Installation
and maintenance

Softstarters

Type SSA
25 – 1125 HP

AC 1006.1

Registered by UL to
ISO 9002

Low Voltage Products & Systems

Power terminal wire range and tightening torque

480V	600V	WIRE RANGE	TORQUE LBS/IN
SA030-48	SA040-60	#18 - #4	20
SA040-48 SA050-48	SA050-60 SA060-60	#14 - #4	50
SA060-48 SA075-48	SA075-60 SA100-60	#14 - #1/0	50
SA100-48 SA125-48	SA125-60 SA150-60	#6 - 250kcmil	325
SA150-48 SA200-48	SA200-60 SA250-60	(2)#6 - 250kcmil	325
SA250-48 thru SA400-48	SA300-60 thru SA500-60	(2)#2 - 600kcmil	375
SA500-48 thru SA700-48	SA600-60 thru SA800-60	(3)4/0 - 600kcmil	375
SA800-48	SA900-60	(4)4/0 - 600kcmil	375
SA900-48 SA1000-48	SA1000-60 SA1125-60	(4)300kcmil - 800kcmil	500

ALL TERMINALS ARE FOR 75˚C CU CABLES

Warranty policy

ABB warrants its products to be free from defects in material and/or workmanship for a period of one year from the date of installation, to a maximum of 18 months from the date of shipment as indicated by the unit's date code. The Company reserves the right to repair or replace any malfunctioning units under warranty at their option. All warranty repairs must be performed by the Company factory, or on site by factory authorized service firms or personnel approved by the Company.

Solid state controls have different operating characteristics from those of electro-mechanical equipment. Because of these differences and the wide variety of applications for solid state controls, each application designer must verify that the solid state equipment is acceptable for his application. In no event will ABB be liable or responsible for indirect or consequential damages resulting from the use or application of this equipment. The diagrams and illustrations in this document are included solely for illustrative purposes. Because of the number of different applications, ABB can not be responsible or liable for actual use based on the examples or diagrams.

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Chapter 1 – Introduction

1.1 – General

The Type SSA solid state reduced voltage starter is a six SCR design which features a voltage/current ramp with an anti-oscillation circuit for smooth load acceleration. The SCRs are sized to withstand starting currents of 500% for 60 seconds (compared with 350% for 30 seconds from other manufacturers). The Type SSA features smooth, stepless ramp control which reduces motor inrush current and excessive wear on the mechanical drive train components. In addition to having easy to understand diagnostic lights, the Type SSA can be set up for the ideal starting cycle. Starting torque, ramp time, current limit, and decel control are standard adjustments on the Type SSA. By adjusting the starting torque, ramp time and current limit potentiometers, the starting electrical characteristics of the motor can be matched to the mechanical characteristics of the drive train for controlled acceleration of the load. The Type SSA includes adjustable overload protection (standard ≥ 100HP, optional < 100HP at 480V), shorted SCR detection and phase loss detection. It is factory wired for 120VAC control voltage (or 240VAC for 415 VAC and 380 VAC units). Auxiliary contacts and provisions for interlocking are also included.

1.2 – Specifications and performance features

Type of load	Three phase AC induction motor	
AC Supply voltage	208, 240, 380, 415, 480 or 575 (VAC ± 10%, 50/60 Hz line voltages)	
HP ratings	Up to 1125HP	
Power circuit	6 SCRs	
	Line voltage	PIV Ratings
SCR/Diode peak inverse	208 to 480	1200
Voltage	575	1500
Phase insensitivity	Unit operates with any phase sequence	
Cooling	Convection or fan cooling	
Ambient operating	Chassis units: 0° to 50°C (32° to 122°F)	
Temperature	Enclosed units: 0° to 40°C (32° to 104°F)	
Control	2 or 3 wire 120 VAC (customer supplied). On 380 and 415V units, the control voltage is 240VAC. CPTs are standard on enclosed units.	
Standard adjustments	Starting torque	0 to 100%
	Starting ramp time	0 to 60 seconds
	Current limit	200% to 500%
Decel adjustments	Step down voltage	0 to 100%
	Deceleration ramp time	0 to 30 seconds
	Stop level voltage	0 to 100%
Current trip	Fixed 10 times FLA	
Auxiliary contacts	3 Form C (N.O., N.C.) 5A @ 240V (1200VA maximum)	
Overload capacity	115% continuous 500% 60 seconds unit rating	
Approvals	UL Listed, Canadian UL	
Standard overload	Class 10, 600% ± 20% for 10 sec. (adjustable) 100HP and above at 480V	

1.3 – Receiving and unpacking

Upon receipt of the product you should immediately do the following:

- Carefully unpack the unit from the shipping carton and inspect it for shipping damage (if damaged, notify the freight carrier and file a claim within 15 days of receipt).
- Verify that the model number on the unit matches your purchase order.
- Confirm that the ratings sticker on the unit matches or is greater than the motor's HP, current and voltage rating.

2.1 – Location

Proper location of the Type SSA is necessary to achieve specified performance and normal operation lifetime. The Type SSA should always be installed in an area where the following conditions exist:

- Ambient operating temperature:
  Chassis unit: 0 to 50°C (32 to 122°F)
  Enclosed unit: 0 to 40°C (32 to 104°F)
- Protected from rain and moisture
- Humidity: 5 to 95% non-condensing
- Free from metallic particles, conductive dust and corrosive gas
- Free from excessive vibration (below 0.5G)
- Open panel units must be mounted in the appropriate type of enclosure. Enclosure size and type must be suitable to dissipate heat generated by the soft starter. Contact factory.

2.2 – Initial unit inspection

Prior to installing, make a complete visual check of the unit for damage in shipping and handling. Report damage immediately before attempting to run unit. Check for loose mechanical assemblies or broken wires which may have occurred during transportation or installation. Loose electrical connections will increase resistance and cause the unit to function improperly. Prior to beginning the installation verify that the motor and the unit are rated for the proper amperage and motor current. Check the motor FLA to ensure that the nameplate rating of the unit will handle this specific motor.

2.3 – Dimensions

Open panel units must be mounted in the appropriate type of enclosure. Enclosure size and type must be suitable to dissipate heat generated by the SCRs. Contact factory for assistance in sizing enclosures.

2.4 – Warning

Do not service equipment with voltage applied! Unit can be source of fatal electrical shocks! To avoid shock hazard, disconnect main power and control power before working on the unit. Warning labels must be attached to terminals, enclosure and control panel to meet local codes.

