Rockwell Automation
Sprecher+Schuh

PG Softstarter
Installation Manual
for 5A, 9A and 16A Controllers

Important User Information

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Sprecher + Schuh cannot assume responsibility or liability for actual use based on the examples and diagrams. In no event will Sprecher + Schuh be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment. Reproduction of the contents of this manual, in whole or in part, without written permission of Sprecher + Schuh is prohibited.

Precautionary Notes

In this manual you will see the following types of precautionary statements: **Bold type** points out specific areas of concern that are critical to your understanding or use of the product.

WARNINGS: tell you where people may be hurt if procedures are not followed properly.

CAUTIONS: tell you where machinery may be damaged or economic loss can occur if procedures are not followed properly.

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Notes

Installation and Wiring

Inspection

Before installing the controller, make a complete visual check of the controller for damage in shipment or handling. Claims for damaged or missing parts must be made to the carrier as soon as possible after receipt of shipment.

Enclosures

The following are recommendations for installing the open-style device in an enclosure.

Customer Installed NEMA 12 Enclosures

When the open style device is installed in an enclosure, the internal temperature of the enclosure must be kept within the range of 0° C to 50° C.

The following table shows the maximum heat dissipation at rated current for the controller.

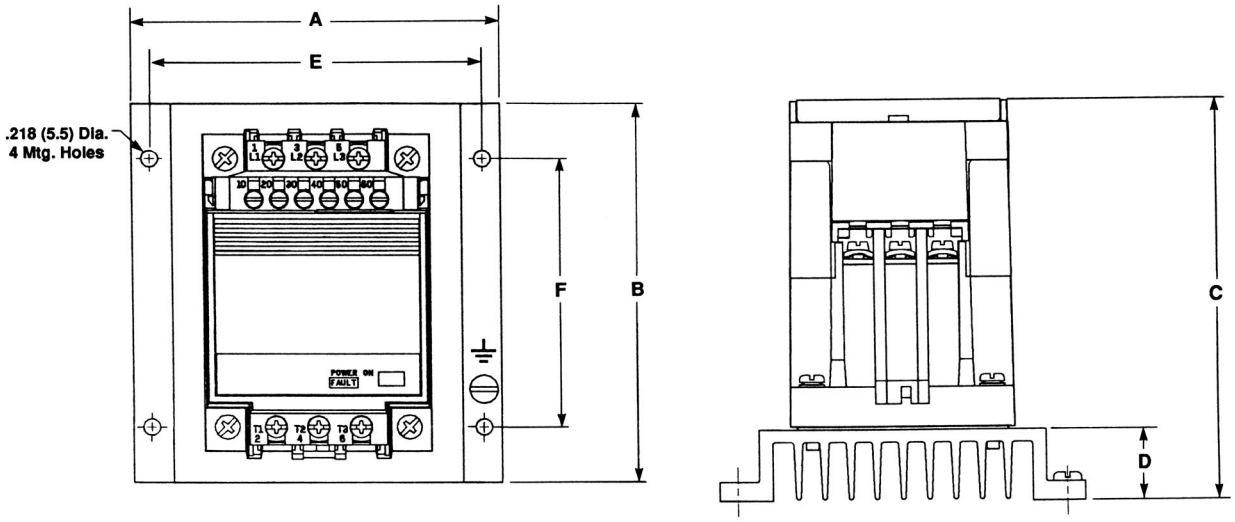
Figure 2.1 - Maximum Heat Dissipation

PG Controller Current Rating	5A	9A	16A
Maximum Watts	32	45	70

Mounting

The controller is convection cooled. It is important to locate the controller in a position that allows free air flow vertically through the controller. The controller must be mounted with heatsink fins in a vertical plane for maximum cooling. See Figure 2.2.

Figure 2.2 - Dimension Drawing



	Unit	A width	B height	C depth	D	E	F	Approx. Ship Wt.
5A Controller	Millimeter	122	127	134	24	110	90	2kg
	Inch	4-13/16	5	5-9/32	61/64	4-11/32	3-35/64	4.5lbs
9A Controller	Millimeter	122	180	134	24	110	140	2.25kg
	Inch	4-13/16	7-3/32	5-9/32	61/64	4-11/32	5-33/64	5lbs
16A Controller	Millimeter	154	180	160	50	140	140	3.15kg
	Inch	6-5/64	7-3/32	6-5/16	1-31/32	5-33/64	5-33/64	7lbs

All dimensions and weights include the interface module. All dimensions and weights are approximate and are not to be used for construction purposes. Refer to nearest Sales Office or Corporate Headquarters at Houston, Texas for complete dimension drawings.

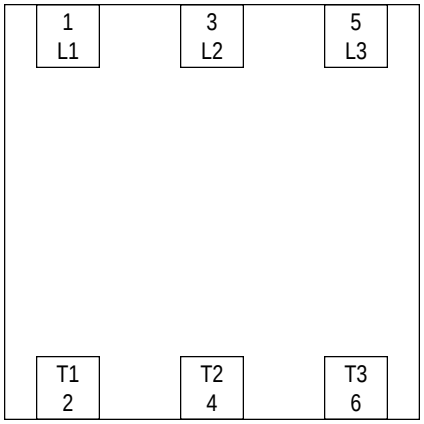
Wiring

The controller wiring terminal locations are shown in Figure 2.4. Make wiring connections as indicated in the typical connection diagrams shown in Figures 2.5, 2.7, 2.8, 2.9 and 2.10. Connect the line to terminals L1/1, L2/3, and L3/5. Connect the load to terminals T1/2, T2/4, and T3/6. A provision is available for grounding the isolated heatsink per applicable codes. Use Figure 2.3 as a guide for wiring:

Figure 2.3 - Power & Control Wire Size and Tightening Torque

	Wire Size	Torque
Metric	1.5-6mm^2	1.36 N-m
AWG	14-12 AWG	12 LB-IN

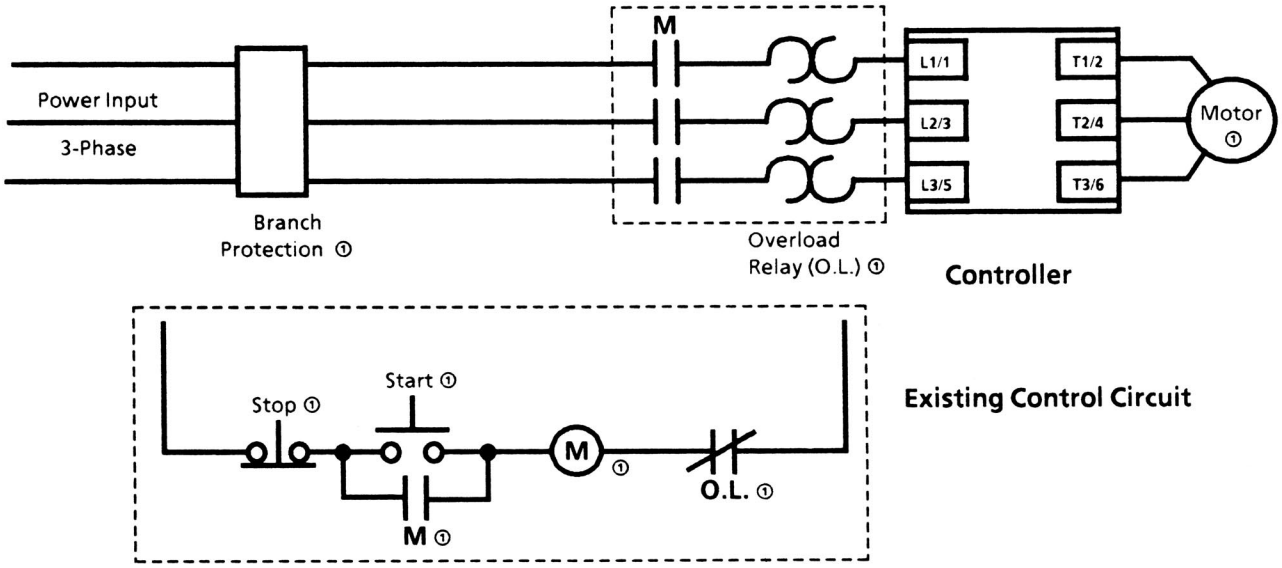
Figure 2.4 - Power Wiring Terminal Locations



Series Controller Mode

This design requires an electromechanical starter on the line side of the unit. The controller requires no control voltage input. See Figure 2.5.

