SASSC MANUAL

PROCESS ELECTRONICS CORPORATION

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SEALED AIR SOLID STATE CONVERTER

PEC SASSC DC Power Supply

Index

Section and Title **Page**

It must be understood that these instructions cannot cover all details or variations on equipment, nor provide for every possible contingency in connection with installation operation or maintenance. When the rectifier is installed, it will require little attention.

Should further information be desired or particular problems arise which are not covered herein, please contact:

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1. INTRODUCTION

1.1 Scope

This manual describes the PEC Sealed Automatic Solid State Converter (SASSC) and provides information for its installation, operation, and maintenance.

1.2 General Description of the SASSC

The PEC SASSC is a sealed, water-cooled, DC power supply designed to give a specified output current and voltage to cover a wide range of applications. Its small cabinet size and sealed construction make it easy to install and maintain.

1.2.1 Cooling System

A re-circulating coolant system is used to remove heat generated by the power components (for example; diodes, main transformer, SCR's and interphase transformer). A small, magnetically coupled pump circulates coolant through a liquid-to-liquid heat exchanger. See **Figure 1**. Raw outside water removes the heat from the coolant through the exchanger and carries it away from the converter. This system efficiently utilizes the raw cooling water and prevents excessive water waste.

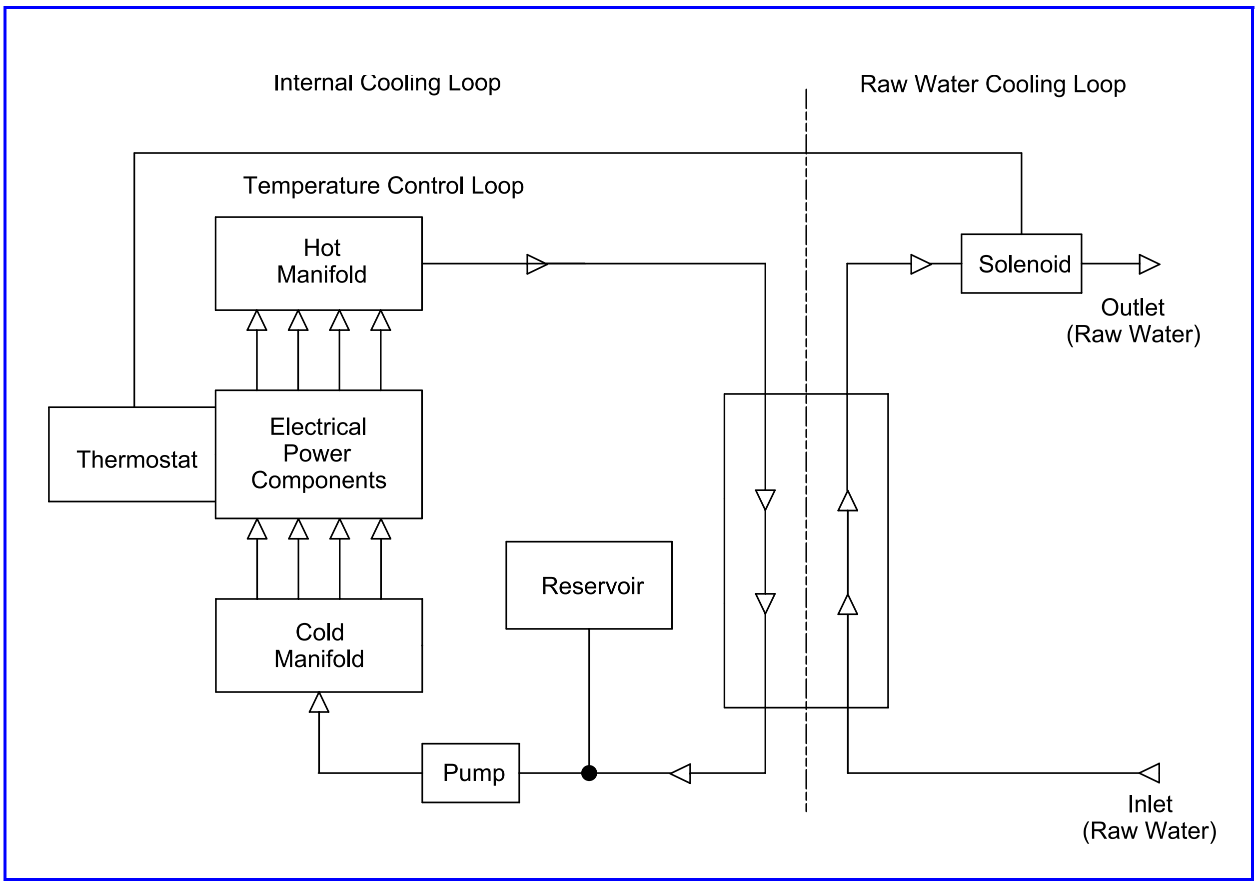


Figure 1 *Cooling System Block Diagram*

1.2.2 Power Conversion System

The power conversion section of the PEC SASSC is completely solid state employing silicon controlled rectifiers (SCR's) as the voltage and current controlling elements and parallel sets of silicon diodes as the rectifying elements. See **Figure 2**. The primary of the main transformer is connected in a solid delta with the SCR's connected as inverse parallel sets in the line. The secondary connection is a six phase, double wye, single way with interphase transformer assembly and polarity output is reversed.

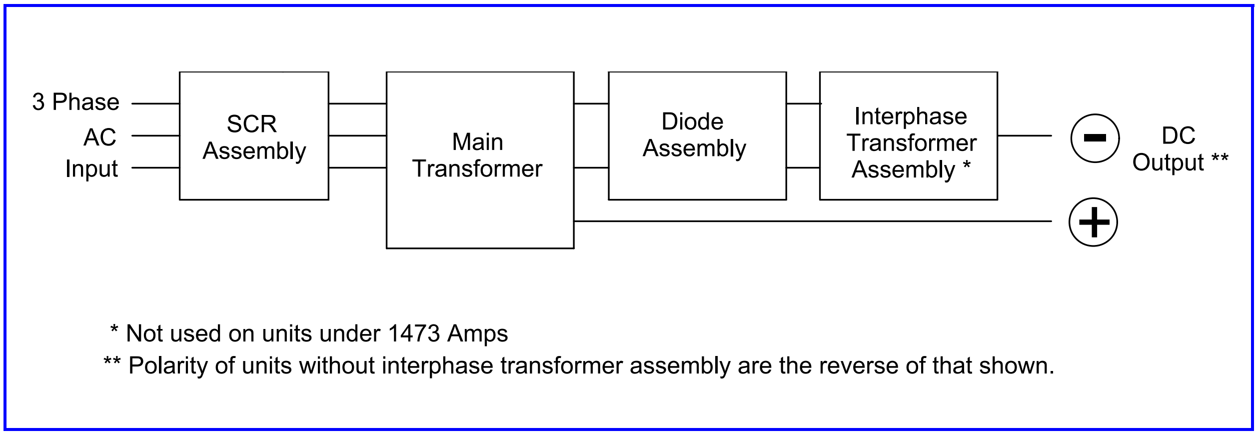


Figure 2 *Power Conversion System Block Diagram*

1.2.3 Control System

The PEC SASSC is connected to the main AC power line by a magnetic starter, which provides primary overload protection. See **Figure 3**. In addition, a unique peak limit circuit offers overload protection within a half cycle of fault current for either external or internal faults.

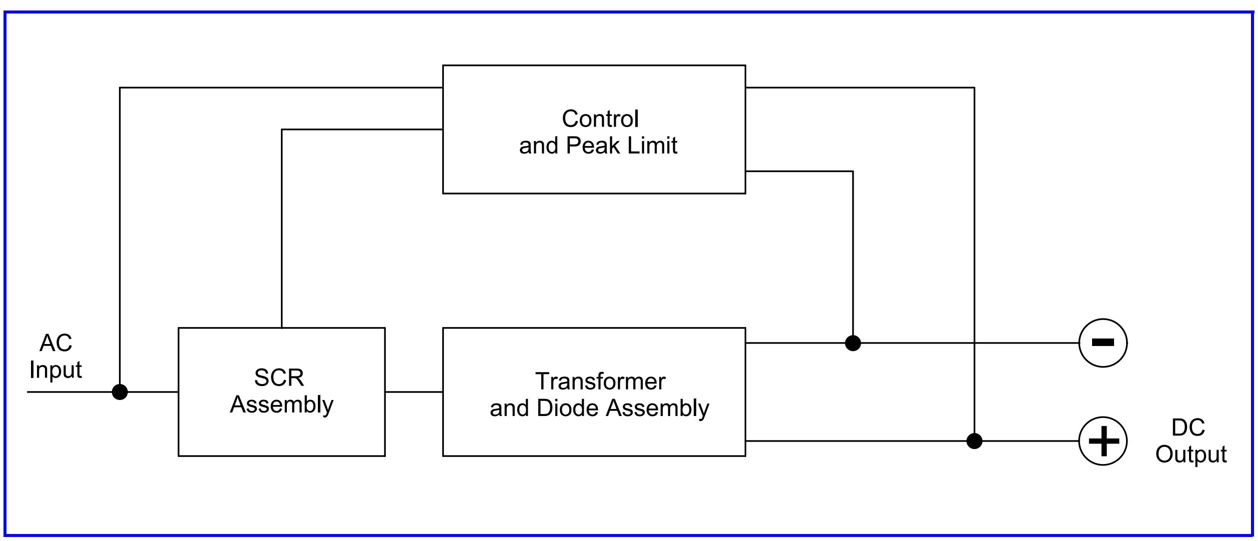


Figure 3 *Control System Block Diagram*

2. INSTALLATION

2.1 Inspection and Storage

As all units are shipped F. O. B. our plant, it is suggested that the shipping container be removed and the converter inspected for possible damage during shipment. If any damage is found, the claim must be handled by the purchaser, and the carrier contacted immediately. The PEC service department should be notified if the nature of the damage is such that operation of the converter has been impaired.

Inspection of the interior of the converter can be done from the front of the cabinet. To open the front door, turn the pawl fasteners counterclockwise until they are unlatched, and pull the door open.

CAUTION

Do not attempt to turn the latches past their stops.

The panels can be taken off by loosening and removing the retaining screws. All connections between the starter, fuses, SCR assembly, main transformer, diodes, DC terminal assembly, and coolant assembly should be checked in case excessive vibration during shipment may have resulted in loosening them.

If it is necessary to store the unit for a period of time before it is installed, be sure to place the converter in a clean, dry area and keep all panels and doors closed. To prevent excessive dust from accumulating on the units, it is advisable to protect the converter by placing it in the original shipping container.

2.2 Handling the SASSC

The SASSC unit must be handled at all times with the same care that would be given any precision electrical equipment. Component weight distribution inside the cabinet is approximately 70% rear and 30% front. See **Table 1**.

Output Amp/Volt	Cabinet Size	Weight in Lbs. (Approximate)		Input KVA
		Lbs	kg	
500/750/1000/6 *	See **Figure 4-A**	715	325	4.4/6.5/8.7
9 *		760	345	6.1/9.2/12/2
12 *		795	360	7.9/11.8/15.7
18 *		895	405	11.3/17.0/22.7
24 *		1015	460	14.8/22.7/29.5
1500/6	See **Figure 4-A**	735	335	13.1
9		785	355	18.4
12		825	375	23.6
18		965	440	34.0
24		1090	495	44.3
* Without Interphase				

Output Amp/Volt	Cabinet Size	Weight in Lbs. (Approximate)		Input KVA
		Lbs	kg	
2000/6	See **Figure 4-A**	815	370	17.4
9		885	400	24.5
12		985	445	31.4
18		1110	505	45.4
24		1255	570	59.0
3000/6	See **Figure 4-B**	845	385	26.1
9		965	440	36.7
12		1000	455	47.2
18		1200	545	68.0
24		1330	605	88.6
4000/6	See **Figure 4-A**	975	445	34.8
9		1075	490	43.5
12		1190	540	62.9
18		1300	590	90.7
24	See **Figure 4-B**	1800	815	118.1
5000/6	See **Figure 4-A**	1055	480	43.5
9		1130	515	61.2
12		1250	570	78.6
18	See **Figure 4-B**	1780	810	113.4
24		2080	945	147.6
6000/6	See **Figure 4-A**	1200	545	52.2
9		1450	660	73.4
12	See **Figure 4-A** **	1930	875	94.3
18	See **Figure 4-B**	2250	1020	136.1
24		2633	1195	177.1+
8000/6	See **Figure 4-B**	2300	1045	69.6
9		2470	1120	97.9
12		2735	1240	125.8
18		3120	1415	181.4+
24		3720	1685	236.2+
10,000/6	See **Figure 4-B**	2455	1115	87.0
9		2565	1165	122.4
12		2780	1260	157.2++
18		3310	1500	226.8+
24		3910	1771	295.2+
12,000/6	See **Figure 4-B**	2700	1223	104.4
9		2820	1277	146.8
12		3060	1386	188.6+
+ Not available for 208 or 230 Volt input.				
++ Not available for 208 Volt input.				
** See **Figure 4-B** for cabinet size for 208 and 230 Volt input on this unit.				