2.5 – Mounting and cleaning

When drilling or punching holes in the enclosure, cover the electrical assembly to prevent metal filings from becoming lodged in areas which can cause clearance reduction or actually short out electronics. After work is complete, thoroughly clean the area and re-inspect the unit for foreign material. Make sure there is sufficient clearance (six inches) all around the unit for cooling, wiring and maintenance purposes. To maximize effective air flow and cooling, the unit must be installed with its heat sink ribs oriented vertically and running parallel to the mounting surface.

Warning: Remove all sources of power before cleaning the unit.

In dirty or contaminated atmospheres the unit should be cleaned on a regular basis to ensure proper cooling. Do not use any chemicals to clean the unit. To remove surface dust, use 80 to 100 psi clean dry compressed air only. A three inch high quality dry paint brush is helpful to loosen up the dust prior to using compressed air on the unit.

Model		Unit maximum amp rating	HP/Voltage				Dimensions		
480V	600V		208V	240V	480V	600V	H	W	D
SSA025 – SSA030	**SSA030 – SSA040**	42	10	15	30	40	16.5	10	10
SSA040 – SSA050	**SSA050 – SSA060**	68	20	25	50	60			
SSA060 – SSA075	**SSA075 – SSA100**	104	30	40	75	100			
SSA100 – SSA125	**SSA125 – SSA150**	154	50	60	125	150	20	20	12.0
SSA150	**SSA200**	192	60	75	150	200	27	20	11.5
SSA200	**SSA250**	248	75	100	200	250			
SSA250 – SSA300	**SSA300 – SSA350**	360	125	150	300	350	29.5	20	11.5
SSA350	**SSA400**	414	—	—	350	400			
SSA400	**SSA500**	480	150	200	400	500			
SSA500 – SSA700	**SSA600 – SSA800**	840	300	350	700	800	45	33	12.75
SSA800	**SSA900**	960	350	400	800	900	33	33	15.25
SSA900 – SSA1000	**SSA1125**	1250	450	500	1000	1125			

3.1 – Thermal overload relay

The Type SSA provides motor overload protection using an adjustable thermal overload relay. The standard Type SSA is furnished with a Class 10 thermal overload. A Class 10 overload will trip after 600% current for 10 seconds or less. Class 20 overload heater packs are also available. These overloads will trip after 600% current for 20 seconds or less.

3.2 – Overload relay

The bimetallic ambient compensated overload relay has an adjustable FLA range set by the dial. The overload relay will ultimately trip at 125% FLA for a 1.15 service factor motor, and 115% FLA for a 1.0 service factor motor. For 25 to 1000 Hp see section 3.3.

3.3 — Class 10 OLR dial adjustment, 25 Hp and larger

Soft starter	Overload relay	Overload dial setting to actual FLA						
		3.5	4.0	4.5	5.0	5.5	6.0	6.5
SSA025	TA25DU5.0	28.0	32.0	36.5	40.0	–	–	–
SSA030	TA25DU6.5	–	–	36.0	40.0	44.5	48.0	52.5
SSA040	TA25DU5.0	42.0	48.0	54.0	60.0	–	–	–
SSA050	TA25DU5.0	52.5	60.0	67.5	75.0	–	–	–
SSA060	TA25DU5.0	56.0	64.0	72.5	80.0	–	–	–
SSA075	TA25DU5.0	84	96	108	120	–	–	–
SSA100	TA25DU5.0	105	120	135	150	–	–	–
SSA125	TA25DU6.5	–	–	135	150	165	180	195
SSA150	TA25DU5.0	140	160	180	200	–	–	–
SSA200	TA25DU5.0	175	200	225	250	–	–	–
SSA250	TA25DU5.0	210	240	270	300	–	–	–
SSA300	TA25DU5.0	280	320	360	400	–	–	–
SSA350	TA25DU5.0	315	360	405	450	–	–	–
SSA400	TA25DU5.0	350	400	450	500	–	–	–
SSA500	TA25DU5.0	420	480	540	600	–	–	–
SSA600	TA25DU5.0	525	600	675	750	–	–	–
SSA700	TA25DU5.0	560	640	720	800	–	–	–
SSA800	TA25DU5.0	700	800	900	1000	–	–	–
SSA900	TA25DU5.0	840	960	1080	1200	–	–	–
SSA1000	TA25DU5.0	840	960	1080	1200	–	–	–

3.4 – Class 20 OLR dial adjustment, 100 Hp and larger

The FLA value for each position of the overload adjustment dial is shown on the model label. Refer to the label on the unit for the current values corresponding to the A, B, C and D letters. For motors having a 1.15 service factor, position the FLA adjustment dial to correspond to the motor FLA rating. Estimate the dial position when the motor FLA falls between two letter values. For motors having a 1.0 service factor (or IEC requirements), rotate the FLA dial as shown on Figure 3.1.

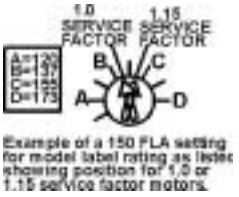


Figure 3.1 – FLA adjustable dial

WARNING: **To provide continued protection against fire or shock hazard, the complete overload relay must be replaced if burnout of the heater element occurs.**

3.5 – Manual/automatic reset

The overload relay is factory set at “M” for manual reset operation. The manual setting is recommended. However, for automatic reset operation, turn the reset adjustment dial marked A and M to the “A” position. To prevent automatic restart on over-temperature or motor overload, two-wire control must be interlocked with the auxiliary contact so the start contact is removed on trip.

3.6 – Test for trip indication

To test overload relay for trip indication when in manual reset, activate the test trip button on the overload. An indicator flag appears when the device trips and the LEDs on the display indicate “Overload.” Push reset button on overload to clear the fault. This test is recommended to ensure that the motor protection is active. On major faults it is recommended that the overload be checked or changed.

4.1 – Power connections

Connect appropriate power lines to the unit input terminals marked L1, L2, L3. Avoid routing power wires near the control board. Connect the motor leads to the unit terminals marked T1, T2, T3. Refer to NEC standards for wire length, sizing and lug torque. Never interchange input and output connections to the unit. This could cause excessive voltage in the control logic circuit and may damage the unit. Note: Never connect power factor correction capacitors on the load side of the unit. If capacitors are located on the load side, serious damage to the SCRs will occur. The unit cannot be tested without a motor or other test load connected to the load side of the unit. It may be necessary to use a load bank to test the unit without a motor. Note that line voltage will appear across the output terminals if there is no motor or load connected to the unit. In areas where lightning is a significant problem, station-type air gap lightning arrestors should be considered and utilized on the input power source.

Note: Some units may have the overload on the load side of the starter.