Figure 2.5 - Series Controller Mode



① Customer supplied.

Description of Interface Module

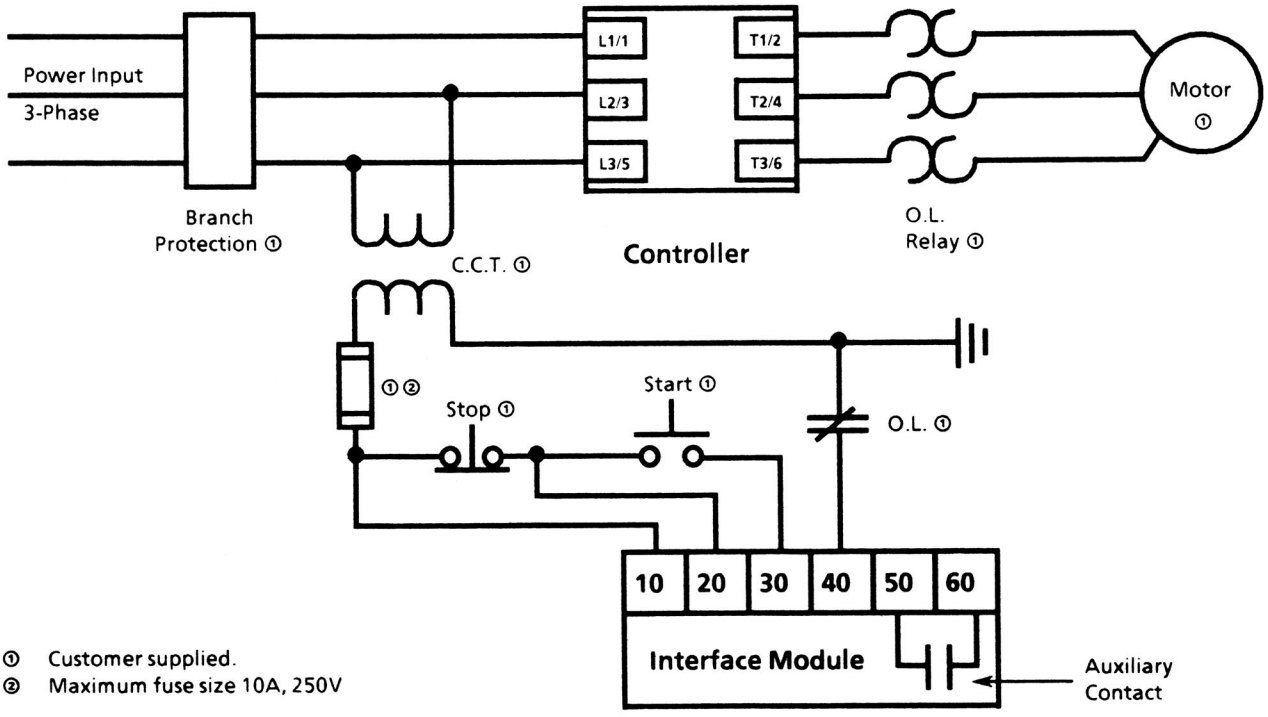
The PG controller is designed to be operated by an external device. An optional interface module is inserted into the PG controller that enhances the capabilities of the controller. This module can be field or factory installed and offers the following features:

- Provides ON/OFF control directly to the controller through an external device. In many applications the interface module may eliminate the need for an additional contactor if electrical isolation or soft stop is not required. This reduces the required panel space.
- Provides a selectable auxiliary contact that operates as either an instantaneous or up-to-speed contact making it available for a wide variety of control schemes.
- Provides a Soft Stop feature that extends stopping time to minimize load shifting or spillage during stopping.

Wiring with Interface Module

Control power requirement for interface module is 5VA at 120V and 15VA at 240V. Auxiliary contact rating is NEMA C300, 2.5 Amps, 20-250VAC; 1 Amp, 12-30VDC.

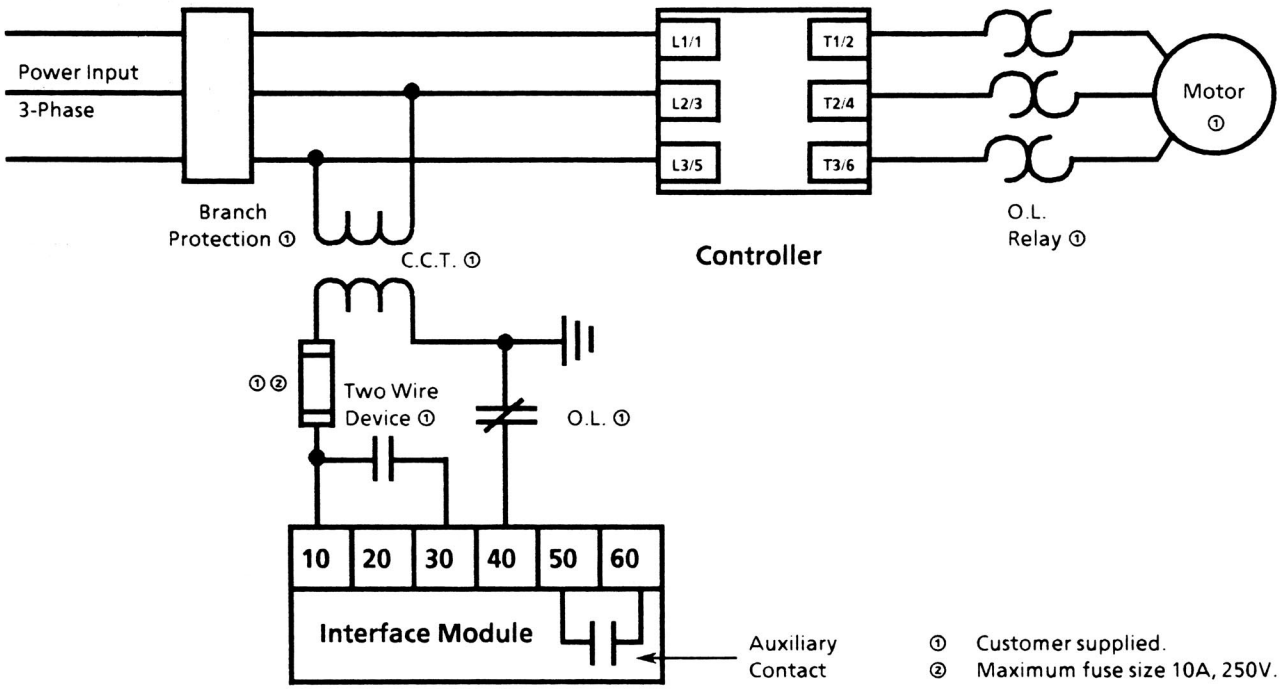
Figure 2.7 - Typical Connection Diagram



Programmable Controller and Sensor Interface

When using solid-state devices to operate the PG controller with interface module, the ON-state voltage range and frequency will be 100-120V, 50/60 HZ, if the 120 volt interface module is used. The ON-state voltage and frequency range will be 200-240V, 50/60 Hz, for the 240 volt interface module. The OFF-state leakage current from the solid-state device must be less than 5mA. The nominal input current is 25mA at 120 VAC and 50mA at 240VAC.