Table 1 *Cabinet Size and Weight Comparison to Input*

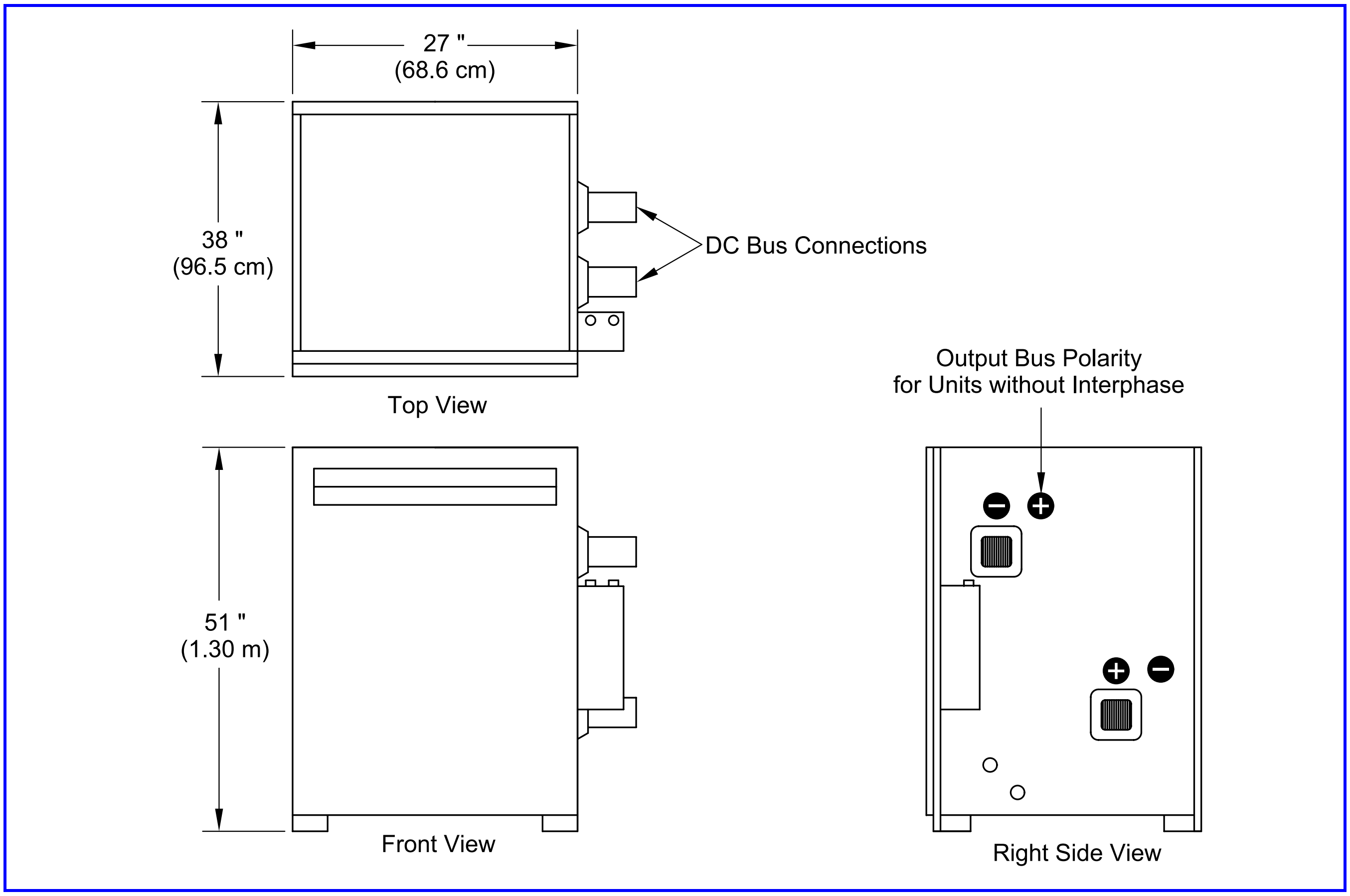


Figure 4-A *Small Cabinet Outline*

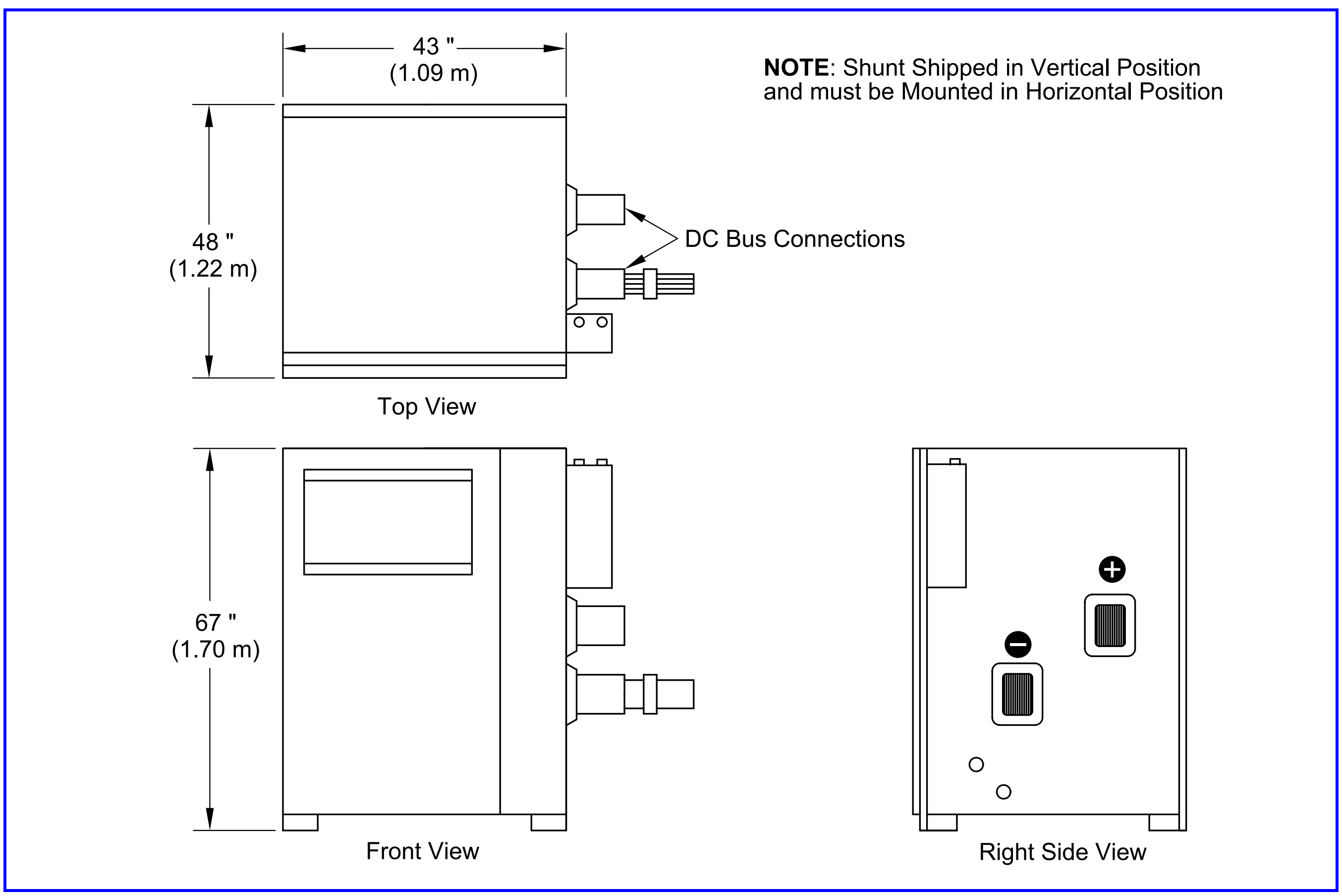


Figure 4-B *Large Cabinet Outline*

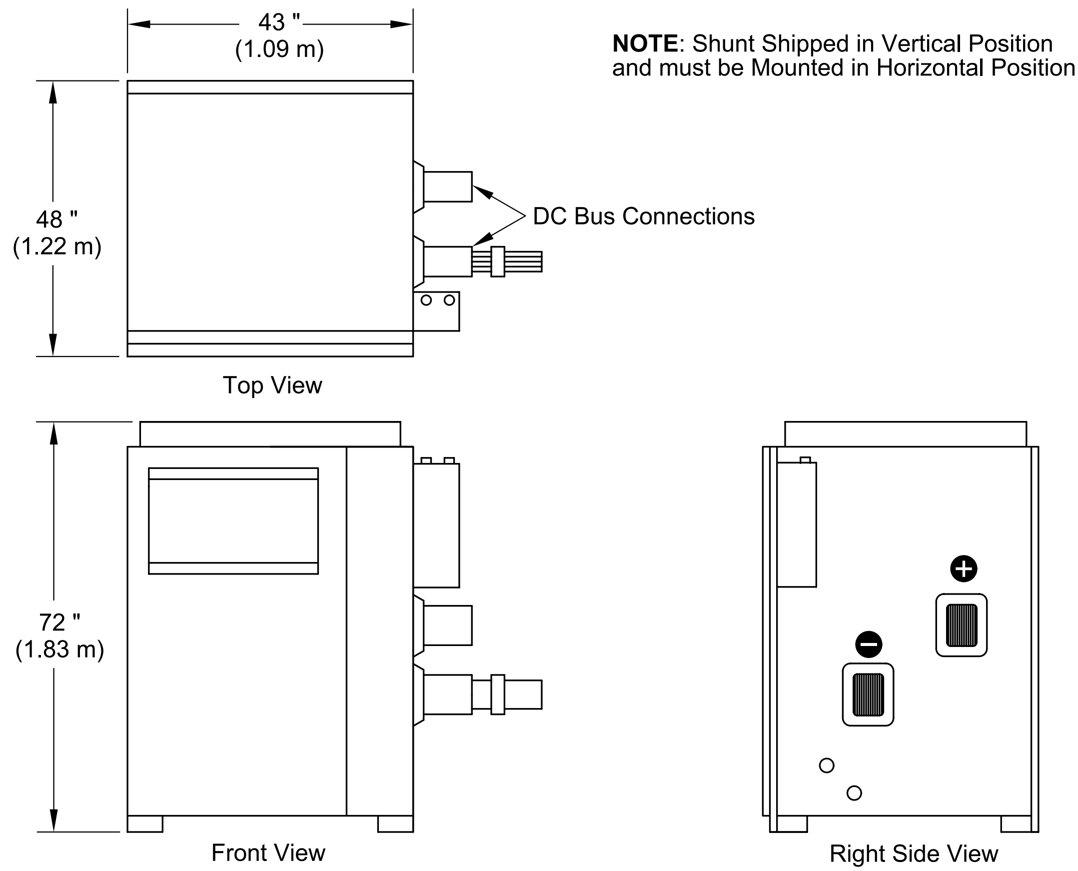


Figure 4-C *Large Cabinet Outline (with Top Shroud)*

2.3 Location

The small physical size and sealed cabinet of the PEC Sealed Automatic Solid State Converter makes it possible to locate the unit close to the tank. This eliminates the need for long and costly bus runs. Normal precautions should be taken to protect the cabinet from splashing from the tank or from overhead piping.

All normal maintenance and service can be performed from the front of the converter making it possible to line the units side by side, with sufficient clearance between the units, for the bus work. See **Figure 5**.