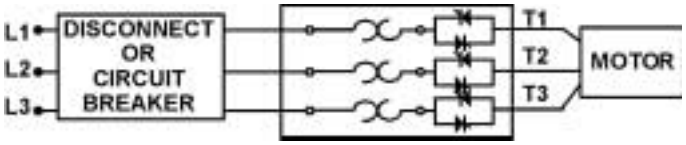


Figure 4.1 – Power Connections

4.1.1 – Grounding

Connect the ground cable to the ground terminal as labeled on the unit. Refer to the National Electrical Code for the proper ground wire sizing and be sure that the ground connector is connected to earth ground.

4.2 – Control connections

4.2.1 – Control power connections

Separate 120VAC supply is required (240VAC on 380V and 415V models). The control voltage should be connected to pins 1 and 6 of TB1. This control voltage must be customer supplied unless an optional control power transformer has been supplied with the unit. On units below 75 HP, the TB1 terminal block is located on the main control board.

4.2.2 – Two-wire connection

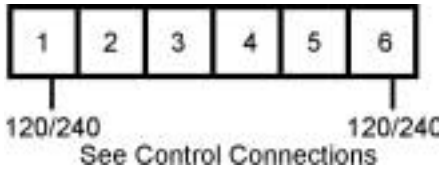


Figure 4.2

An alternate connection for unattended operation replaces start/stop buttons by connecting a maintained contact closure between pins 3 and 5 on TB1 (see Figure 4.3). When the maintained contact is used for start/stop it is necessary to set the overload relay to the manual reset position. This will prevent a restart of the motor that would occur if the thermal overload trips and then cools off (refer to Figure 4.3 for 120 VAC connections and interlocks).

Note: When two-wire connection method is used, the start circuit must be interlocked to prevent automatic restart when either of the two protective devices (overload or thermostat) reset. Thermostats always automatically reset on cool down.

4.2.3 – Three-wire connection

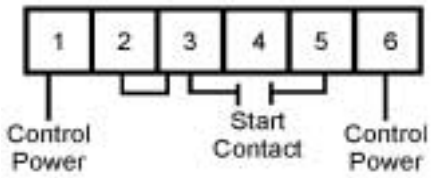


Figure 4.3 – Two-wire connection

For standard 3-wire control connect 120VAC (or 240VAC for 415V and 380V units) to TB1 pins 1 and 6. Connect N.C. (normally closed) stop button between pins 3 and 4 of TB1. Connect N.O. (normally open) start button between pins 4 and 5 of terminal block TB1.
(See Figure 4.4)

4.2.4 Resetting faults

To reset phase loss, overcurrent, or other faults, remove control

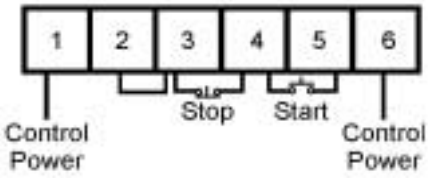


Figure 4.4 – Three-wire connection

power for two seconds to clear the fault condition. Check unit to ensure that the fault has been corrected before reenergizing unit. An external reset can be accomplished by sending a closed signal to terminals 1 and 2 on TB5.

4.2.5 – Relay contacts

All the relay contacts are FORM C common, normal open, normal closed. ABB recommends fusing all contacts with external fuses. TB2 is the terminal block for all external contacts. Refer to Figure 4.5. Each contact is explained in the following sections.

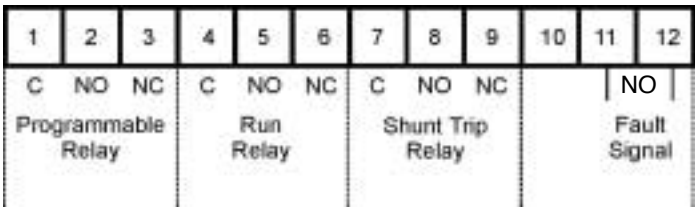
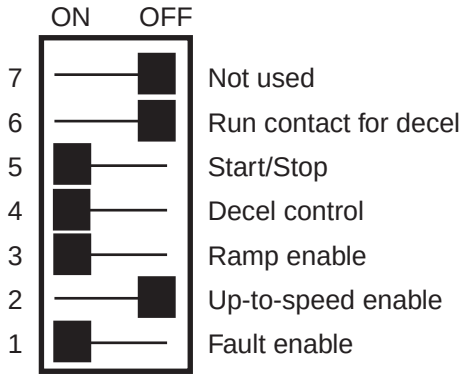


Figure 4.5 – TB4



4.2.6 – Run contacts

Auxiliary N.O. and N.C. FORM C contacts are available on TB2. These contacts are rated 5 amps, 240 VAC maximum (1200 VA maximum) for external use. Auxiliary contacts on the control board energize (change state) when the start command is given and de-energize (change back) when stop or fault condition occurs. In decel mode, the run contact can be modified to drop out at the stop command or can stay latched until the end of the decel command. Dip switch 5 is on and dip switch 6 is off for normal start/stop mode. To keep the run contact latched until the end of decel, turn dip switch 6 on and dip switch 5 off.

4.2.7 – Programmable relay

The SSA also includes a programmable relay on TB4. The relay is rated for 240 VAC, 5A, 1200VA. The relay responds to either a fault condition or an up-to-speed condition. For the relay to act as a fault relay, turn dip switch 1 on and dip switch 2 off (Factory Setting). For an up-to-speed contact turn dip switch 1 off and dip switch 2 on. In the up-to-speed mode, the programmable relay can be used to control a bypass contactor

4.2.8 – Emergency shunt trip relay

The shunt trip relay at TB4 on the main circuit board will also activate when a shunt trip signal is received. This relay is rated for 240VAC, 5 Amps, 1200VA. This relay can be used in your external shunt trip circuit. Check inrush rating on shunt trip breaker. This relay is not programmable. This relay only operates if current is flowing in an off condition.

4.2.9 – Fault signal (solid state)

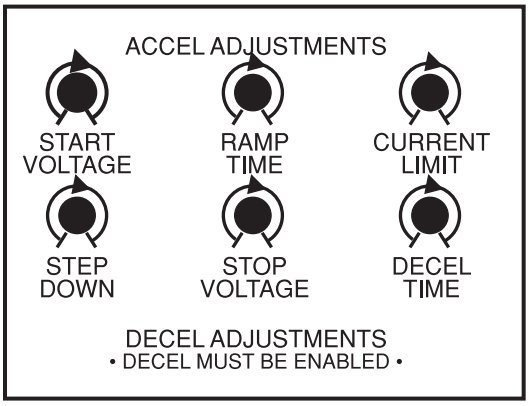
Optical AC switch triac driver that is used for fault indication. This signal energizes with the fault LED, 50 mA maximum output.