Figure 2.8 - Typical Connection with 2-Wire Control Scheme



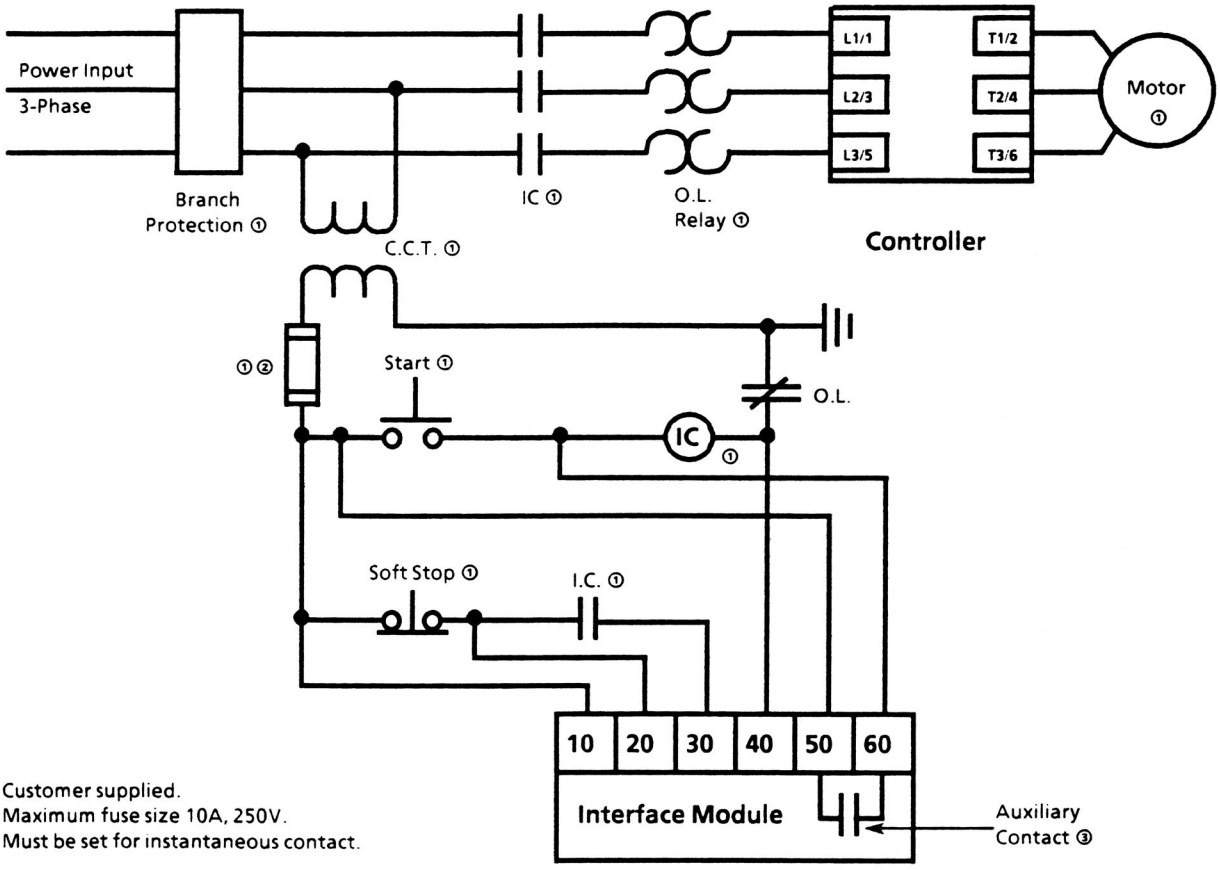
Isolation Contactor

An isolation contactor is used to provide electrical isolation of the controller and motor circuit when the controller is shut down by either manually pressing the stop button, or automatically by the occurrence of abnormal conditions.

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. Warning labels must be attached to the motor terminal boots, the controller enclosures, and the control station. Additional circuitry must be included to provide automatic isolation.

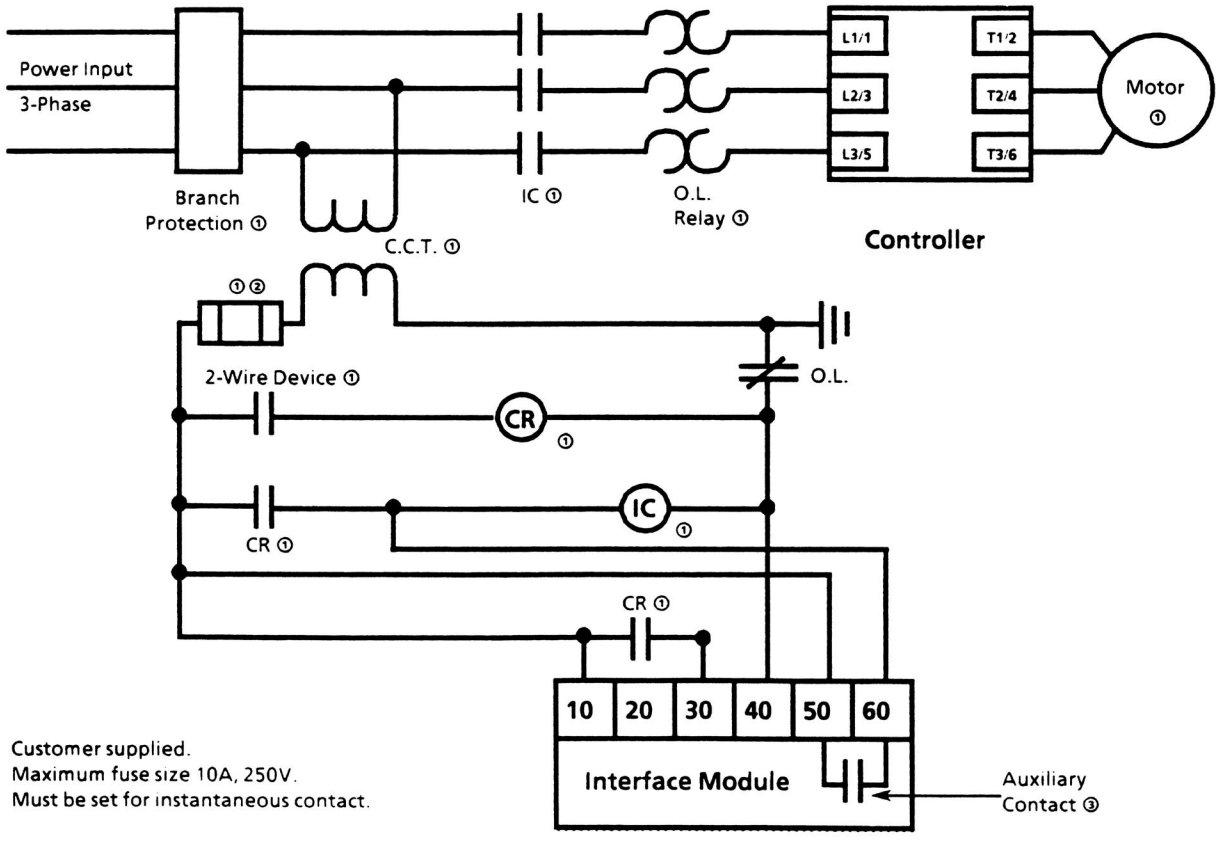
If Soft Stop is required, wire per Figure 2.9. If wired per Figures 2.7 or 2.8 and an overload occurs while an isolation contactor is not used, the PG controller will continue to soft stop the motor.

