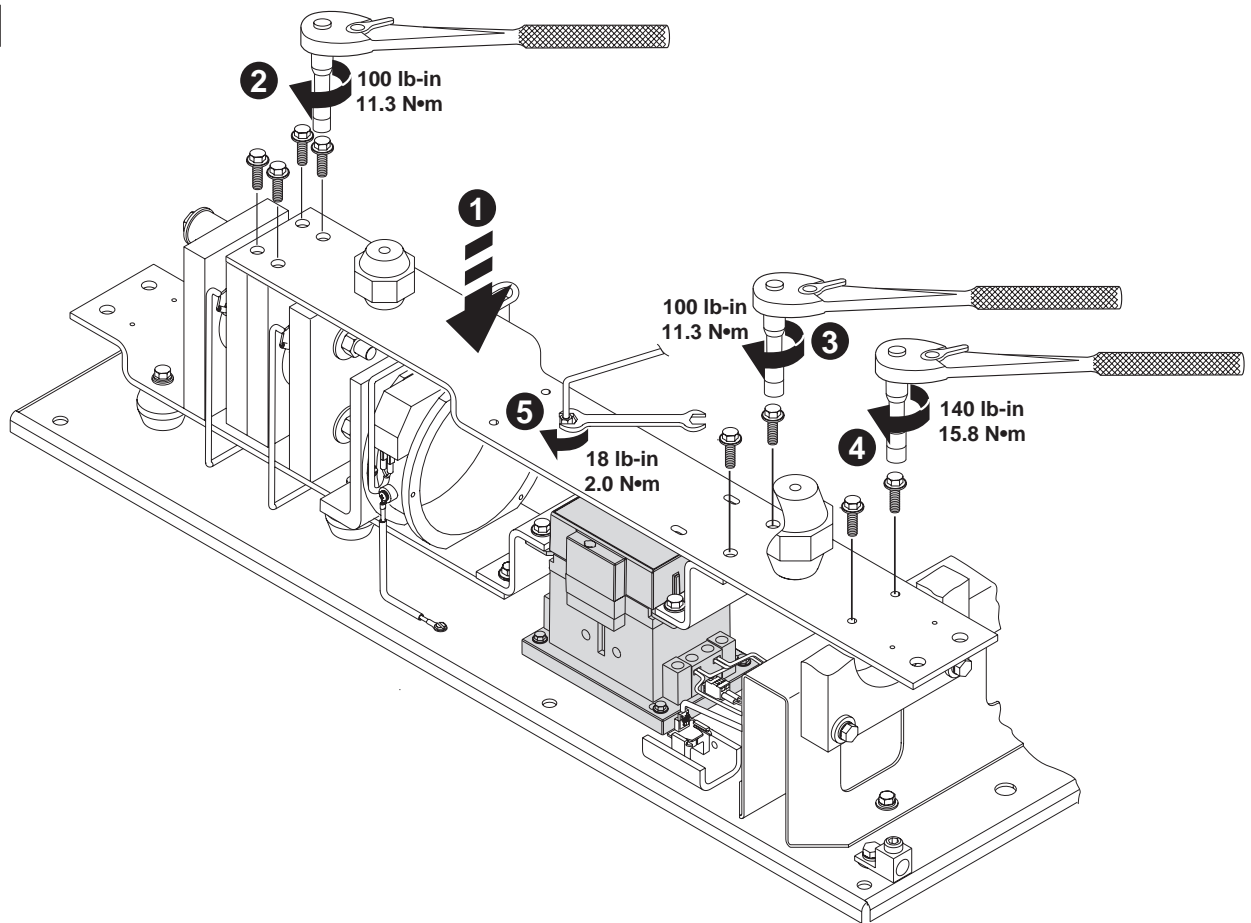
Accessories

Description	Description/Used With	Catalog No.
Protective Modules	5…85 A, 480V	PFP-0085-480V
	108…480 A, 480V	PFP-0480-480V
	5…85 A, 600V	PFP-0085-600V
	108…480 A, 600V	PFP-0480-600V
Terminal Lugs	108…251 A	PNX-1120
	317…480 A	PNX-1240
	625...1250 A	CA6-L630 CA6-L860
IEC Terminal Covers	108…135 A	PFT-0135
	201…251 A	PFT-0251
	317…480 A	PFT-0480

AC   Alternating current.

AC Contactor   An alternating current (AC) contactor is designed for the specific purpose of establishing or interrupting an AC power circuit.

Ambient Temperature   Ambient temperature is the temperature of air, water, or a surrounding medium where equipment is operated or stored.

American Wire Gauge (AWG)   A standard system used for designing the size of electrical conductors. Gauge numbers have an inverse relationship to size; larger numbers have a smaller cross sectional area. However, a single-strand conductor has a larger cross-sectional area than a multi-strand conductor of the same gauge so that they have the same current-carrying specification.

Block Transfer   Block Transfer is the method used by a PLC™ to transfer data that does not require continuous updates. To perform this function, the module provides a status word to the PLC during normal discrete transfer scan. This status word occupies the first module group in the PLC I/O image table for the designated rack. The status word is then used by the PLC program to control the BTW and BTR functions of the PLC.

BTR   A PLC Block Transfer Read instruction.

BTW   A PLC Block Transfer Write instruction.