5.1 – Introduction

It is best to operate the motor at its full load starting condition to achieve the proper time, torque and ramp settings. Note that the potentiometers have a turning range of 3/4 revolution. Forcing the potentiometer beyond this range will damage the unit. Initial settings are set to accommodate most motor conditions. **TRY INITIAL SETTINGS FIRST.**

5.1.1 – Initial settings (factory set)

Starting Voltage = 60% of line voltage
Ramp Time = 10 seconds
Current Limit = 350% of unit full load amps



5.2 – Acceleration adjustments

The unit is set at the factory with typical starting characteristics that perform well in most applications. When the system is ready to start, try the initial unit settings. If the motor does not come up to speed, increase the current limit setting. If the motor does not start to turn as soon as desired, raise the starting torque adjustment. The unit has three accel adjustments. Adjustment description and procedures are described as follows:

5.2.1 – Starting voltage adjustment/rotation check

Turn dip switch 3 to the OFF position, disabling the ramp function, to allow starting voltage adjustment. Starting voltage adjustment changes the initial starting voltage level to the motor. This voltage level is adjustable from 0 to 100% of line voltage. Start voltage is increased by rotating the start voltage potentiometer clockwise.

5.2.2 – Ramp time adjustment

Ramp time adjustment changes the amount of time it takes to reach the current limit point or full voltage if the current limit point was not reached. Acceleration time (ramp) can be increased by rotating the ramp potentiometer in a clockwise direction. The ramp time adjustment is made after the starting torque has been set. Set the ramp time potentiometer by slowly rotating it until the desired ramp time is reached. The unit should be stopped and restarted to see if the desired acceleration time has been achieved.

Note: Refer to your motor manual for the maximum number of starts allowed by the manufacturer and do not exceed the recommended number.

5.2.3 – Current limit adjustment

Current limit adjustment is factory set for 350% of the unit's rating. The range of adjustment is 200% to 500%. The main function of current limit is to cap the peak current. It may also be used to extend the ramping time if desired. The interaction between the voltage ramp and the current limit will allow the soft start to ramp the motor until the maximum current is reached and the current limit will hold the current at that level. Current

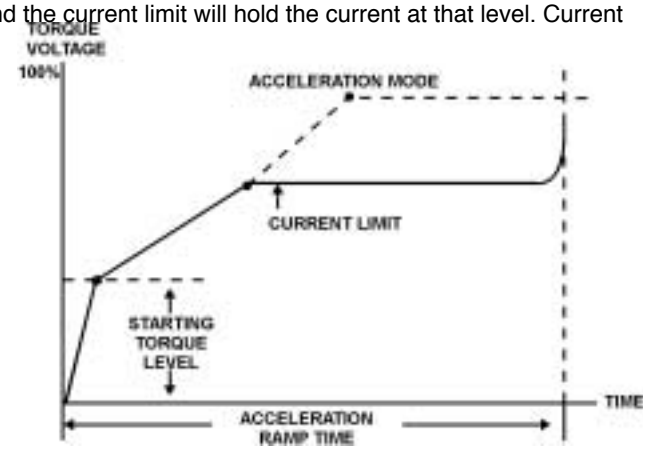


Figure 5.2 – Ramp characteristics

limit must be set high enough to allow the motor to reach full speed. The factory setting of 350% is a good starting point. Caution should be taken not to set the current limit too low on variable starting loads as this will cause the motor to stall and eventually cause the system overloads to trip. Note: if the motor does stall, refer to the motor manufacturer for the proper cooling time.

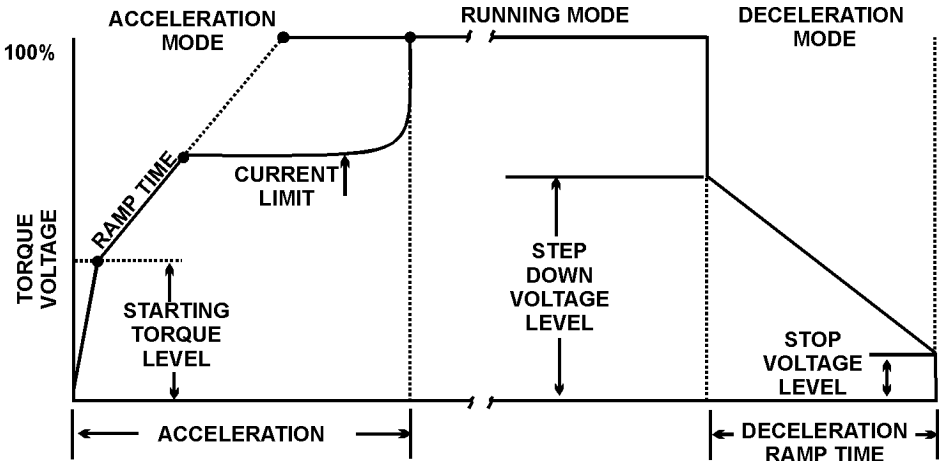
5.3 – Deceleration adjustments

The soft starter is shipped from the factory with the decel feature disabled. Turn off dip switch 4 to enable decel control feature. (See page 6 for dip switch drawing.)

5.3.1 – Deceleration control (pumping application)

Decel extends the stopping time on loads that stop too quickly and will provide smooth deceleration until the load stops. Three adjustments optimize the deceleration curve to meet the most demanding requirements.

- The step down voltage adjustment eliminates the dead band in the deceleration mode that is experienced while the voltage drops to a level where the motor deceleration is responsive to decreased voltage. This feature allows for an instantaneous drop in voltage when deceleration is initiated.
- The stop voltage level set point is where the deceleration voltage drops to zero.
- The deceleration ramp time is adjustable from 0 to 30 seconds and adjusts the time it takes to reach the stop voltage level set point.



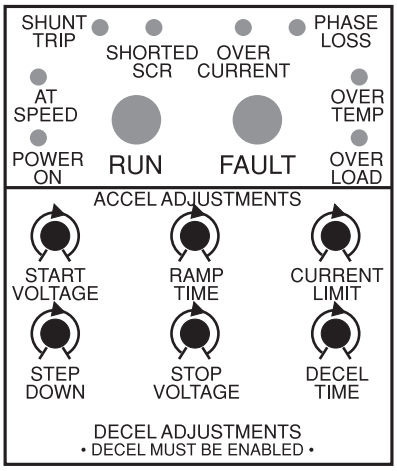
5.3.2 – Adjustments

1. Verify that the soft start adjustments are made as recommended in Section 5.2.

2. Verify that the deceleration board settings are set as listed below. **Try factory settings before adjusting.**

- Step down — 70% voltage
- Stop voltage — 20% voltage
- Decel time — 10 seconds

3. Apply power and adjust the soft start before modifying the deceleration adjustments. Both acceleration and deceleration adjustments should be made under normal load conditions.