Figure 2.9 - Typical Connection with Soft Start, Soft Stop and Isolation Contactor



① Customer supplied.
② Maximum fuse size 10A, 250V.
③ Must be set for instantaneous contact.

Figure 2.10 - Typical Connection with Two-Wire Control Scheme for Soft Start and Soft Stop



① Customer supplied.
② Maximum fuse size 10A, 250V.
③ Must be set for instantaneous contact.

Power Factor Capacitors

The controller can be installed on a system with power factor correction 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 PG controller.

Fast Acting Current-Limiting Fuses

Fast acting current limiting fuses are coordinated with the SCRs for protection of the SCRs in the event of short circuits in the load. Refer to Figures 2.11 for recommended fast acting current limiting fuses.

Figure 2.11 - Fast Acting Current-Limiting Fuses

Fuse Manufacturer	PG Controller Rating		
	PGS-005	PGS-009	PGS-016
Shawmut	A70P12	A70P20	A70P40
Buss	FWP15	FWP20	FWP40
Brush	XL70F015	XL70F020	XL70F040

NOTES:
1. Fuse numbers are fuse manufacturer's catalog number.
2. Fuse size listed is for 230, 460 or 575 volt.

CAUTION: The fast acting current-limiting fuses specified in the above table do not provide branch circuit protection. Branch circuit protection in accordance with applicable electrical codes is required even though fast acting current-limiting fuses are used.

Motor Overload Protection

Thermal motor overload protection is not provided unless specified with the open style or non-combination controller. It can be separately provided. The overload trip time should be greater than the acceleration time to avoid nuisance tripping.

CAUTION: Overload relays should be properly coordinated with the motor.

Protective Module (optional)

A protective module containing metal oxide varistors (MOVs) and snubbers can be installed to protect the power components from electrical transients and/or high electrical noise. The protective modules clip transients generated on the lines and prevent such surges from damaging the SCRs. The snubbers in the protective modules are used to shunt noise energy away from the controller electronics. There are two general situations that can occur which would indicate the need for utilizing the protective modules.

1. Transient spikes can occur on the lines feeding the controller (or feeding the load from the controller). Lightning can cause these spikes. These spikes are also created on the lines when devices are attached to the same lines with current carrying inductances that are then 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.
2. The second situation arises when the controller is installed on a system which has fast-rising wavefronts present, although not necessarily high peak voltages. Lightning strikes can cause this type of response. Additionally, if the controller is on the same bus as AC/DC drives, induction heating equipment and welding equipment, the firing of the SCRs in those devices can cause noise. This high frequency noise can penetrate the controller through stray capacitance always present in real systems.

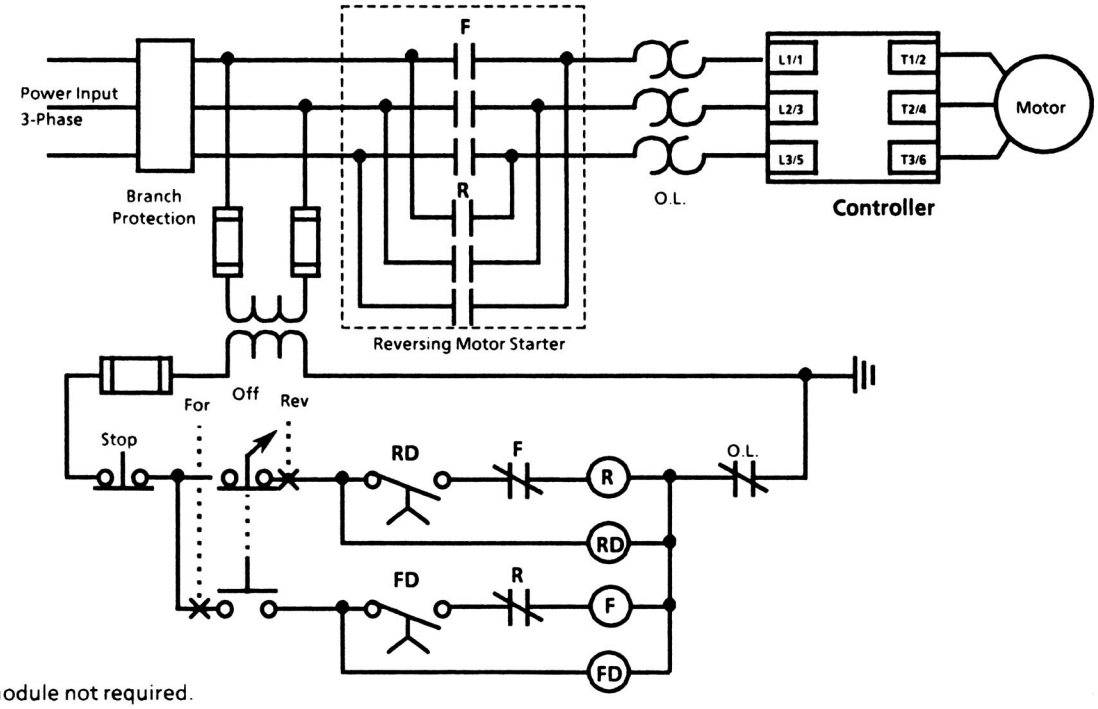
WARNING: When installing or inspecting the protective module, make sure the controller has been disconnected from the power source. The protective module must be checked periodically for damage. Inspect for damage or discoloration. Replace if necessary.

Single-Speed, Reversing Starters
(Series Controller Mode)

By using the controller as shown in Figure 2.12, the motor accelerates under a controlled start mode in either direction.

NOTE: Minimum transition time for reversing is 1/2 second.