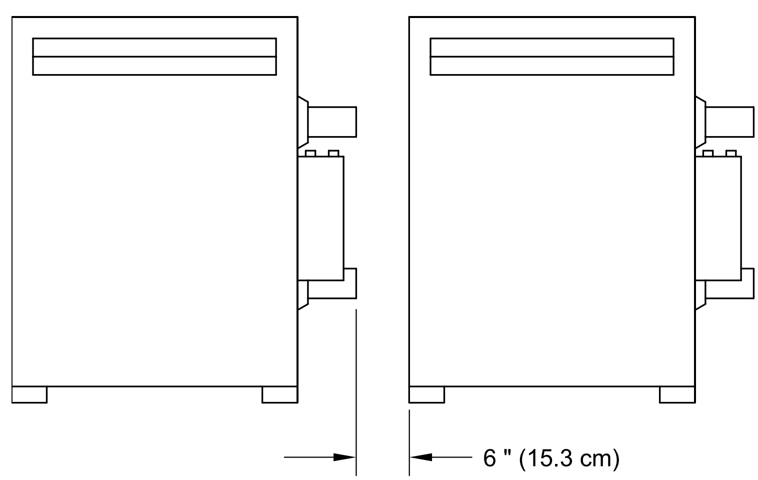


Figure 5 *Converter Minimum Horizontal Clearance*

The converters should not be stacked unless suitable supports are provided. See **Figure 6**.

The cabinet frame of the converter will not support any weight. A space of 12 inches, (30.5 cm), is required for access to the coolant filler cap, located in the front left corner and the control panel which is located under the top right hand cover.

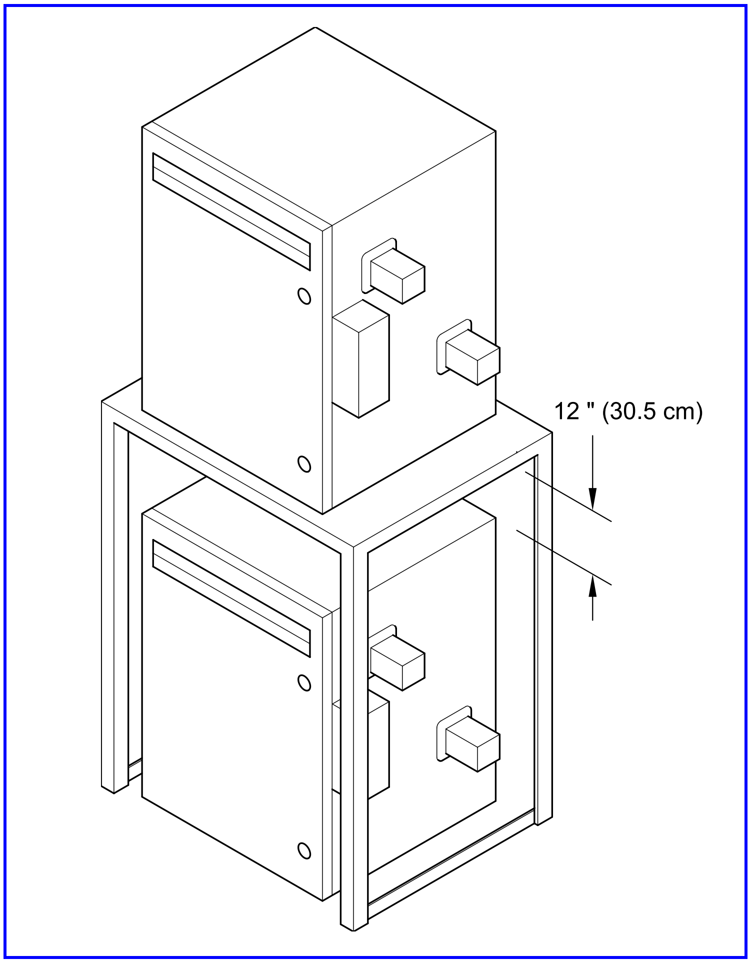


Figure 6 *Converter Minimum Stacked Clearance*

2.4 Electrical

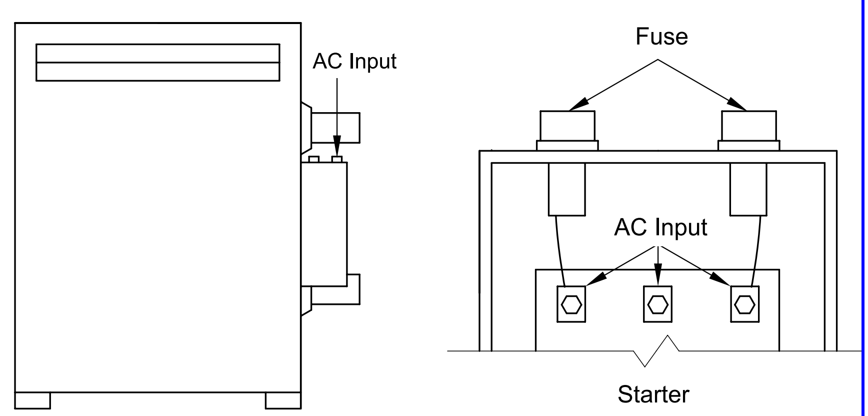
Check the converter data nameplate to be sure that the rated input voltage and frequency match the available power supply. If the supply voltage or frequency differs from the rated input voltage or frequency, contact PEC to advise of the necessary changes. This must be done before the unit can be operated. The converter should not be connected, under any circumstances, to a source which does not match the data nameplate rating, without the approval of PEC.

The input wiring and installation should conform to the National Electrical Code, and/or local codes as required.

2.4.1 AC Input Connection

The primary input connections can be made through the top of the starter box mounted on the right side of the converter. See **Figure 7**.

Care should be taken to insure a secure connection of the primary control transformer fuse leads, which are made at the top of the starter. See **Table 1** for converter input KVA.



$$\text{A.C. Input Current} = \frac{\text{KVA} \times 1000}{\text{A.C. Input Voltage} \times \sqrt{3}}$$

Figure 7 *Converter Minimum Horizontal Clearance*

CAUTION

Do not run AC input wiring through the bottom base of the cabinet. Grounding lugs are provided in the starter box and in the remote meter box. A ground connection must be made or the unit will fail to operate properly.

2.4.2 DC Output Connection

The DC terminal assembly is 1/4 " x 4 " or 1/4 " x 6 " aluminum, nickel plated for corrosion resistance and punched with a standard four-hole pattern. See **Figure 8**. Additional bus, required for the tank connection, may be either aluminum or copper and should be plated at the connection ends to decrease contact resistance. A joint compound should be used before bolting the bus together. Belleville washers, supplied with the converter, should be used at the bolted connections to prevent loosening of the bus connections due to the expansion and contraction of the bus. See **Figure 9**.

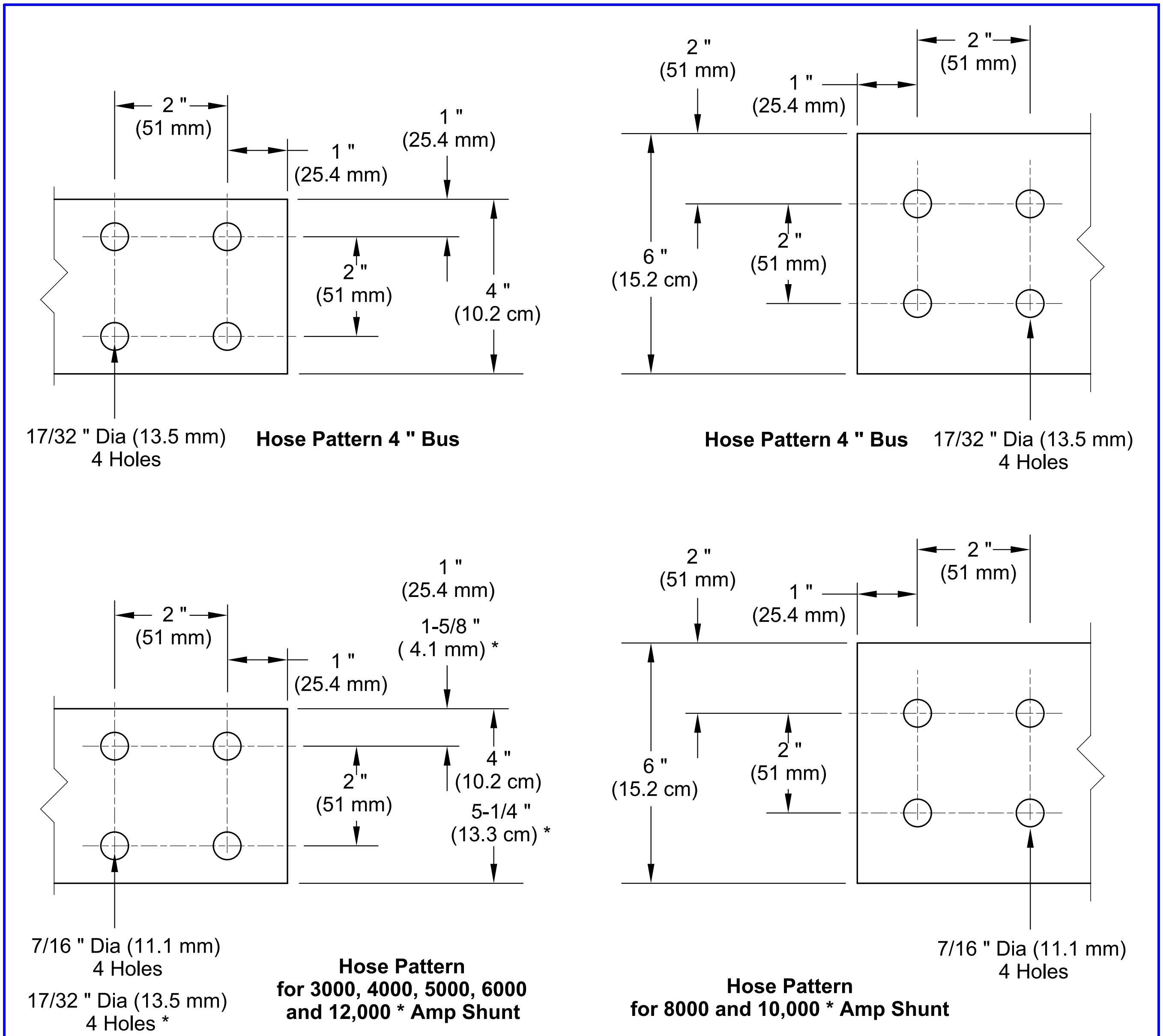


Figure 8 *DC Terminal Assembly*

2.4.3 Control Connections

A. Integral Control Converter

All of the indicating and controlling elements for integral units are mounted on the front of the control door. All connections have been made by quick connect terminal to a terminal strip mounted on a sub-panel behind the control door. See **Figure 10**.

All that is necessary is to make the primary input and DC output connections and the SASSC wiring installation is complete. See **Section 2.5** for the cooling system connections to be made.

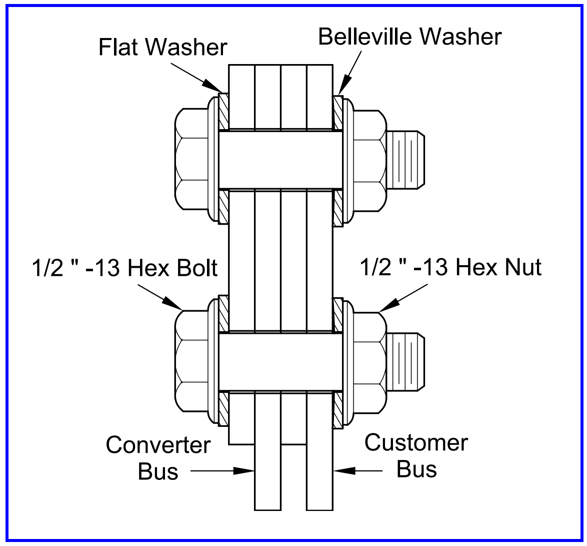


Figure 9 *Customer Bus Connection*

D. Remote Control Converter

The indicating and controlling elements for the remote controlled units are mounted in a Nema 12 enclosure. The enclosure should be mounted close to the operator's normal position. Connections from the converter are made to a terminal strip mounted inside the enclosure behind the front door. See **Figure 11**.