Softstarter operator panel

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6.1 – Start-up check list

- Supply voltage matches the rated supply voltage of the unit.
- Horsepower and current ratings of the motor and unit match or the unit has a higher rating.
- Initial ramp time and torque adjustments have been checked.
- Power lines are attached to the unit input terminals marked L1, L2 and L3.
- Motor leads are connected to the unit load terminals marked T1, T2, and T3.
- Appropriate control power is applied and/or control connections have been made.
- The motor area and equipment are clear of people and parts before start-up.
- The thermal overload is set to motor rating.

6.2 – Sequence of operation

First, check all power connections on the unit with all power removed; second, apply control power and check that the "Power On" LED comes on. Apply three phase power to the unit. The motor should run only when the start command is applied.

Apply start command. The "Run" LED should light up and the motor should begin to accelerate. When the motor reaches full speed, the "At Speed" LED comes on. If the motor decelerates or stops during the acceleration period, hit the stop button immediately and open the disconnect line.

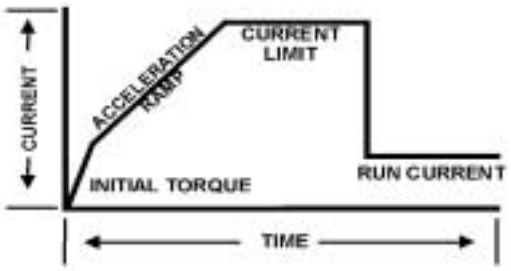

Figure 6.1 – Sequence of Operation

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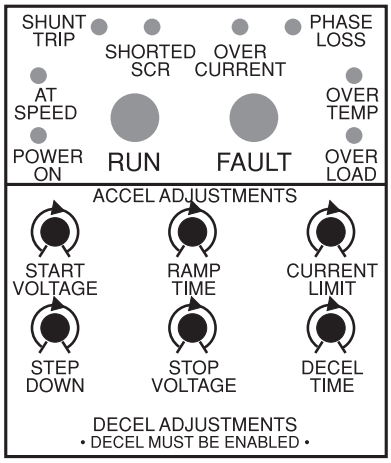
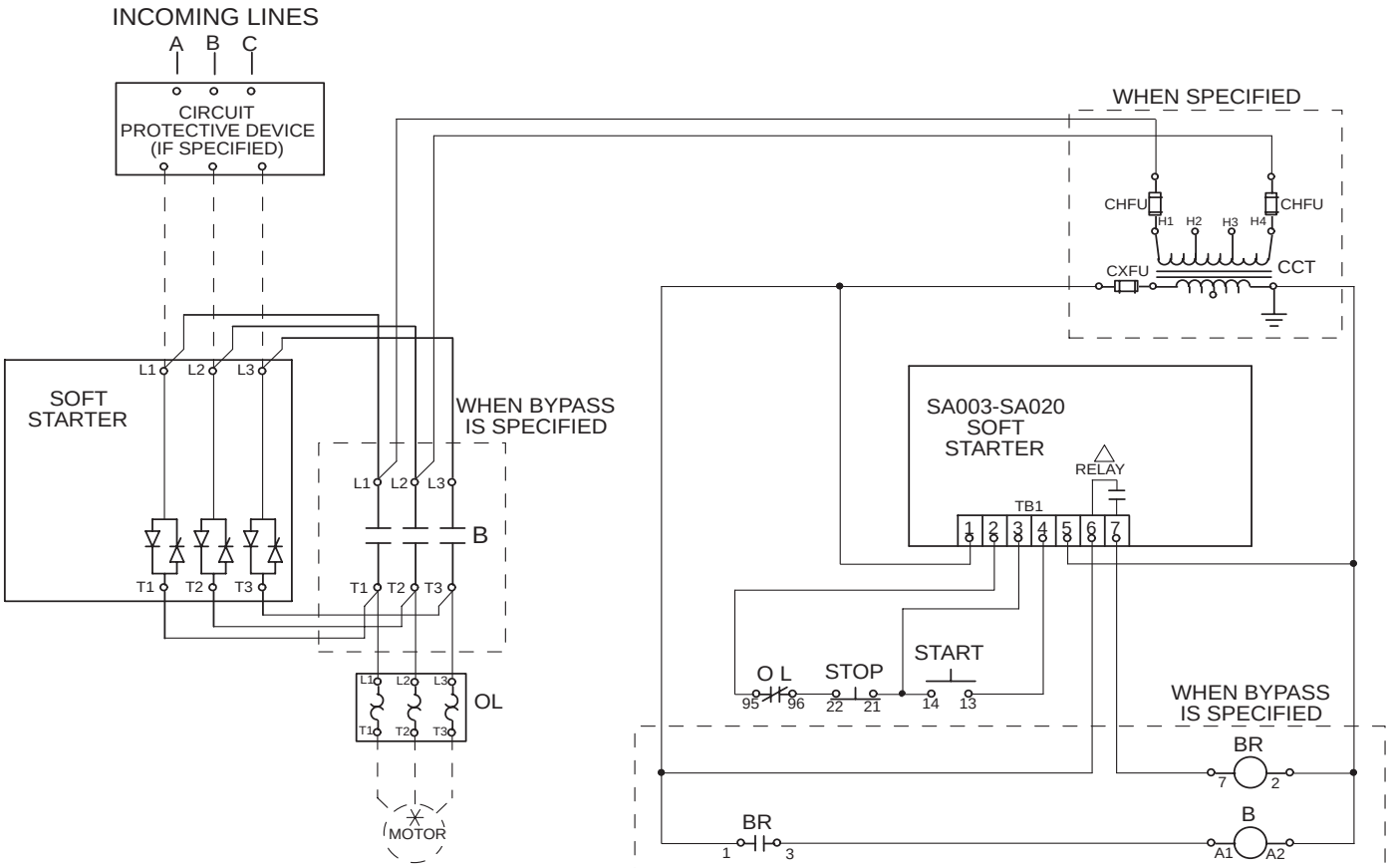
7.1 – LED functions

The unit has 10 LEDs on the status display.