Figure 2.12 - Typical Application with a Single Speed, Reversing Starter



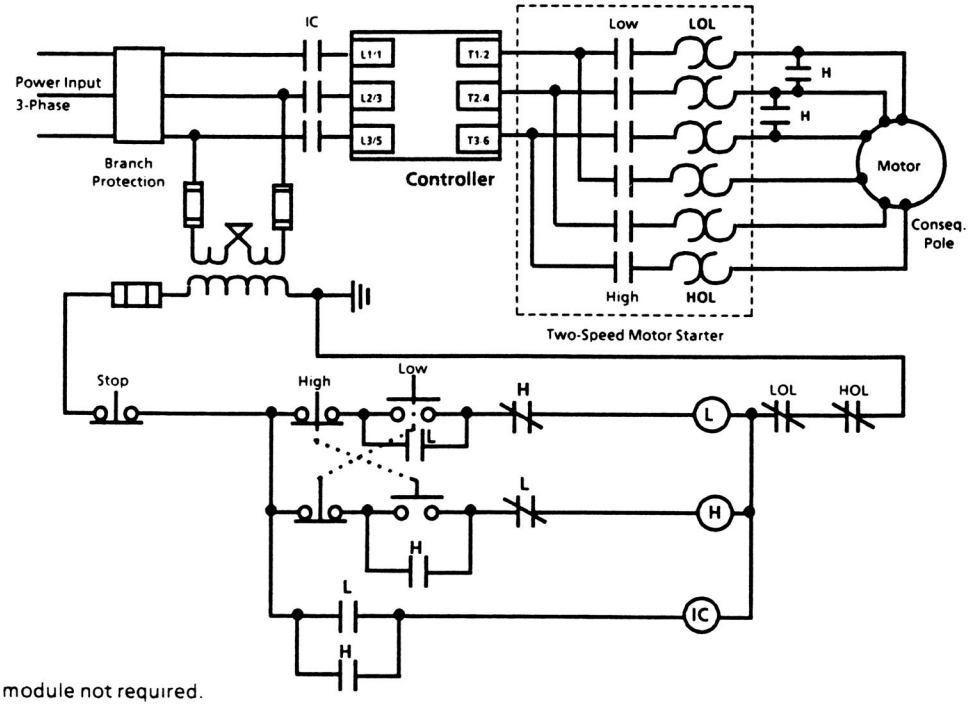
NOTE: Interface module not required.

Two-Speed, Two-Winding, Non-Reversing Starters
(Series Controller Mode)

By using the controller in this fashion, the motor accelerates in a controlled manner when in "Low" or "High" speed.

The isolation contactor is used to provide automatic isolation from the power source. Recommendations for an isolation contactor are detailed on page 6.

Figure 2.13 - Typical Application with a Two-Speed Motor Starter



NOTE: Interface module not required.

Notes

Start and Stop Sequences

Without Interface Module

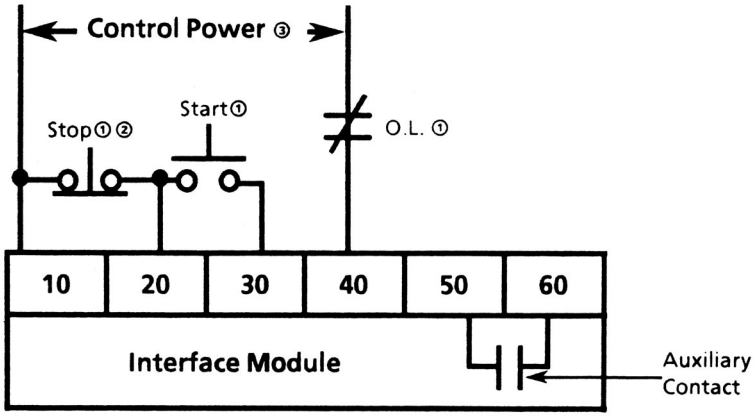
The PG controller, without the optional interface module, is designed to operate as a series controller. (Refer to Figure 2.5 on page 4). It is wired between an electromechanical starter and the motor. When the starter is energized, three-phase power is delivered to the line side of the PG controller. This causes it to automatically go through the start sequence. No control inputs are required.

Without the interface module, all that is required to stop the PG controller is to remove three-phase power from the line side of the unit. This is accomplished by de-energizing the electromechanical starter.

With Interface Module

When the PG controller has the interface module installed, the controller operates using 3-wire control. See Figure 3.1 below.

Figure 3.1 - Typical Connection Diagram when Interface Module is Used



① Customer Supplied
② For two wire control, remove stop/start pushbuttons and connect two wire device between terminals 10 and 30.
③ Control power source as required by voltage rating on interface module.

In this mode, the controller can operate with or without an electromechanical contactor. The unit is operated by pressing the start button. The internal hold-in circuit latches across terminals 20 and 30, and the auxiliary contact changes state (if so selected on the DIP switches). The controller then goes through the selected start sequence.

WARNING: Disconnect main power before servicing motor controller or associated wiring. HAZARDOUS voltages are present in the motor circuit even when the solid-state controller is off.

With the interface module, there are two methods of stopping: normal coast-to-stop and Soft Stop. To use coast-to-stop, the Soft Stop DIP switches (1 and 2) must be turned off. Simply pressing the stop button initiates stop.

Soft Stopping requires that the unit be preset: the Soft Stop DIP switches (1 and 2) must be in the ON position, and the appropriate DIP switches must be set for the time required for stopping.

Overload Trips

When an overload trip occurs, the normally closed contact (wired into terminal 40) opens, causing the controller logic to shut off immediately.

Fault Trips

There is a single red LED on the front of the PG controller for diagnostic indication. When three-phase power is applied to the controller, the LED will be on.

The PG controller monitors the following fault conditions:

- Shorted SCR (pre-start only)
- Phase Loss (line side and pre-start only)
- Stalled Motor (when stall switch is on)

If a shorted SCR or phase loss exists, the PG controller will not start and the LED will flash. If a stalled motor condition exists, the controller shuts down and flashes the LED. In the event three-phase input power is lost, the LED turns off.

Stalled Motor

The controller is designed to sense motor stall in both the "Starting" and "Running" modes. If during the "Starting" cycle, the controller senses that the motor is stalled and if the motor remains stalled, the controller shuts down in a predetermined time based on the selected ramp time. In the "Running" mode, the controller trips in 4 seconds in the event of a locked rotor condition. The LED flashes in either case. Starting stall trip times are illustrated in Figure 3.2.

Figure 3.2 - Starting Stall Trip Characteristics

Start Times (sec.)			Maximum Stall Trip Times (sec.) from Start
Soft Start	Current Limit	Full Voltage	
-	-	1/10	4
2	-	-	6
5	-	-	9
10	-	-	14
20	-	-	24
25	-	-	29
30	-	-	34
-	15	-	19
-	30	-	34