The wiring diagram, included with each converter, shows the number of wires required to connect the converter and control unit together. It is a good practice to include a spare wire or two for future requirements.

The ammeter leads should be sized according to **Table 2**.

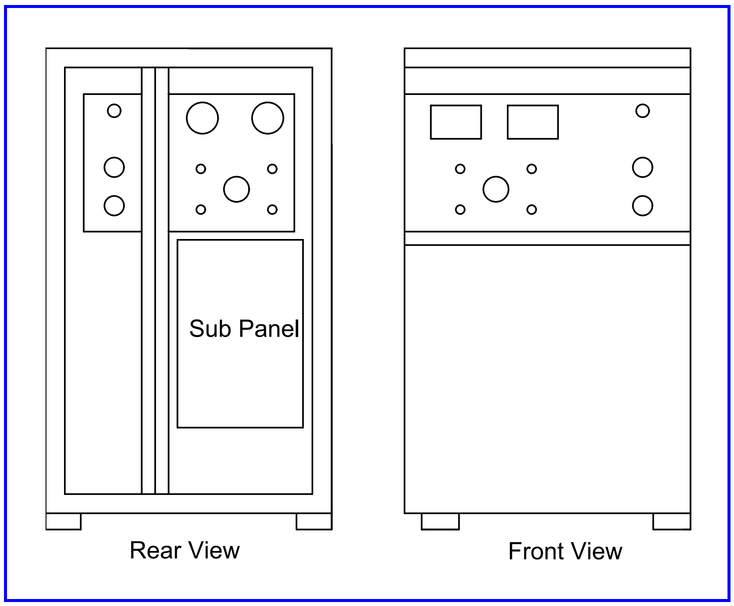


Figure 10 *Control Location*

Wire Size	Length of Lead Run	
	Feet	**Meters**
No. 14	0 - 15	0 - 4.5
No. 12	16 - 25	4.8 - 7.5
No. 10	26 - 40	7.2 - 12
No. 8	41 - 60	12.3 - 18.2
No. 6	61 - 100	18.5 - 30.5

Table 2 *Ammeter Lead Lengths Comparison to Wire Size*

CAUTION

Do not run remote control wiring through the bottom base of the cabinet.

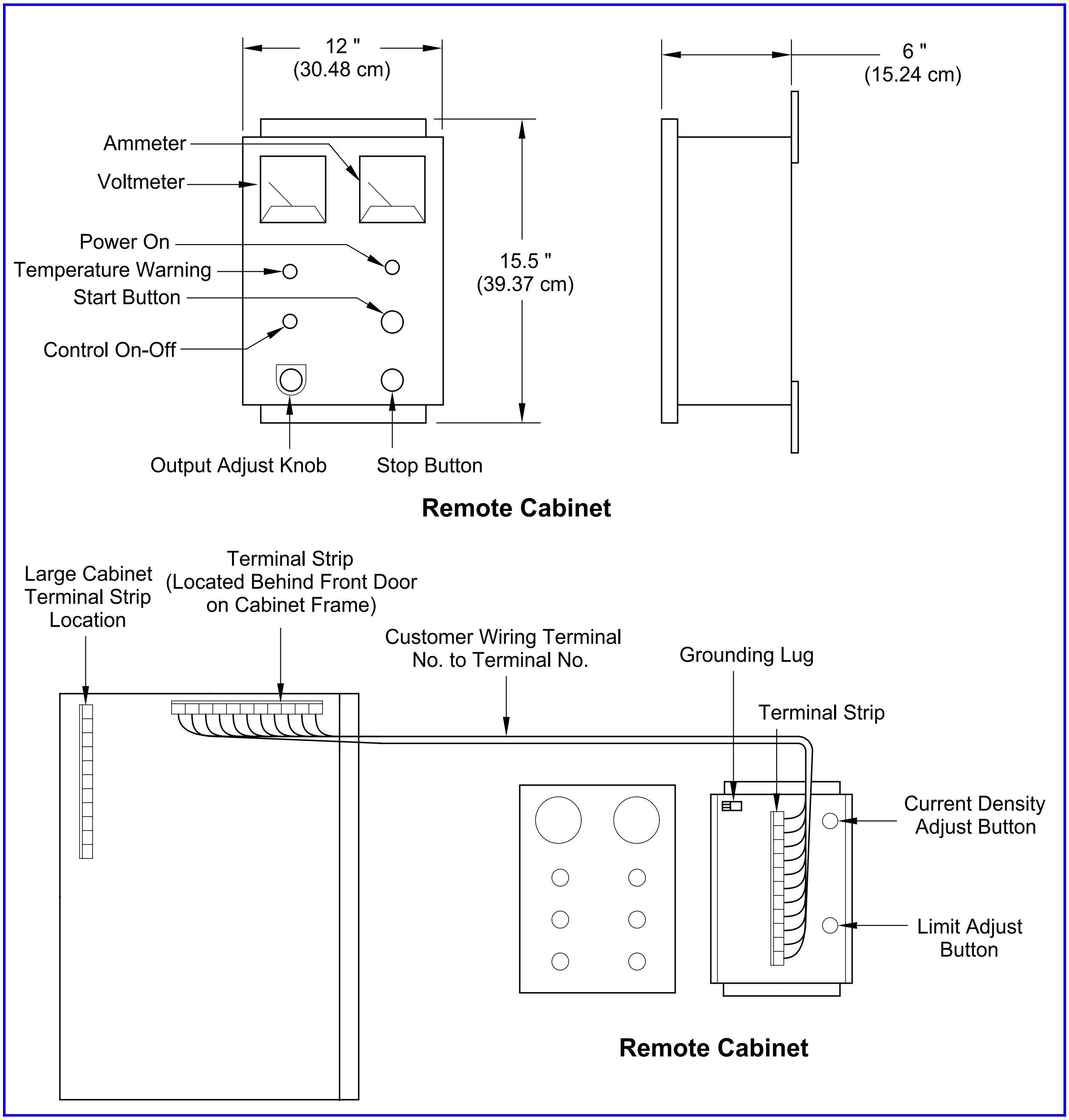


Figure 11 *Remote Control Converter Interconnection*

2.5 Cooling System Connection

The connections for the raw water supply are located on the right side of the converter and should be made to the rubber hose connectors supplied as an option. See **Figures 12-A** and **12-B**. These connectors prevent any stresses from being transferred to the internal piping and avoid the possibility of damage to the piping. The maximum inlet water temperature is 85° F (29.4° C) and the maximum water pressure allowable is 100 psi (7.03 kg per sq. cm).

The minimum raw water flow rate required for 85° F (29.4° C) input water can be determined from **Table 3**. Customer piping must be sized to insure flow requirements are available at all times.

NOTE: An inline filter screen must be installed between the inlet hose and the customer piping.