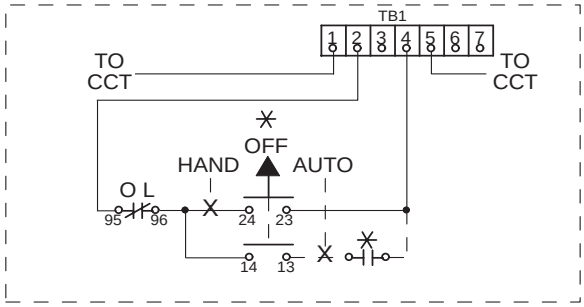
LED		STATUS
Green	Power On	Indicates control power is present
	Run	Indicates the unit is accelerating after acknowledging the start command.
	At Speed	Indicates the unit is running.
Yellow	Over Temperature	This LED indicates the motor starter has tripped due to over temperature.
	Overload	Indicates the starter's motor overload has tripped. The overload must be reset before the fault can be cleared.
	Phase Loss	This LED indicates that one of the incoming phases were lost while the motor was running.
	Shorted SCR	Indicates a shorted SCR was detected in the unit. Refer to 8.2 for checking SCRs. This fault will prevent a start command.
Red	Fault	This is a general indication of a fault occurring in the system. This LED illuminates when another yellow LED comes on to indicate the type of fault.
	Overcurrent	Indicates the unit experienced approximately ten times the FLA (Full Load Amps) and has shut down from a load failure of some type such as a phase to ground failure or a phase to phase short. The overcurrent trip is fixed at 10 times full load motor current and is not adjustable. Check for load faults before a restart. Verify SCRs are not damaged from the fault before restart.
	Shunt Trip	Indicates the starter has two or more power poles shorted and is passing current to the motor while in the off mode. For positive motor protection the "Shunt Trip" relay on the main circuit board must be interlocked with a shunt trip breaker or contactor in front of the unit. Do not re-power the unit without repairing the power poles.

7.2 – Wiring diagram — 25 to 75HP @480V



NOTES

1. COLOR OF CONTROL WIRE SHALL BE PER VOLTAGE OF CONTACTOR COILS:
   RED - ALL AC VOLTAGES
   WHITE MAY BE USED ON THE GROUNDED SIDE OF THE AC CIRCUIT IF SPECIFIED.
   BLUE - ALL DC VOLTAGES
2. ALL DEVICES ARE SHOWN DE-ENERGIZED.
3. DO NOT USE SELECTOR SWITCHES WITH AUTO-RESET OVERLOAD RELAYS



CONNECTION DIAGRAM FOR HOA

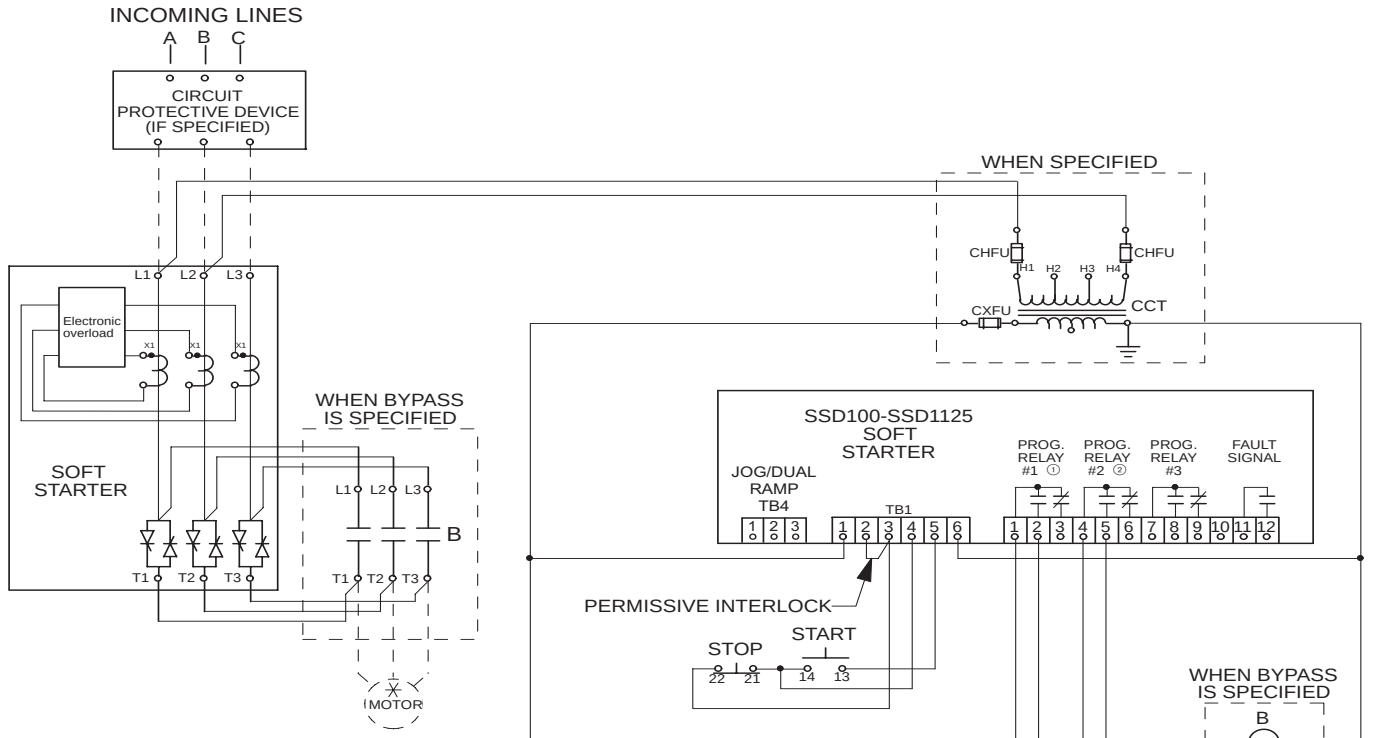
△ MOVE JUMPER AT X6 TO X8. JUMPER LOCATED ON MAIN CONTROL BOARD.

LEGEND	
CCT	CONTROL CIRCUIT TRANSFORMER
CHFU	CCT PRIMARY FUSE
CXFU	CCT SECONDARY FUSE
B	BYPASS CONTACTOR
OL	OVERLOAD RELAY
°13	CONN POINT ON DEVICE WITH NUMBER
⚹	REMOTE DEVICE
⌀	CONN POINT AT TERMINAL BLOCK

7

AC 1006.1 – 10/98

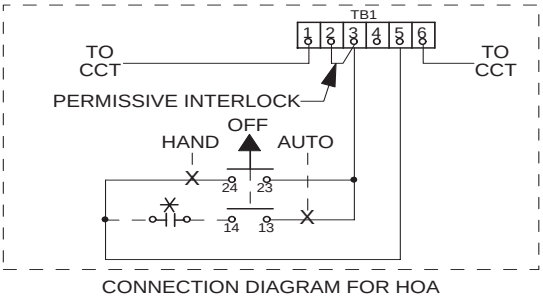
7.3 – Wiring diagram — 100HP and larger @480V