Energy Saver

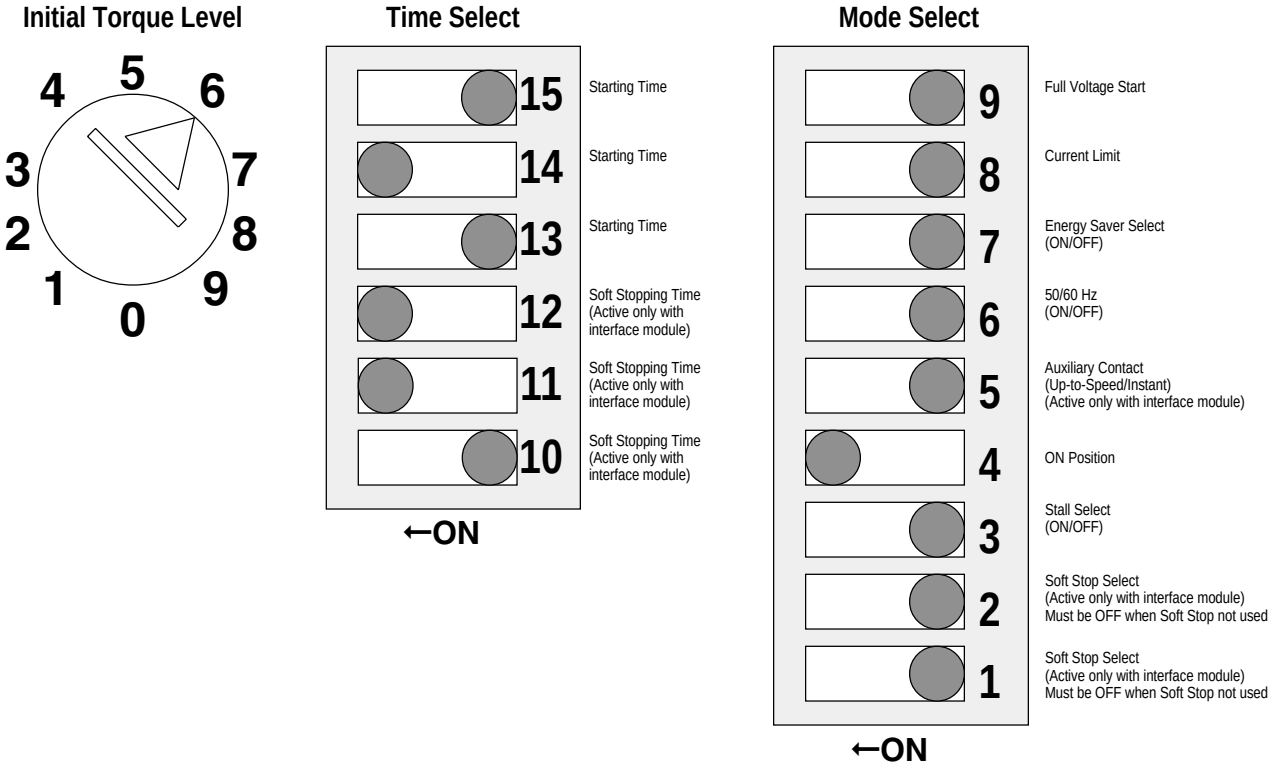
This is a built-in feature with the PG controller. It is used to save energy on applications where the motor is lightly loaded or unloaded for long periods of time.

Factory Settings

The controller has been factory set for the following parameters (refer to Figure 3.3):

- 10 Second Soft Start
- Initial Torque 30%
- Current Limit "OFF"
- Energy Saver "OFF"
- 60 Hz
- Auxiliary Contact "OFF"
- Stall feature "OFF"
- Full Voltage "OFF"
- Soft Stop "OFF"

Figure 3.3 - Factory Switch Settings



Customer Settings

After the controller has been installed, further set-up may be necessary. This set-up is accomplished through DIP and rotary digital switches located on the front of the controller.

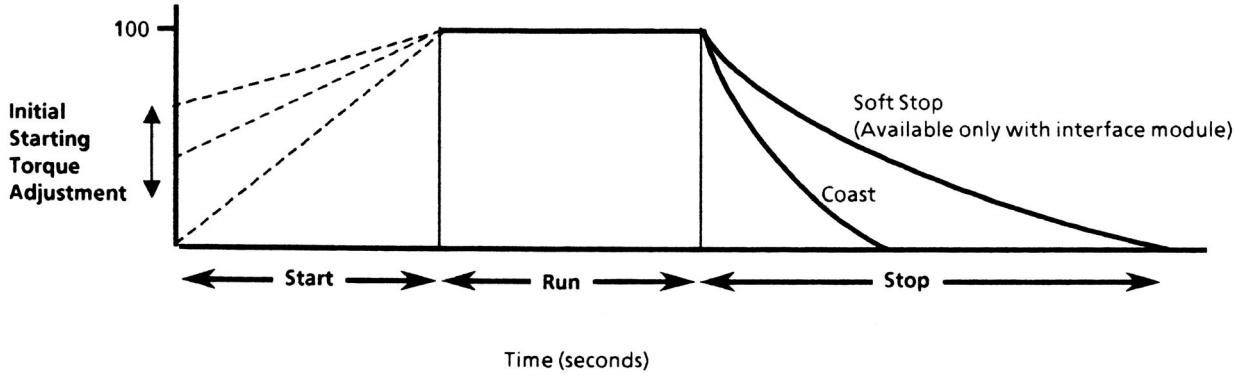
If the factory settings are not suitable for the specific application, pages 14 through 18 describe how to set the unit for Soft Start, Current Limit and Full Voltage Starting.

WARNING: Disconnect power before opening access door and making adjustments to DIP and rotary digital switches.

Use a small screwdriver to pry open the access door. Set the switches to meet application requirements.

Soft Start

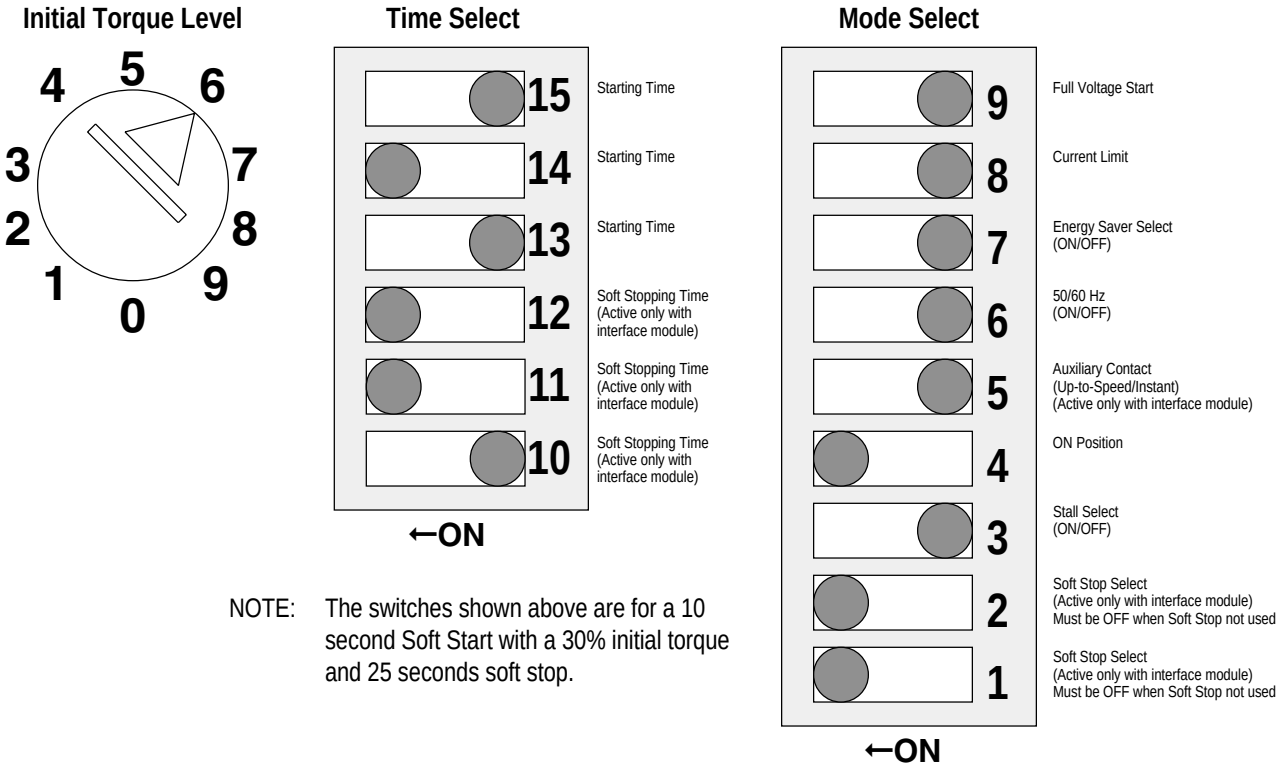
This method has the most general application. The motor voltage gradually increases during the acceleration ramp period, which can be adjusted from 2 to 30 seconds nominal. The controller is shipped with the acceleration ramp time set for 10 seconds. Therefore, in most cases, resetting the controller is not required.