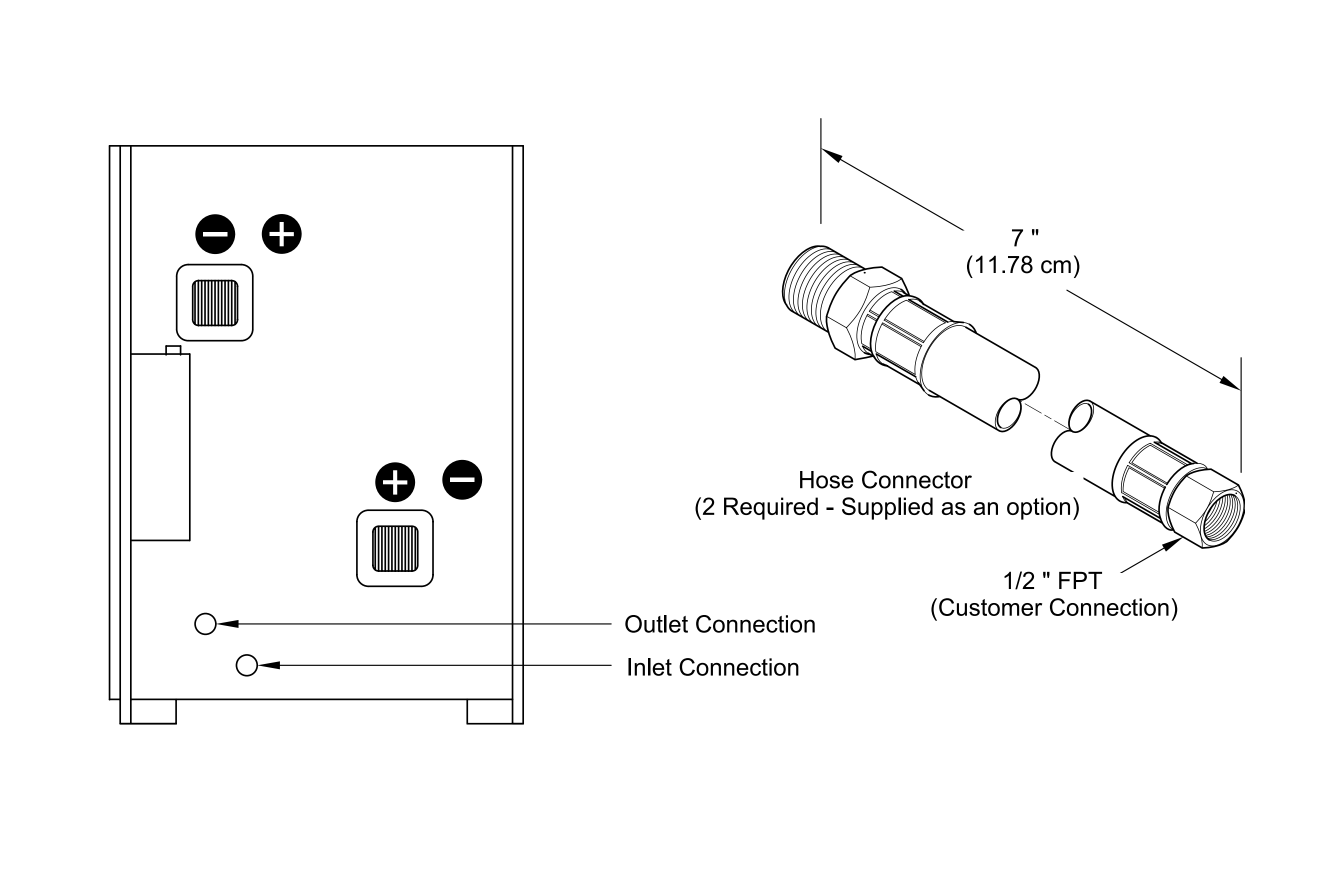


Figure 12-A *Small Cabinet Water Connections*

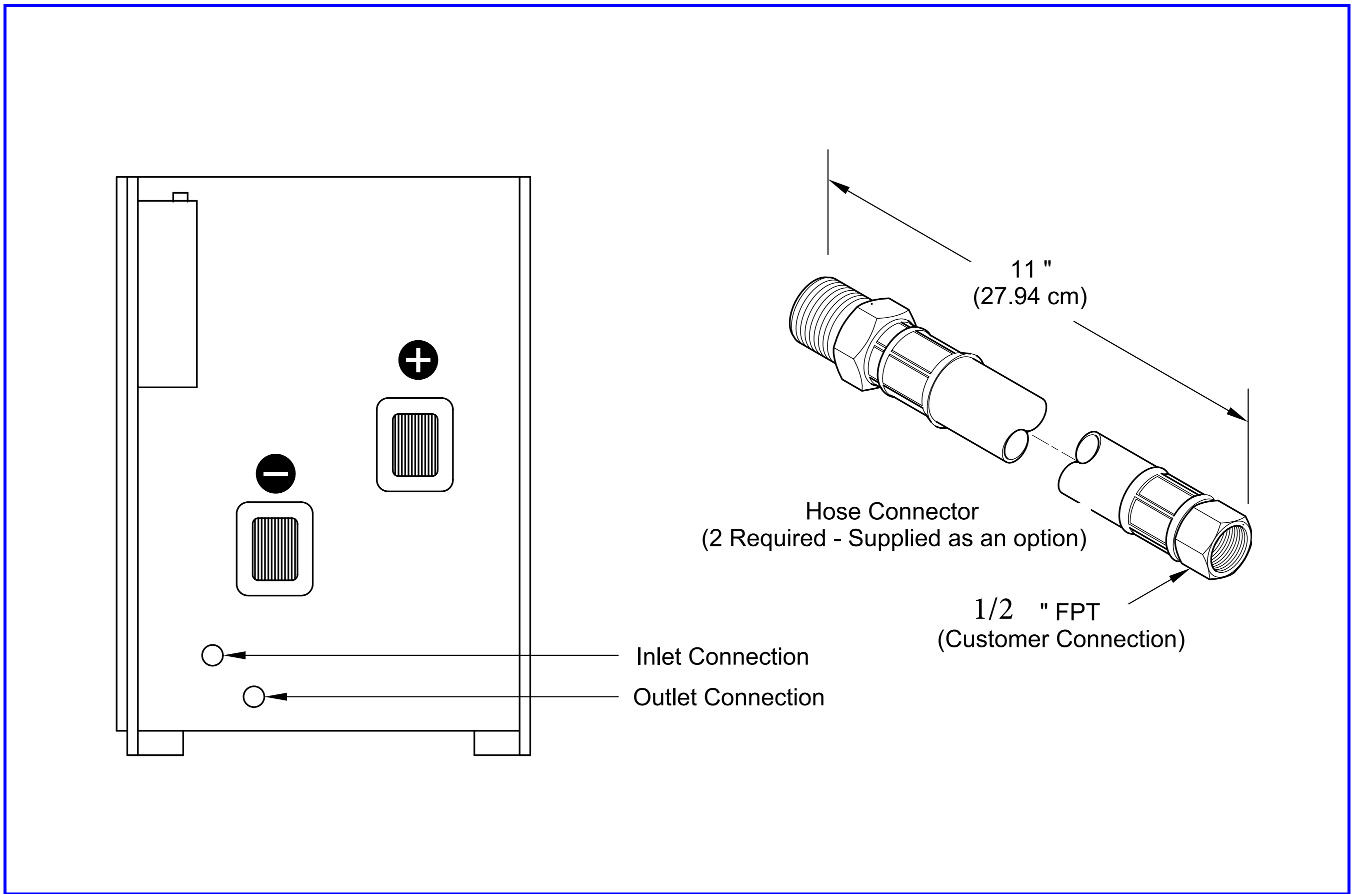


Figure 12-B *Large Cabinet Water Connections*

Converter Size Amp/Volt	Weight in Lbs. (Approximate)		
	g/m	L/m	M^3/hr
500/750/1000/6	1.0	3.8	.227
9			
12			
18			
24			
1500/6	2.0	7.6	.454
9			
12			
18			
24	2.5	9.5	.568
2000/6	2.0	7.6	.454
9			
12			
18	2.5	9.5	.568
24			
3000/6	3.5	13.3	.795
9	4.0	15.2	.908
12	4.5	17.0	1.02
18	5.0	18.9	1.14
24	5.5	20.8	1.25
4000/6	4.5	17.0	1.02
9	5.5	20.8	1.25
12	6.0	22.7	1.36
18	8.0	30.3	1.82
24 *			
5000/6	7.5	28.4	1.7
9	9.0	34.1	2.04
12	9.5	36.0	2.16
18 *	8.0	30.1	1.82
24 *			
6000/6	8.0	30.1	1.82
9			
12	10.0	37.8	2.27
18 *	12.0	45.5	2.73
24 *			
8000/6 *	12.0	45.5	2.73
9	14.0	53	3.18
12			
18	15.0	56.8	3.4
24			
10,000/6 *	15.0	56.8	3.4
9			
12			
18			
24			
12,000/6 *	15.0	56.8	3.4
9			
12			
* Large Cabinet			

Table 3 *Minimum Raw Water Flow Rate Comparison to Converter*

3. OPERATION

3.1 Component Operation

3.1.1 Starter

The starter provides protection in the event of a major component failure or line fault. The starter will trip on interruption of its coil by protection devices and circuitry. See **Figure 13**.

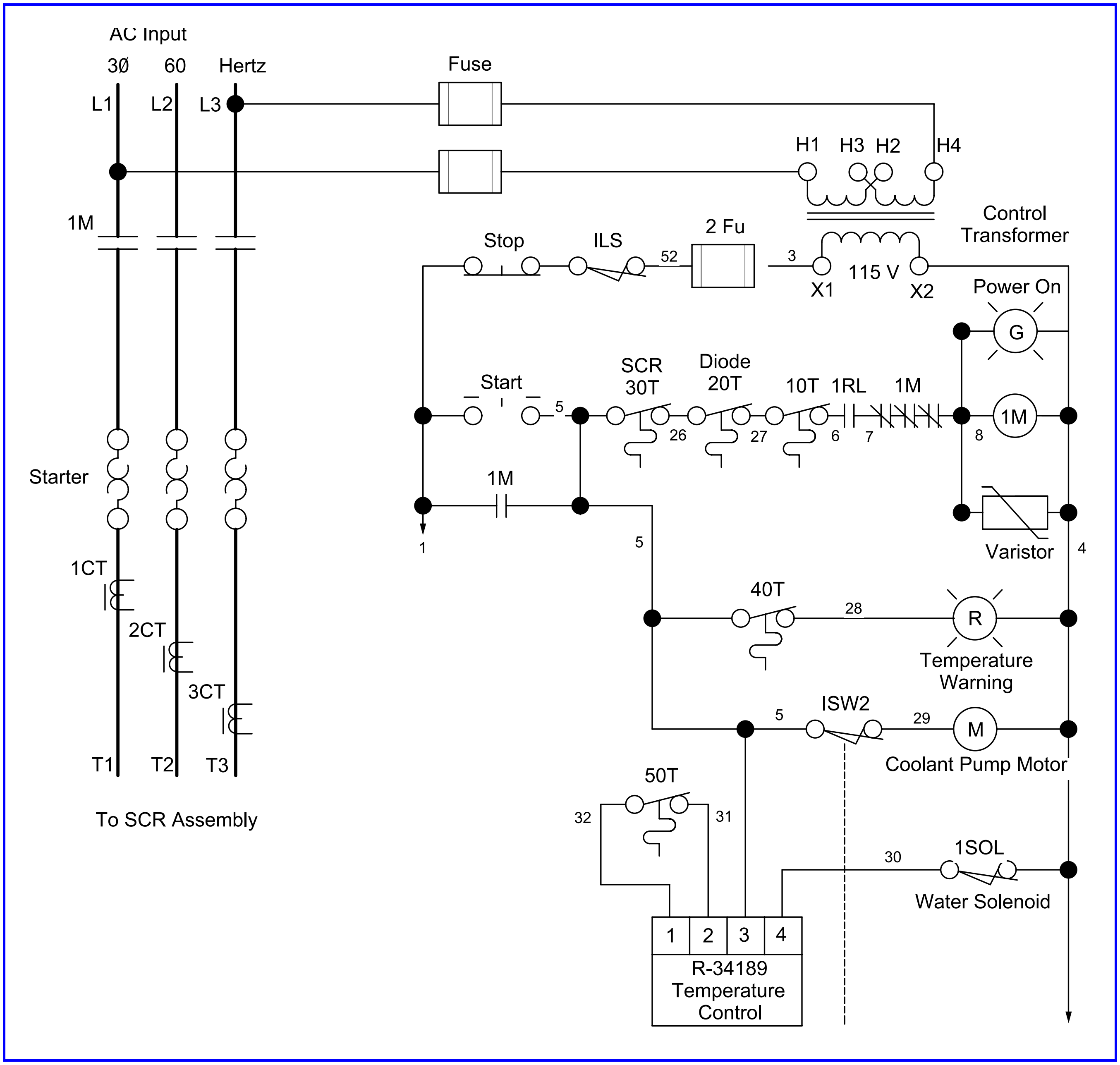


Figure 13 *Converter Wiring Diagram*

3.1.2 Line Current Transformers

As part of the peak limit circuit, the line current transformers (1, 2, 3 CT) continuously monitor the input line current while the converter is operating.

3.1.3 Silicon Controlled Rectifier

The silicon controlled rectifier (SCR) is a regenerative semiconductor switch. See **Figure 14**.

It is a silicon diode with a third element, a gate, which controls the flow of current through the SCR. The gate determines the point in each half cycle when the SCR will "fire" or start to conduct.

Without a gate signal, the SCR blocks the flow of the current in both directions. Not until a signal is applied to the gate does the SCR behave like a diode.

SCR firing is accomplished by introducing a DC voltage between the gate and the cathode. Conduction through the SCR starts within microseconds after voltage is applied between gate and cathode. When sufficient current has started to flow through the SCR, it "latches" into conduction until the current falls below the value of holding current at the end of that half cycle. Holding current is the current necessary to keep the SCR latched in conduction. When the SCR stops conducting, it returns to the blocking state and will not turn again until the gate is "pulsed" and the anode is positive with the respect to the cathode.

Figure 15 shows two SCR's connected in a back-to-back arrangement. SCR1 will conduct current when T1 is positive with respect to T2. SCR2 will conduct current in the opposite direction when T2 is positive with respect to T1. Assuming that voltage is applied between the gate and cathode at midpoint in each half cycle, 90 ° of conduction angle can be obtained for each SCR resulting in a current flow through the load as shown in **Figure 16**. Therefore, it is possible by introducing gate-cathode voltage at other times during the half cycle to control the time the SCR's are "on" in each half cycle and vary the load current.

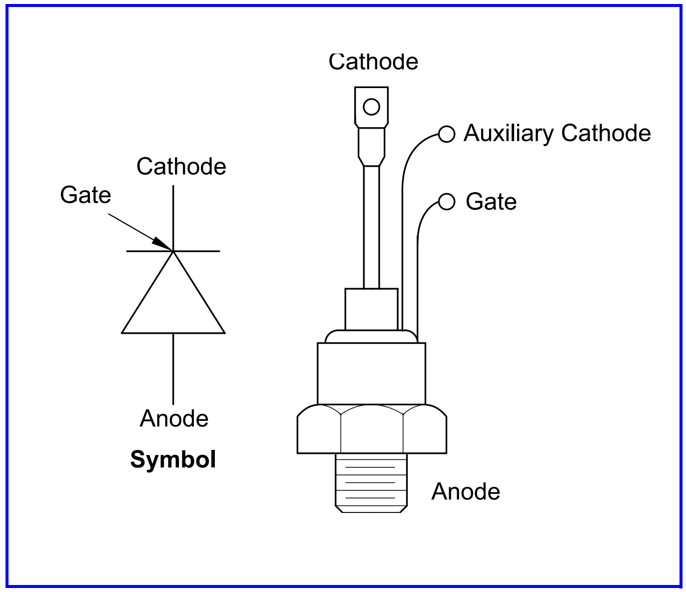


Figure 14 *Silicon Controlled Rectifier (SCR)*

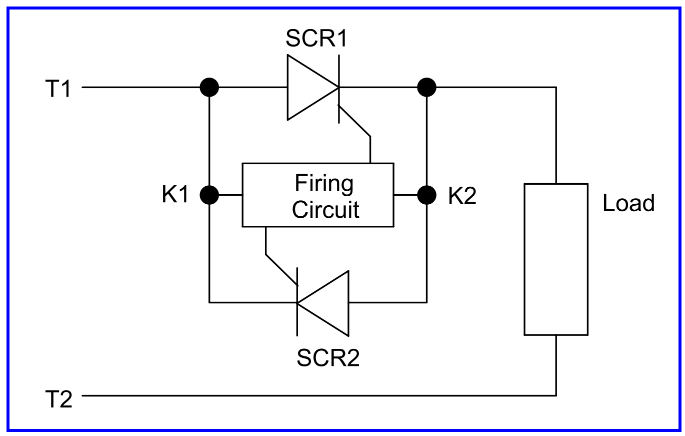


Figure 15 *Two SCR's in Back-to-Back Arrangement*

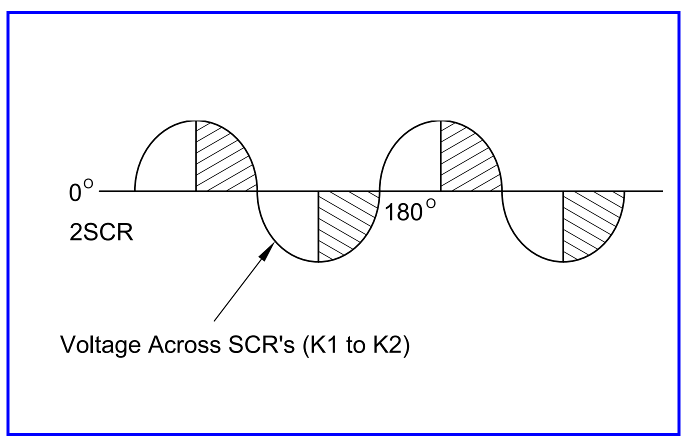


Figure 16 *SCR Current Flow (90 ° Phase Angle)*

In the SASSC the SCR's are connected in the back-to-back arrangement and placed in the line. The transformer primary is connected in a solid delta. See **Figure 17**.