LEGEND	
CCT	CONTROL CIRCUIT TRANSFORMER
CHFU	CCT PRIMARY FUSE
CXFU	CCT SECONDARY FUSE
B	BYPASS CONTACTOR
OL	OVERLOAD RELAY
°13	CONN POINT ON DEVICE WITH NUMBER
⚹	REMOTE DEVICE
⌀	CONN POINT AT TERMINAL BLOCK

NOTES

1. COLOR OF CONTROL WIRE SHALL BE PER VOLTAGE OF CONTACTOR COILS:
   RED - ALL AC VOLTAGES
   WHITE MAY BE USED ON THE GROUNDED SIDE OF THE AC CIRCUIT IF SPECIFIED.
   BLUE - ALL DC VOLTAGES
2. ALL DEVICES ARE SHOWN DE-ENERGIZED.
3. DO NOT USE SELECTOR SWITCHES WITH AUTO-RESET OVERLOAD RELAYS



CONNECTION DIAGRAM FOR HOA

① Function F050 set to Run/Stop (#1)
② Function F051 set to At Speed/Stop (#2)
③ Motor nameplate FLA, Function F001, must be programmed for proper operation.

8.1 – Failure analysis

Problem	Possible LED Display	Possible Causes	Solution
One of the main fuses blows or circuit breaker opens when the power is applied	Fault and Shunt Trip LEDs: ON	Short circuit between line inputs	Locate and remove short
		Faulty SCR(s)	Remove power and test SCR(s). Refer to section 8.2 for SCR testing procedure
One of the main fuses blows or circuit breaker opens when start command is given	Fault and Overcurrent LEDs: ON Fault and Phase Loss LEDs: ON	Short circuit or ground fault in motor or cabling	Locate and remove short or ground
		Phase loss	Repair cause of phase loss
		Branch circuit protection not correctly sized	Verify correct sizing of branch circuit protection
		Faulty SCR(s)	Remove power and test SCR(s). Refer to section 8.2 for SCR testing procedure
		Single phase incoming power	Correct problem with incoming power
		Faulty main circuit board	Remove power and replace main circuit board. Refer to section 8.4 for board replacement procedure
Motor overload trips during start	Fault and Overload LEDs: ON	Overload improperly adjusted	Adjust O.L.
		Excessive load on motor	Lighten load on motor
		Current limit set too low	Increase current limit set point
		Incorrect start adjustment	Readjust starting parameters. Refer to Chapter 5
Motor overload trips during run	Fault and Overload LEDs: ON	Excessive load on motor (measure motor current at full speed)	Lighten load on motor
		Overload improperly adjusted	Readjust overload
Thermostat trips during run	Fault and Over Temp LEDs: ON	Fan(s) not functioning	If fans have power, remove power and replace fan(s). If fans do not have power, find cause of loss of power and repair
		Heatsink coated with dirt	Remove power and clean heatsink with high pressure air (80-100 PSI max clean and dry air)
		Over-current on unit	Verify that running current does not exceed unit rating.
		Environment temperature over 120F (ambient temperature for panel version) or over 104F (ambient temperature for enclosed version)	Place unit in environment temperature less than 120F for panel version or less than 104F for enclosed version

8.1 – Failure analysis

Problem	Possible LED Displays	Possible Reasons	Solution
Motor will not start	All LEDs: OFF Power On LED: OFF Start LED: OFF Fault and Phase Loss LEDs: ON Fault and Shorted SCR LEDs: ON	No control voltage applied to logic board	Apply control voltage to TB1 pins 1 and 6 on control board
		Control power transformer failure or CPT fuse failure	Remove power and replace control power transformer or CPT fuse
		Start circuit wired incorrectly	Remove power and correct start circuit wiring
		No start command	Apply start command
		No 3 phase line voltage	Apply 3 phase line voltage to unit
		Failure of main circuit board	Replace main circuit board
		Faulty control logic	Remove power and repair control logic
		Faulty control logic	Check logic board for faults and replace blown fuses
		Shorted SCR in starter	Refer to section 8.2 for SCR testing procedure and replace faulty (shorted) SCR(s)
Motor vibrates/Motor growls	Fault and Phase Loss LEDs: ON	Faulty motor	Check motor and motor connections
		Faulty SCR(s)	Remove power, perform SCR device checks
		Faulty gate/cathode on SCR(s)	Refer to section 8.2 for SCR testing procedure and replace faulty (shorted) SCR(s)
		Faulty main circuit board	Replace main circuit board
Extremely unbalanced motor currents during start or run mode	Fault and Phase Loss LEDs: ON	Faulty motor/wiring	Troubleshoot and repair
		Faulty wiring	Troubleshoot and repair/replace wiring
		Faulty main circuit board	Replace main circuit board
Motor stopped during run	Fault and Overcurrent LEDs: ON	Warning: This is a serious fault condition. Ensure that the fault condition is cleared on the load before attempting to restart the motor.	
		Load shorted/grounded/faulted	Remove power and repair
		Faulty main circuit board	Replace main circuit board
Control circuit fuses blow after control power is applied	All LEDs: OFF	Short in control circuit	Remove power, locate and remove short
		Wrong control voltage	Apply correct voltage to logic board

8.2 – SCR testing procedure

Remove line power and control power from the unit and lock out. Disconnect any two motor load leads and any two line leads. Disconnect SCR connections to main circuit board J1, J2 and J3. Note the type of color coding of the wires connected to J1, J2 and J3. ABB uses two possible configurations. Both configurations have 4 wires going to each plug. The first configuration consists of 4 wires color coded black, yellow, grey and white. The second configuration consists of 4 wires color coded red, white, red, white.

The testing procedure for SCRs is comprised of two separate tests. The first one tests the anode to cathode integrity of the SCR by performing the following ohm checks:

+ LEAD	- LEAD	GOOD	CONSULT FACTORY
L1 LUG	T1 LUG	Greater than 10K ohm	Less than 10K ohm
L2 LUG	T2 LUG	Greater than 10K ohm	Less than 10K ohm
L3 LUG	T3 LUG	Greater than 10K ohm	Less than 10K ohm

The second tests the gate to cathode integrity of the SCR. Place the leads of an ohm meter into the receptacle that was unplugged from the main circuit board. Ohm the pair of wires on one end of the plug. Then ohm the pair of wires on the other end of the plug. The chart below indicates good versus bad readings.