Soft Start Selection

1. Set Initial Torque rotary digital switch to the desired setting. Refer to next page.
2. Adjust DIP switches 13, 14 and 15 for soft start time. Refer to the next page for settings.
3. Set Energy Save DIP switch 7 to ON for energy savings. Set Stall DIP switch 3 to ON for stall protection.
4. Soft Stop is only available with the interface module. Set Soft Stop Select DIP switches 1 and 2 to ON for soft stop. Set DIP switches 10, 11, and 12 for stopping time. Refer to next page for settings.
5. Auxiliary contact is only available with the interface module. Set mode of the auxiliary contact with DIP switch 5. Set to OFF for instantaneous, ON for up-to-speed.
6. Switch 4 should be ON.
7. Switches 8 and 9 should be OFF.
8. Set switch 6 for line frequency (ON for 50 Hz, OFF for 60 Hz).

Soft Start Selection (continued)



NOTE: The switches shown above are for a 10 second Soft Start with a 30% initial torque and 25 seconds soft stop.

Initial Torque Level

Rotary Position	0	1	2	3	4	5	6	7	8	9
% of Locked Rotor Torque	0	1	2	5	10	20	30	40	50	70

Soft Start Time

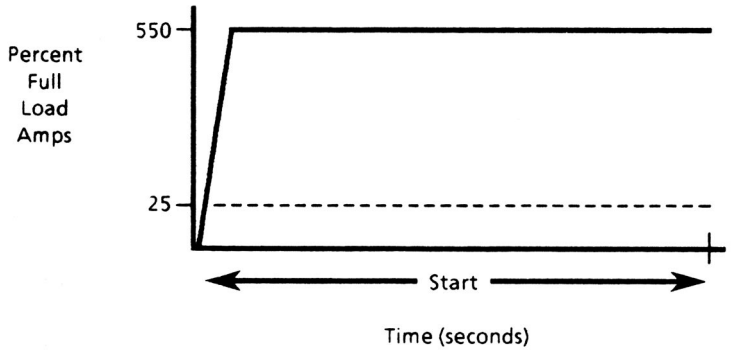
Switch Number	Time (seconds)						
	2	5	10	15	20	25	30
15	Off	**ON**	Off	**ON**	Off	**ON**	Off
14	Off	Off	**ON**	**ON**	Off	Off	**ON**
13	Off	Off	Off	Off	**ON**	**ON**	**ON**

Soft Stop (Available only with interface module)

Switch Number	Time (seconds)							
	5	10	15	25	35	45	55	110
12	Off	**ON**	Off	**ON**	Off	**ON**	Off	**ON**
11	Off	Off	**ON**	**ON**	Off	Off	**ON**	**ON**
10	Off	Off	Off	Off	**ON**	**ON**	**ON**	**ON**

Current Limit

This starting mode is used when it is necessary to limit the maximum starting current. The current limit is adjusted according to starting current restrictions. This can be adjusted from 25 to 550% of full load amperes nominal.

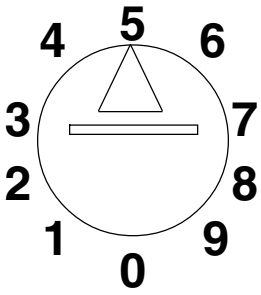


Current Limit Selection

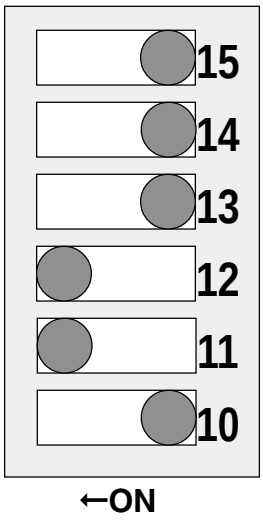
1. DIP switch 8 must be ON for current limit mode. Refer to next page.
2. Set rotary digital switch for current limit level. Refer to next page for settings.
3. Set switches 13, 14 and 15 for current limit start time.
4. Set Energy Saver DIP switch 7 to ON for energy savings. Set Stall DIP switch 3 to ON for stall protection.
5. Soft Stop is only available with the interface module. Set Soft Stop Select DIP switches 1 and 2 to ON for soft stop. Set DIP switches 10, 11 and 12 for stopping time. Refer to next page for settings.
6. Auxiliary contact is only available with the interface module. Set mode of the auxiliary contact with DIP switch 5. Set to OFF for instantaneous, ON for up-to-speed.
7. Switch 4 should be ON.
8. Switch 9 should be OFF.
9. Set switch 6 for line frequency (ON for 50 Hz, OFF for 60 Hz).

Current Limit Selection (continued)

Current Limit Level

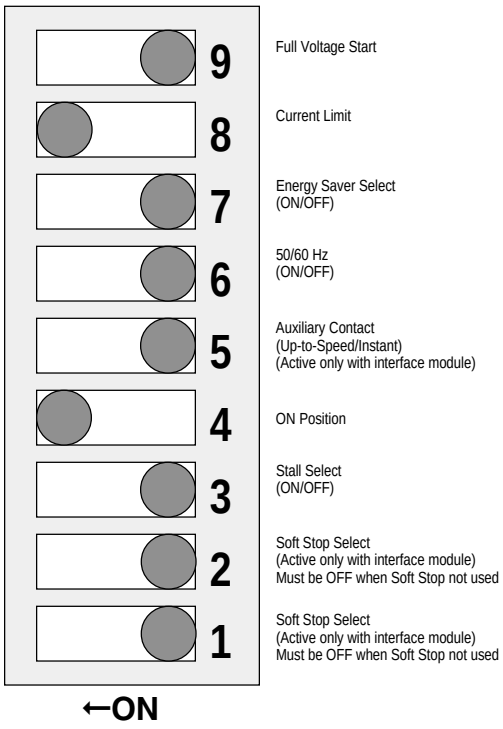


Time Select



NOTE: The switches shown above are for a 15 second 300% current limit start.

Mode Select



Rotary Position - % Current Limit

Position	0	1	2	3	4	5	6	7	8	9
% of Full Load Amps	25	50	100	200	250	300	350	450	500	550

Current Limit Start Time

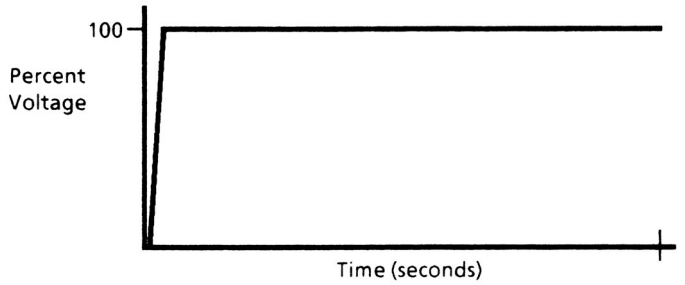
Switch Number	Time (seconds)	
	15	30
15	Off	**ON**
14	Off	Off
13	Off	Off

Soft Stop (Available only with interface module)