The DV/DT and pulse transformer boards provide both the controlling gate-cathode pulses for varying the converter output and DV/DT protection for the SCR from line voltage transients.

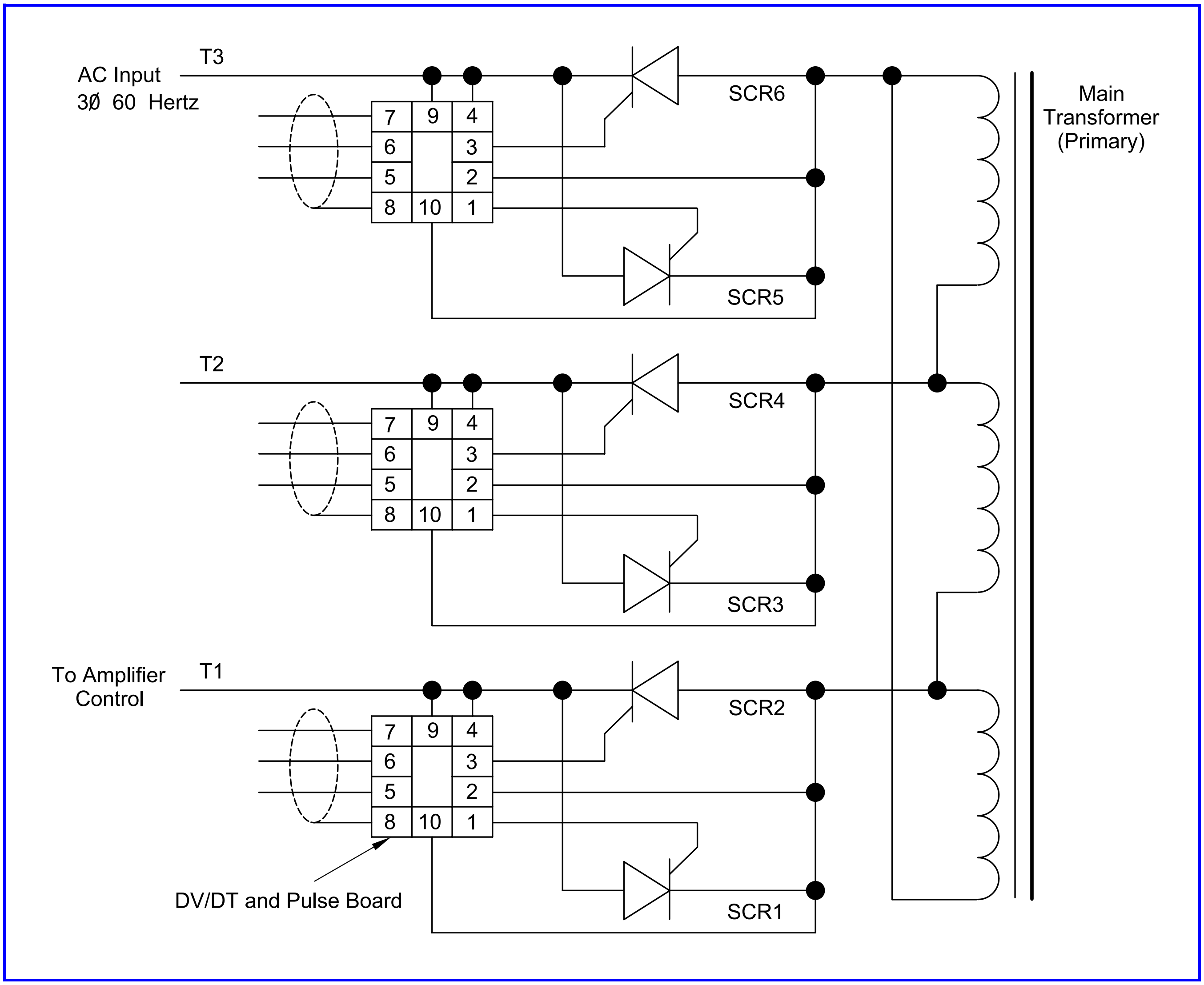


Figure 17 *DV/DT and Pulse Transformer Boards*

3.1.4 Main Transformer

The main transformer converts the high voltage, low current input from the controlling SCR's into a low voltage, high current output to the diode assembly. The main transformer is designed specifically for each particular SASSC rating.

3.1.5 Diode Assembly

The diode assembly of the converter is completely solid state. It employs parallel sets of silicon diodes as the rectifying elements. See **Figure 18**.

A six phase double wye, single way with interphase rectifier connection is employed to permit optimum utilization of the diodes and the rectifier transformer.

The shunt provides the current feedback for the control and also the signal for the indicating ammeter. The DC output bus provides the voltage feedback for the control.

For units under 1500 Amp output current, the interphase transformer is not used. Six diodes are used in a six phase double wye, single way connection. See **Figure 19**.

The shunt provides the current feedback for the control and also the signal for the indicating ammeter. The DC output bus provides the voltage feedback for the control.

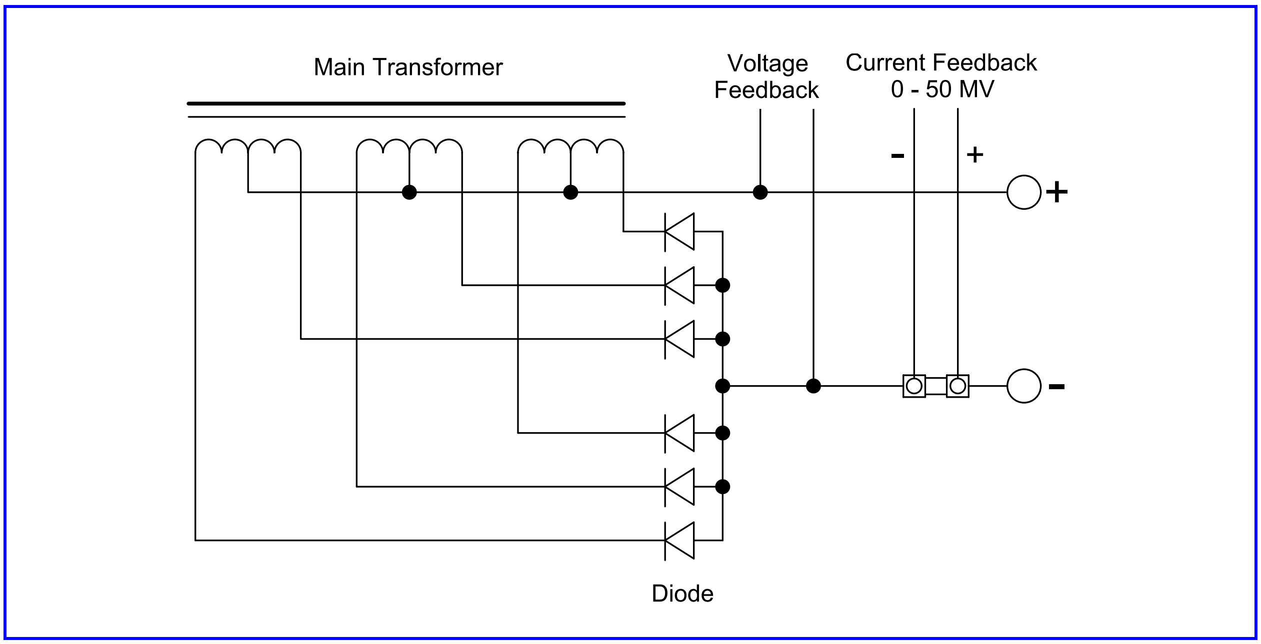


Figure 18 *Diode Assembly*

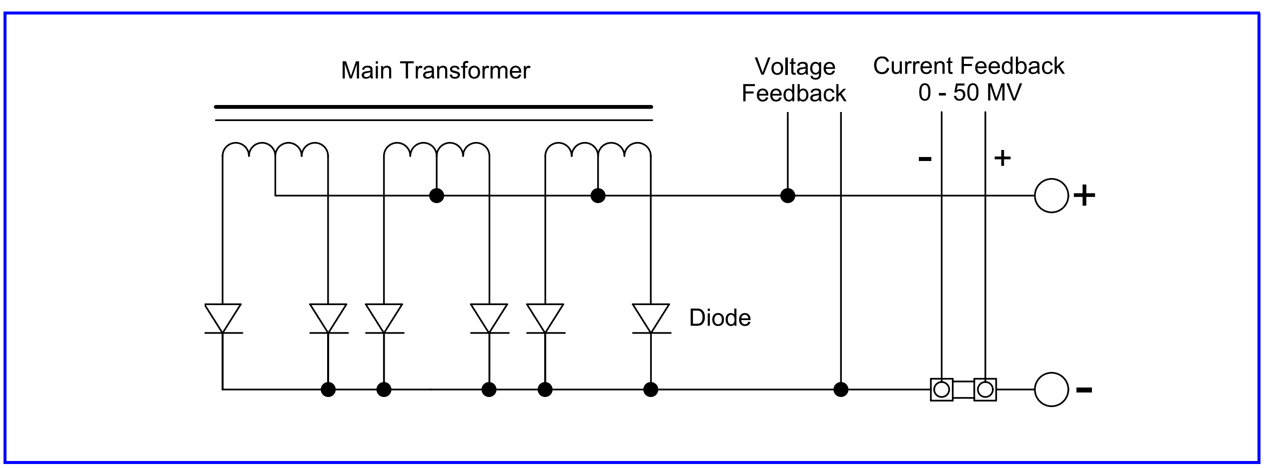


Figure 19 *Diode Assembly without Interphase Transformer*

3.1.6 Control Supply Transformer

Provides power for the control board which steps down 110 Volts to 50 Volts - center tapped. See **Figure 20**.

A. Synchronization Transformer

Provides power for the trigger and amplifier board. It also provides the timing signal for the proper sequence of SCR firing into the primary of the main transformer. See **Figure 21**.

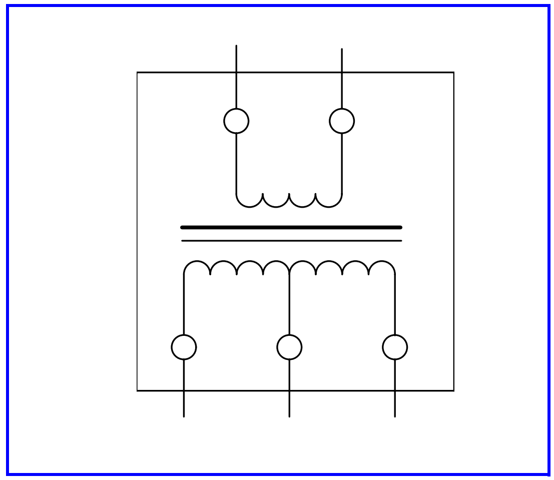


Figure 20 *Control Supply Transformer Diagram*

3.1.7 Control Transformer

Steps down the primary line voltage to 110 Volts for use in the control circuit. Provides power to the starter coil pump(s) and solenoid control board.

3.1.8 Protective Devices

In addition to the magnetic starter, these devices provide protection for the converter.