For wire that is color coded black, yellow, grey and white:			
+ LEAD	**- LEAD**	**GOOD**	**BAD**
BLACK	YELLOW	Between 5 and 90 ohms	Less than 5 or greater 90 ohms
GREY	WHITE	Between 5 and 90 ohms	Less than 5 or greater than 90 ohms
For wire that is color coded red, white, red and white:			
+ LEAD	**- LEAD**	**GOOD**	**BAD**
RED	WHITE	Between 5 and 90 ohms	Less than 5 or greater than 90 ohms
RED	WHITE	Between 5 and 90 ohms	Less than 5 or greater than 90 ohms

Note: If any of the above readings are out of specifications, replace the faulty SCR.

8.3 – Replacing SCR devices

Two types of SCRs are used in ABB SSA Series depending on the horsepower/amperage rating of the unit. Isolated SCRs are used in smaller units and “hockey puck” type SCRs are used in larger units.

8.3.1 – Changing an isolated SCR

- Remove both line and control power from unit, tag and lock out.

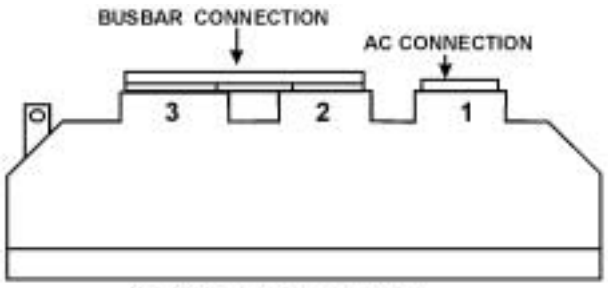
WARNING: Failure to remove both line and control power before starting this procedure may cause personal injury or death.

- Label location of wires connected to the SCR.
- Remove mounting screws, lugs and associated wiring from the existing SCR.
- Make sure the surface to which the power module mounts is clean and free from dirt, nicks and scratches.
- Apply thermal grease uniformly along the grooved area. Spread the grease thinly (3 mil thick) to completely cover the base of the power module and minimize air pockets. Grease must be free of contamination.
- Replace the screws and tighten down firmly. The following chart shows recommended torque values for various SCRs.

VOLTAGE	HP	MOUNTING SCREW	BUSBAR AND POWER LUG
208 VAC	1 – 10	44 lbs/in	26 lbs/in
208 VAC	15 – 20		44 lbs/in
240 VAC	1 – 15		26 lbs/in
240 VAC	20 – 25		44 lbs/in
380 VAC	1 – 25		26 lbs/in
380 VAC	30 – 40		44 lbs/in
415 VAC	1 – 25		26 lbs/in
415 VAC	30 – 40		44 lbs/in
480 VAC	1 – 30		26 lbs/in
480 VAC	40 – 50		44 lbs/in
575 VAC	1 – 40		26 lbs/in
575 VAC	50 – 75		44 lbs/in

- Reconnect all busbars, lugs, and wires. Check to make sure gate and cathode are wired correctly. Use the following chart to verify wiring of J1, J2, and J3:
- After verifying that all wiring is correctly connected test the SCR.

Main Circuit Board Pin#	DESTINATION
Pin 1	Load Gate
Pin 2	Load Cathode (Output Load Lug)
Pin 5	Line Gate
Pin 6	Line Cathode (Input Line Lug)



Isolated SCR Configuration

8.3.2 – Changing a hockey puck type SCR

- Remove both line and control power from unit, tag and lock out.

WARNING: Failure to remove both line and control power before starting this procedure may cause personal injury or death.

- ABB uses two types of clamps with gauges for reading the amount of force on the device. The first type of force gauge uses a spin washer. When the proper force is applied, the washer will be free to spin. The second type of gauge uses a step indicator on the end of the lever. Before proceeding, note the type of clamp used and, if the clamp has a step indicator, document the position of the indicator before removing the clamp to facilitate proper mounting of the new SCR device.
- Label location of wires connected to the SCR.
- Remove any lugs, snubbers, printed circuit boards (refer to section 8.4) and associated wiring that may get in the way of reaching the faulty SCR. Document the location and wiring of all parts before removing them to facilitate the re-installation of the devices later.
- Document the position of the indicator on the SCR clamp. Then remove the top clamp holding the SCR stack together. Remove the top heatsink. Use extreme caution when handling the heat sink so it does not become dented or damaged.
- Remove the faulty SCR device, noting the direction in which the SCR is oriented. The new SCR puck **must be** inserted in the same direction.
- Make sure the SCR mounting surface, tools, and hands are clean and free from dirt, nicks, and scratches. Do not sand or scrape SCR mounting surface. If necessary, super fine Scotch Brite pads can be used to clean the heatsink before installing the new SCR.
- Apply a thin (3 mil thick) layer of thermal grease uniformly along both sides of the SCR. Spread the grease to cover the entire surface of both sides of the SCR in a manner that minimizes air pockets. The grease must be free of contamination.
- Locate the centering pin in the bottom and top of the heatsink and center it in the SCR hole (making sure that the SCR is pointed in the same direction as the SCR that was removed in step 6). Locate the centering pin in the top heatsink and center it in the SCR hole. **Caution: If center pin is not placed correctly it will damage the SCR and the heat sink.** Hand tighten the clamps evenly so that the same number of threads appear at both ends of the U-clamp. Tighten the clamp 1/4 turn at a time alternating sides of the U-clamp until the correct force is reached. Check the gauge or spin washer every time the clamp nuts are tightened 1/4 turn to ensure that the SCR is not over torqued. The gauge reading should be similar to the initial reading taken in step 2. If the clamp uses the spin washer gauge, verify that the washer spins freely after clamping. Once proper force is reached make sure that the SCR pucks are securely held between the heatsinks and aligned evenly.
- Replace any lugs, MOVs, snubbers, power straps, printed circuit boards and associated wiring that was removed in step 4. Use the following chart to verify wiring of J5, J6 and J7:
- After verifying that all wiring is correctly connected, test the SCR and then test the unit.

Main Circuit Board Pin#	**DESTINATION**
Pin 1	Load Gate
Pin 2	Load Cathode (Output Load Lug)
Pin 5	Line Gate
Pin 6	Line Cathode (Input Line Lug)

8.4 – Replacing printed circuit boards.

The printed circuit boards are not intended to be field repaired. If the board is faulty, the entire board should be replaced using the following procedure:

- Remove three phase power and control power from the unit and lock out.
- Remove plugs and tag plugs with connector numbers.
- Remove control wires from terminals and tag wires with terminal numbers.
- Note the settings of all potentiometers and dip switches
- Remove mounting screws.
- Remove old printed circuit board.
- Mount new printed circuit board.
- Install mounting screws.
- Set the potentiometers and dip switches on the new board to the same positions as on the old board (if applicable).
- Install control wires from terminals and tag wires with terminal numbers.
- Install plugs.
- Apply power to the unit and test.

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