Buffer   1. In software terms, a register or group of registers used for temporary storage of data to compensate for transmission rate differences between the transmitter and receiving device.

                                2. In hardware terms, an isolating circuit used to avoid the reaction of one circuit with another.

Contactor, Reversing   A method of reversing motor rotation by the use of two separate contactors, one of which produces rotation in one direction and the other produces rotation in the opposite direction. The contactors are electrically (and mechanically) interlocked so that both cannot be energized at the same time.

COP   This instruction copies data from one location into another. It uses no status bits. If you need an enable bit, program a parallel output using a storage address.

Cursor   The intensified or blinking element in a video display. A means for indication where data entry or editing occurs.

Cycle   1. A sequence of operations that is repeated regularly.
                                2. The time it takes for one sequence of operations to occur.

DH-485 Link	Data Highway 485 link. An Allen-Bradley token-passing baseband link for a local area network based on the RS-485 standard.
Disable	To inhibit logic from being activated.
Duty Cycle	The relationship between the operating and rest times or repeatable operation at different loads.
Enable	To allow an action or acceptance of data by applying an appropriate signal to the appropriate input.
Fault	Any malfunction that interferes with normal system operation.
G File	G File configuration is based on the devices that you have on the RIO link. G File configuration consists of setting logical device starting addresses and the logical device image size of each physical device/adapter with which the scanner communicates.
Gate	The control element of an SCR (silicon controlled rectifier) commonly referred to as a thyristor. When a small positive voltage is applied to the gate momentarily, the SCR will conduct current (when the anode is positive with respect to the cathode of the SCR). Current conduction will continue even after the gate signal is removed.
Jogging	Jogging is a means of accomplishing momentary motor movement by repetitive closure of a circuit using a single push button or contact element.
Jumper	A short conductor with which you connect two points.
LCD	Liquid crystal display, which is a reflective visual readout device commonly used in digital watches and laptop computers.
Locked Rotor Torque	The minimum torque that a motor will develop at rest for all angular positions of the rotor (with rated voltage applied at rated frequency).
Mode	A selected method of operation. Example: run, test, or program.
Normally Closed Contacts	A set of contacts on a relay or switch that are closed when the relay is de-energized or the switch is de-activated. They are open when the relay is energized or the switch is activated.
Normally Open Contacts	A set of contacts on a relay or switch that are open when the relay is de-energized or the switch is de-activated. They are closed when the relay is energized or the switch is activated.
PLC® Controller	1. A programmable controller. 2. A programmable controller with a name that includes the letters PLC. See Programmable Controller.

Port	On a communication link, the logic circuitry or software at a station that determines its communication parameters for a particular communication channel.
Power Factor	A measurement of the time phase difference between the voltage and current in an AC circuit. It is represented by the cosine of the angle of this phase difference. Power factor is the ratio of Real Power (kW) to total kVA or the ratio of actual power (W) to apparent power (volt-amperes).
Preset Speed	Preset speed refers to one or more fixed speeds at which the drive will operate.
Programmable Controller	A solid-state system that has a user-programmable memory for storage of instructions to implement specific functions such as I/O control, logic, timing, counting, report generation, communication, arithmetic, and data file manipulation. A controller consists of a central processor, input/output interface, and memory. A controller is designed as an industrial control system.
Protocol	A set of conventions governing the format and timing of data between communication devices.
Remote I/O	I/O connected to a processor across a serial link. With a serial link, remote I/O can be located long distances from the processor.
RS-232-C	An EIA standard that specifies electrical, mechanical, and functional characteristics for serial binary communication circuits in a point-to-point link.
RS-422	An EIA standard that specifies electrical characteristics of balanced-voltage digital interface circuits in a point-to-point link.
RS-485	An EIA standard that specifies electrical characteristics of balanced-voltage digital interface circuits in a multi-point link.
Scrolling	The vertical movement of data on a display screen caused by the dropping of one line of displayed data for each new line added at the opposite end.
Serial	Pertaining to time-sequential transmission of, storage of, or logic operations on data, using the same facilities for successive parts.
Service Factor (S-F)	When used on a motor nameplate, a number which indicates how much above the nameplate rating a motor can be loaded without causing serious degradation (i.e., a motor with 1.15 S-F can produce 15% greater torque than one with 1.0 S-F) to adjust measured loads in an attempt to compensate for conditions which are difficult to measure or define.
Silicon Controlled Rectifier	A solid-state switch, sometimes referred to as a thyristor. The SCR has an anode, (SCR) cathode and control element called the gate. The device provides controlled rectification since it can be turned on at will. The SCR can rapidly switch large currents at high voltages. They are small in size and low in weight.
SLC™ Controller	A programmable controller with a name that includes the letters SLC. See Programmable Controller.

Status   The condition at a particular time of any numerous entities within a system. These conditions may be represented by values in a status line.

Surge Protection   The process of absorbing and clipping voltage transients on an incoming AC line or control circuit. MOVs (Metal Oxide Varistors) and specially designed R-C networks are usually used to accomplish this.

Toggle   To switch alternately between two possible selections.

Transient   A momentary deviation in an electrical or mechanical system.

UL   Underwriters Laboratories (a third-party safety certification agency).

Notes

sprecher+
schuh

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