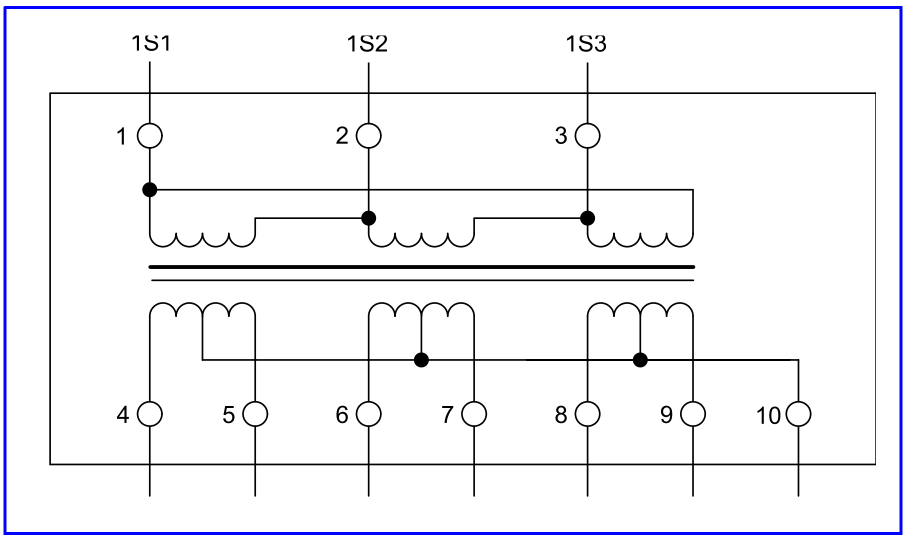


Figure 21 *Synchronization Transformer Diagram*

A. Peak Limit Control

In the event of excessive instantaneous line current, due to either an internal or external fault, the current is electronically interrupted after a single half cycle (worst case) of fault current. The control then automatically "eases" the converter back on while continuing to monitor the line current. The control will continue to limit the peak input current to a safe preset level, and after 5 seconds, will turn the converter off. In a case of a short on the output of the converter, the normal current limit control will take over and maintain the converter average output current at rated current.

I. Thermal Overloads (10T, 20T, 60T)

Three NC thermal overloads are used in the converter, two mounted on the diode stud and one on the thyristor heat sink. They will open and shut the converter off if the stud temperature is excessive [approximately 230° F (110° C) for the diode or 170° F (77° C) for the thyristor.]

J. Float Switch (on Super SASSC models only)

A float switch is used to indicate the loss of coolant by energizing a light on the control panel. It will not shut the converter off.

K. Temperature Sensor (40T)

A normally open thermal sensor, mounted on the diode heat sink, will close and turn on the temperature warning light located on the meter panel. It will not shut the converter off.

L. Interlocks

Two types of interlocks are provided.

The control door and starter panel cover, of the small cabinet, energize limit switches electrically interlocked with the starter coil. Opening either door or cover, while operating the converter, will immediately shut the unit down. They are mechanically unable to be defeated by pulling the actuator out until down. These switches will automatically reset when pushed back in. The large cabinet has a limit switch on the left front door only.

3.2 Cooling System Operation

3.2.1 Coolant

A special solution of inhibited propylene glycol and distilled water is used as the coolant for power components. A blue dye is used as a visual aid to determine if there are any leaks in the system.

3.2.2 Heat Exchanger

A cleanable water-to-water heat exchanger is used to remove heat from the coolant and carry it away from the converter.

3.2.3 Pump

A magnetically driven pump, that contains no seals, is used to circulate the coolant through the power components and provide efficient operation.

3.2.4 Cooling Circuit

This circuit consists of parallel connections to extruded aluminum semiconductor heat sinks and extruded aluminum transformer windings with high temperature nylon tubing. They route through a manifold assembly to provide even coolant distribution. An expansion tank is used as a reservoir to hold additional coolant.

3.2.5 Solenoid Valve

The raw cooling water flow is controlled by the solenoid valve to prevent excessive waste of water. The flow of cooling water is not continuous and is controlled by the solenoid control board.

3.2.6 Solenoid Control Board

This board uses a bimetallic thermostat mounted on a diode heat sink to control the solenoid valve in the raw cooling water supply line. It maintains the coolant at a minimum temperature of about 125° F (52° C).

3.3 Control Operation

3.3.1 Electronic Microprocessor Board

This board continuously monitors the current transformer (1, 2, 3 CT) output while the converter is operating. In the event of an external or internal fault, the peak limit circuitry will shut the converter off. The monitor section also accepts the feedback signals from the DS Bus and shunt to provide reference levels for the trigger/amplifier section. This controls the converter output.

By controlling the firing of the line SCR's, the trigger/amplifier section varies the converter output voltage and current. Using the feedback signals from the monitor section, the converter output can be controlled and held constant at:

- voltage with current limiting
- average current density with current limiting
- or current with voltage limiting

The board provides the reference controlling voltage and accepts the control input from the potentiometers.

3.3.2 Control Function

A. Automatic Voltage Control with Current Limiting

The function of this control is to maintain the converter output voltage at a value preset by the operator's control knob. This preset value of output voltage will be held constant within ± 1% of the converter's full rated output voltage over a range of 10% to 100% of output current under varying load conditions. For example, with a 3000 Amp @ 12 Volt unit, the output voltage will be held constant ± 0.12 Volts over a range of operation from 30 Amp to 3000 Amp. The voltage will remain constant throughout the operational cycle and will eliminate the costly burning or over-plating, which can result from widely varying load voltages.

Protection of the converter from DC overloads is provided for by the automatic current limiting. Any decrease in load resistance above the converter current rating will result in a decrease of output voltage and the converter output current will be limited at its maximum rated current. See **Figure 22**.

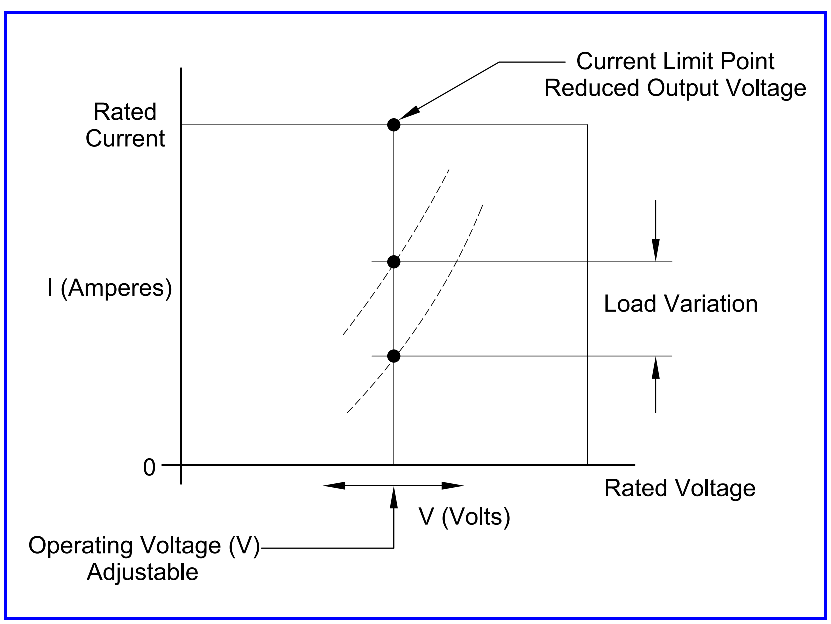


Figure 22 *Automatic Voltage Control with Current Limiting*

In chrome plating, and related processes, where a current interruption by a DC overload device can result in costly stripping and replating, the current limiting feature automatically prevents the overload from damaging the converter while maintaining continuous operation at reduced output voltage.

C. Automatic Average Current Density Control With Current Limiting

The need for average current density control is due to the fact that the current in a plating system does not increase in direct proportion as the plating area is increased, even though the plating voltage is held constant. It is necessary to increase the voltage as work area is added in order to maintain the proper average current density.

The Automatic Average Current Density Control increases the converter's output voltage as a greater amount of bus current is sensed. This is done by converting a current signal to a proportional voltage and adding it to the basic operating voltage. A current limiting feature automatically prevents an overload from damaging the converter while maintaining continuous operation at reduced voltage. See **Figure 23**.

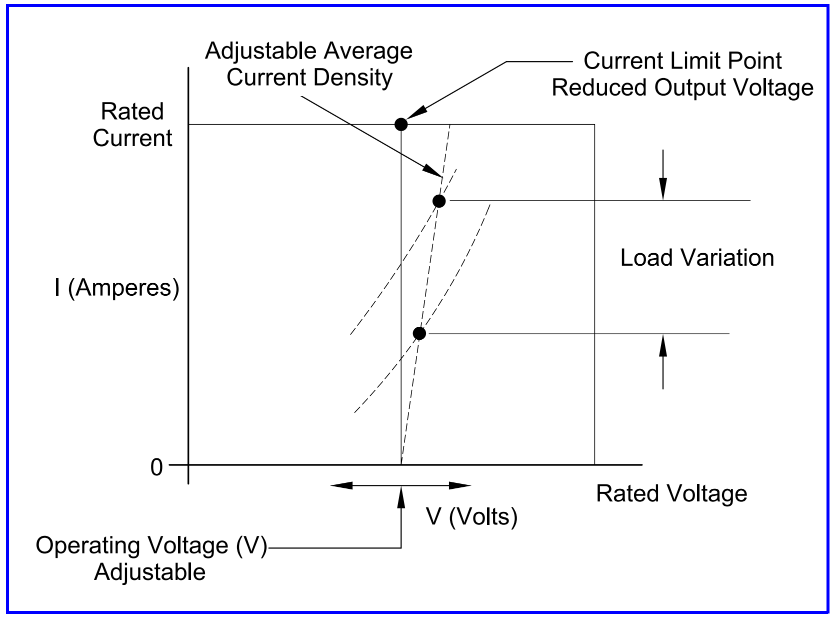


Figure 23 *Automatic Current Density Control with Current Limiting*

D. Automatic Current Control With Voltage Limiting

This control maintains the converter output current at a value preset by the operator's control knob. A preset value of output current will be held constant within ± 1% of the converter's full rated current value over a range of 10% to 100% of output voltage under varying load conditions during operation. For example, the output of a 3000 Amp @ 12 Volt converter will be held constant ± 30 Amp from 1.2 Volts to 12 Volts.

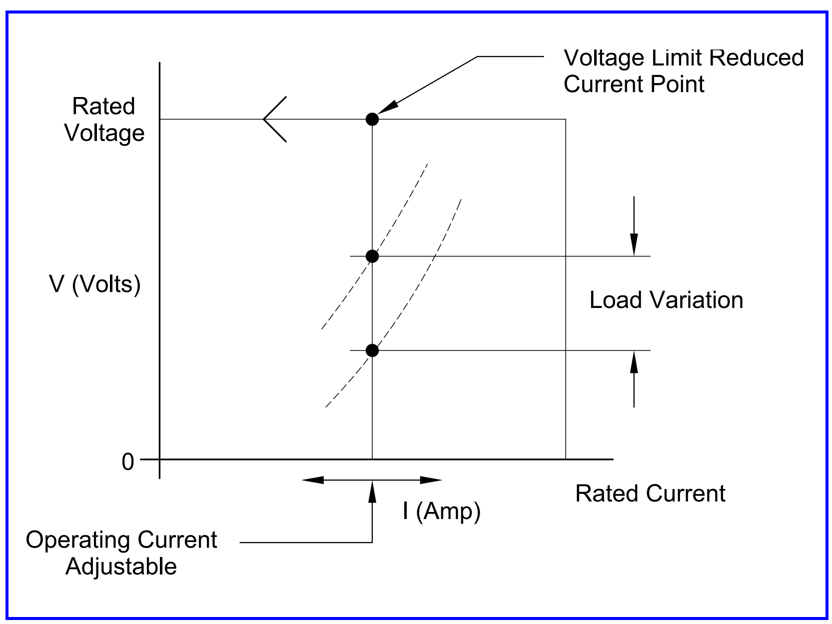


Figure 24 *Automatic Current Control with Voltage Limiting*

The voltage limit control is designed to reduce load burning due to over voltage and prevent power interruption to the load. Any increase in load resistance will result in a decrease of output current and the converter will be limited at its rated voltage output. See **Figure 24**.

This automatic current control can be used in operations such as hard chrome where thickness must be accurately controlled. It can eliminate costly grinding and stripping operations. An automatic current control can be used in any type of operation where variations in solution, temperature, thickness, and contact area will adversely affect the work being done.

3.3.5 Control On-Off Switch

This switch allows the operator to turn the converter off without tripping the starter. It also shuts off the coolant pump motor.

3.4 Converter Operation

3.4.1 Turn On Procedure

All open panels and doors must be closed before the converter is energized.