Switch Number	Time (seconds)							
	5	10	15	25	35	45	55	110
12	Off	**ON**	Off	**ON**	Off	**ON**	Off	**ON**
11	Off	Off	**ON**	**ON**	Off	Off	**ON**	**ON**
10	Off	Off	Off	Off	**ON**	**ON**	**ON**	**ON**

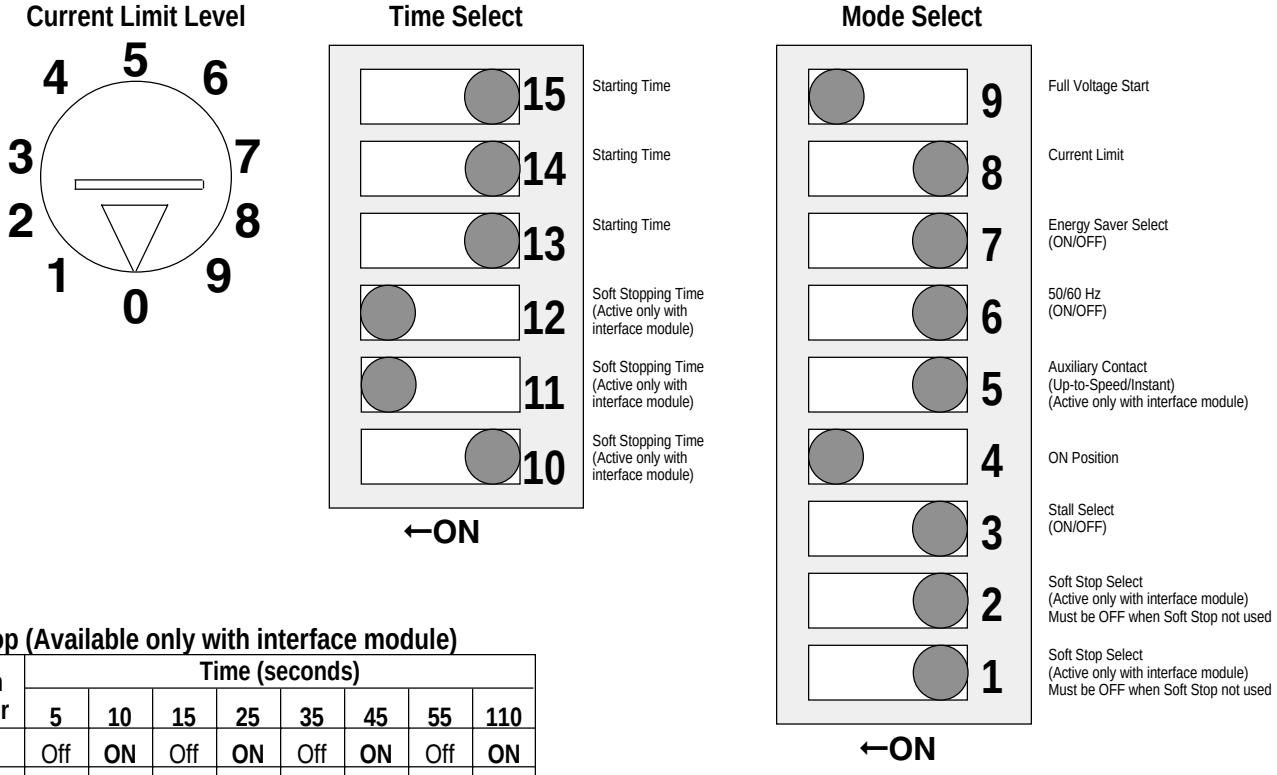
Full Voltage

For applications requiring a full voltage start, the acceleration ramp time is set to minimum (1/10 second). This, in effect, allows the controller to start the load across-the-line.



Full Voltage Selection

1. For full voltage starting, switch 9 must be ON and switches 13, 14 and 15 must be OFF. This results in a full voltage start of approximately 1/10 second.
2. Set Energy Saver DIP switch 7 to ON for energy savings. Set Stall DIP switch 3 to ON for stall protection.
3. Soft Stop is only available with the interface module. Set Soft Stop Select DIP switches 1 and 2 to ON for soft stop. Set DIP switches 10, 11, and 12 for stopping time. Refer to chart below for settings.
4. Auxiliary contact is only available with the interface module. Set mode of auxiliary contact with DIP switch 5. Set to OFF for instantaneous, ON for up-to-speed.
5. Switch 4 should be ON.
6. Switch 8 should be OFF.
7. Set switch 6 for line frequency (ON for 50 Hz, OFF for 60 Hz).



Soft Stop (Available only with interface module)

Switch Number	Time (seconds)							
	5	10	15	25	35	45	55	110
12	Off	**ON**	Off	**ON**	Off	**ON**	Off	**ON**
11	Off	Off	**ON**	**ON**	Off	Off	**ON**	**ON**
10	Off	Off	Off	Off	**ON**	**ON**	**ON**	**ON**

Troubleshooting

For safety of maintenance personnel as well as others who might be exposed to electrical hazards associated with maintenance activities, the safety related work practices of NFPA 70E, Part II, should always be followed when working on electrical equipment. Maintenance personnel must be trained in the safety practices, procedures, and requirements that pertain to their respective job assignments.

WARNING: To avoid shock hazard, disconnect main power before working on the controller, motor, or control devices such as Start/Stop pushbuttons.

CAUTION: Disconnect the controller from the motor before measuring insulation resistance (IR) of the motor windings. Voltages used for insulation resistance testing can cause failure to SCRs. 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 less than the Start Time setting and will vary depending on the frictional load and inertial characteristics of the system.

Motor Will Not Start - Series Controller Configuration (Figure 2.5 on Page 4)

Symptom	Possible Cause	Remedy
LED off	● No three-phase power ● Failed overload	● Check three-phase line voltage ● Check overload relay
LED on	● DIP switch 2 on	● Turn DIP switch 2 off
LED flashing	● Fault condition exists	● Check that all three-phase voltages are present. ● Check resistance between L1 & T1, L2 & T2 and L3 & T3. Less than 50 Ohms indicates shorted SCR. Replace unit. ● Motor stall

Motor Attempts To Start - Series Controller Configuration

Symptom	Possible Cause	Remedy
Motor does not accelerate to full speed	● Motor overload ● Motor stall ● Initial torque too low	● Check motor load ● Check if LED is flashing and DIP switch 8 is on. If so, motor stalled. ● Adjust initial torque

Motor Will Not Start With Interface Module (Figure 2.7 on Page 5)

Symptom	Possible Cause	Remedy
LED off	● No three-phase power ● Failed overload ● Interface module requires control voltage	● Check three-phase line voltage ● Check overload relay ● Check for control voltage
LED on	● Tripped overload ● No control voltage ● No start signal	● Check overload relay ● Check control voltage between terminals 10 and 40 ● Check that start signal is present from 50 to 40
LED flashing	● Fault condition exists	● Check that all three-phase voltages are present. ● Check resistance between L1 & T1, L2 & T2 and L3 & T3. Less than 50 Ohms indicates shorted SCR. Replace unit. ● Motor stall

Motor Attempts To Start With Interface Module

Symptom	Possible Cause	Remedy
Motor does not accel to full speed	● Motor overload ● Motor stall ● Initial torque too low	● Check motor load ● Check if LED is flashing and DIP switch 8 is on. If so, motor stalled. ● Adjust initial torque
Auxiliary contact will not pick up	● Auxiliary contact not working	● Check terminals 50/60 for proper operation ● Replace interface module

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