1. Turn on raw water supply to converter.
2. Close main (customer) disconnect or breaker.
3. Turn the "Output Adjust" knob completely counterclockwise.
4. Switch the "Control On-Off" to the "Off" position.
5. Depress the start button.
6. See **Sections 3.4.2**, **3.4.3**, or **3.4.4** for particular operation required by the application.

NOTE: Without a load connected to the converter, an output voltage indication will be seen on the voltmeter. This is the normal result of the thyristor DV/DT protective circuit and will disappear when a load is applied.

3.4.2 Automatic Voltage with Current Limit Operation Adjustment Procedure

All converters are shipped in the voltage mode of control unless otherwise specified at time of order. Refer to **Section 3.4.6** for instruction on changing control mode if required.

IMPORTANT: The "Current Density Adjust" potentiometer must be turned completely counterclockwise for Automatic Voltage operation.

1. The "Current Density Adjust" potentiometer is located on the front panel of integral control units. On remote control units the pot is inside the remote cabinet. To adjust the current density potentiometer, remove the locknut and turn the pot with a screwdriver completely counterclockwise. Replace and tighten the locknut.
2. The "Limit Adjust" pot should be turned completely clockwise. At this setting the converter current output will be limited at its full rated value. If a lower current limit point is desired, turn the pot counterclockwise to the desired setting. For example, setting the potentiometer at midpoint will limit the current to approximately half the rated output current. This pot is located on the front panel of integral control units or inside the remote cabinet for the remote control units. To adjust, remove the locknut, turn the pot to the desired setting with a screwdriver, then replace and tighten the locknut.
3. Turn the "Output Adjust" knob completely counterclockwise.

4. Energize the converter as outlined in **Section 3.4.1**.

5. Switch the "Control On-Off" to the "On" position.

6. Adjust the "Output Adjust" knob to the desired voltage level. The converter will hold the desired voltage level constant for varying load conditions.

NOTE: Desired voltage level setting must be between 10% and 100% of the full rated output voltage of the converter.

3.4.3 Automatic Average Current Density Control with Current Limit Adjustment Procedure

All converters are shipped in the voltage mode of control unless otherwise specified at the time of order. The Automatic Average Current Density control must be used with the control in the voltage control or current density mode. See **Section 3.4.6**.

1. Turn the "Current Density Adjust" pot completely counterclockwise. This pot is located on the front panel of integral control units. To adjust, remove the locknut and turn the pot with a screwdriver completely counterclockwise. Do not replace the locknut until the remainder of the adjustment is complete.

2. The "Limit Adjust" pot should be turned completely clockwise. This pot is located on the front panel of integral control units. To adjust, remove the locknut, turn the pot with a screwdriver, replace and tighten the locknut.

3. Turn the "Output Adjust" knob completely counterclockwise.

4. Energize the converter as outlined in **Section 3.4.1**.

5. Switch the "Control On-Off" to the "On" position.

6. With the smallest anticipated workload in the tank, turn the "Output Adjust" knob clockwise to produce the desired current output for that workload.

7. Increase the workload in the tank to the maximum expected load. Although the current has increased, the total current will be less than desired for that load.

8. Turn the "Current Density Adjust" knob clockwise until the proper current is reached.

9. Repeat steps 5, 6, and 7 to minimize the current difference from small to large loads.

10. Replace and tighten locknut on "Current Density Adjust" pot.

NOTE: This control works well for repeated loads of the same type. A change in size and shape of the workload may require readjustment of the pot settings.

3.4.4 Automatic Current Control with Voltage Limit Adjustment Procedure

All converters are shipped in the voltage mode of control unless otherwise specified at the time of order. For automatic current control, refer to **Section 3.4.6** for instruction on changing control mode to the current control mode.

1. The "Current Density Adjust" pot must be turned completely counterclockwise for Automatic Current operation. This pot is located on the front panel of integral control units or inside the remote cabinet for remote control units. To adjust, remove the locknut and turn the pot with a screwdriver completely counterclockwise, then replace and tighten the locknut.
2. The "Limit Adjust" pot should be turned completely clockwise. At this setting the converter voltage output will be limited at its full rated value. If a lower voltage limit point is desired, turn the pot counterclockwise to the desired setting. For example, setting the pot at midpoint will limit the voltage to approximately half the rated output voltage. This pot is located on the front panel of integral control units or inside the remote cabinet for remote control units. To adjust, remove the locknut, turn the pot to the desired setting with a screwdriver, then replace and tighten the locknut.
3. Turn the "Output Adjust" knob completely counterclockwise.
4. Energize the converter as outlined in **Section 3.4.1**.
5. Switch the "Control On-Off" to the "On" position.
6. Adjust the "Output Adjust" knob to the desired current level. The converter will hold the desired current level constant for varying load conditions.

NOTE: The converter will hold the desired current level for an operating range from 10% to 100% of the converter's full rated output voltage.

3.4.5 Turn Off Procedure

The SASSC output may be shut off by two methods:

1. For Operation without interrupting the starter, switch the "Control On-Off" switch to the "Off" position. This stops the firing pulses to the line SCR's and shuts off the converter.
2. Depress the "Stop" button. This will interrupt the coil of the starter, removing the converter from the line.

3.4.6 Conversion To Current Mode Of Control

The conversion from voltage mode to current mode of control is easily accomplished.

1. Open the door of the remote meter cabinet and locate the terminal strip mounted on a panel inside the cabinet. See **Figure 11**.
2. Locate terminals No. 20 and No. 21 on the terminal strip. See **Figure 25**.
3. Remove wire No. 20 from terminal No. 20 and wire No. 21 from terminal No. 21.
4. Connect wire No. 20 to terminal No. 21 and wire No. 21 to terminal No. 20. See **Figure 26**.
5. Reverse steps 3 and 4 for conversion back to the voltage or current density mode of control.

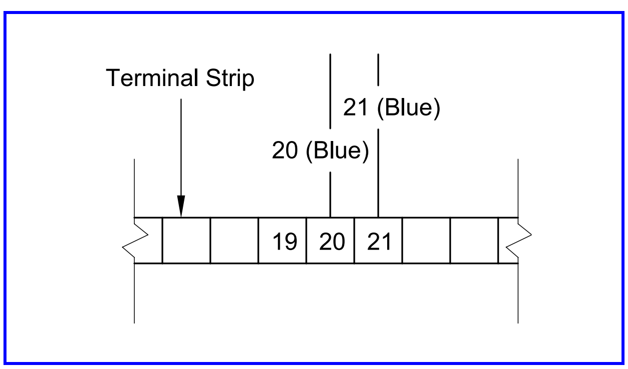


Figure 25 *Wiring Connection for Current Density Mode of Operation*

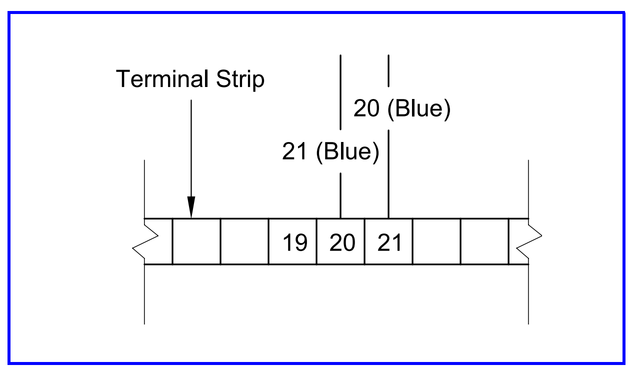


Figure 26 *Wiring Connection for Automatic Current Control Mode of Operation*

4. MAINTENANCE

The PEC Sealed Automatic Solid State Converter has been designed for minimum maintenance. A regular schedule of periodic checks should be set up to keep the converter in peak operating condition. All components requiring normal maintenance are easily accessible from the front of the converter.

4.1 Cabinet

Very little, if any, maintenance is required on the cabinet. However, all doors and panels should be kept securely fastened to prevent corrosive buildup on interior components.

4.2 Component Location

See **Figure 27-A** or **27-B**.

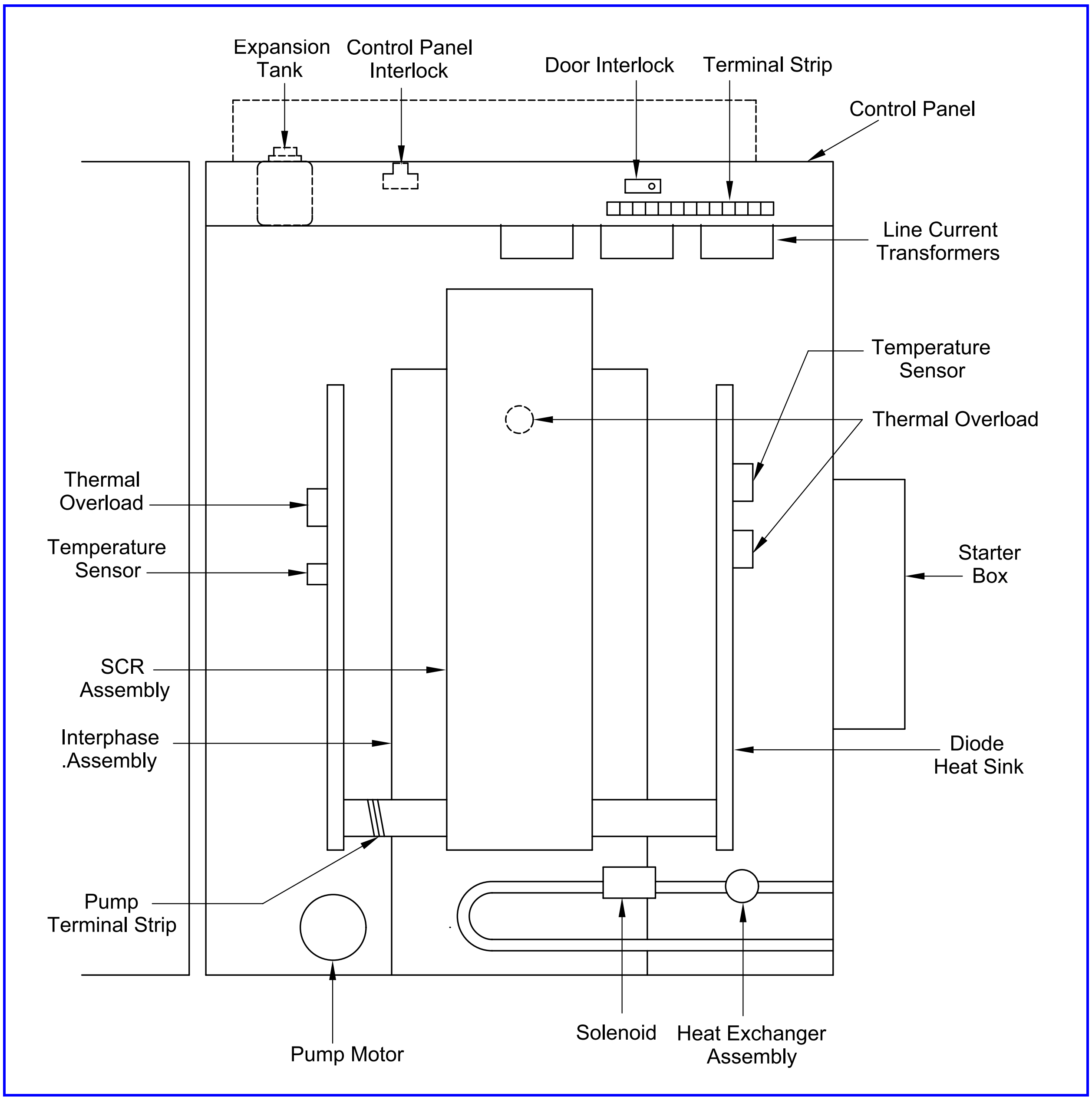


Figure 27-A *Small Cabinet Component Location*

4.3 Control Door

The control door contains the indicating and controlling elements for integral units. A sub-panel mounted on the inside of the door contains the electronic control board for all units. Connections between the control door and the converter are made by screw terminals and plugs.

Control Door Device	Id	Color	Converter Area
Plug	P1	Gray Shielded Cable	SCR's Connections
	P2	Yellow	Current Transformer
Wire		Red	AC Connections
		Orange	DC Connections
		Blue	Control Connections

Table 4 *Control Door and Converter Connections*

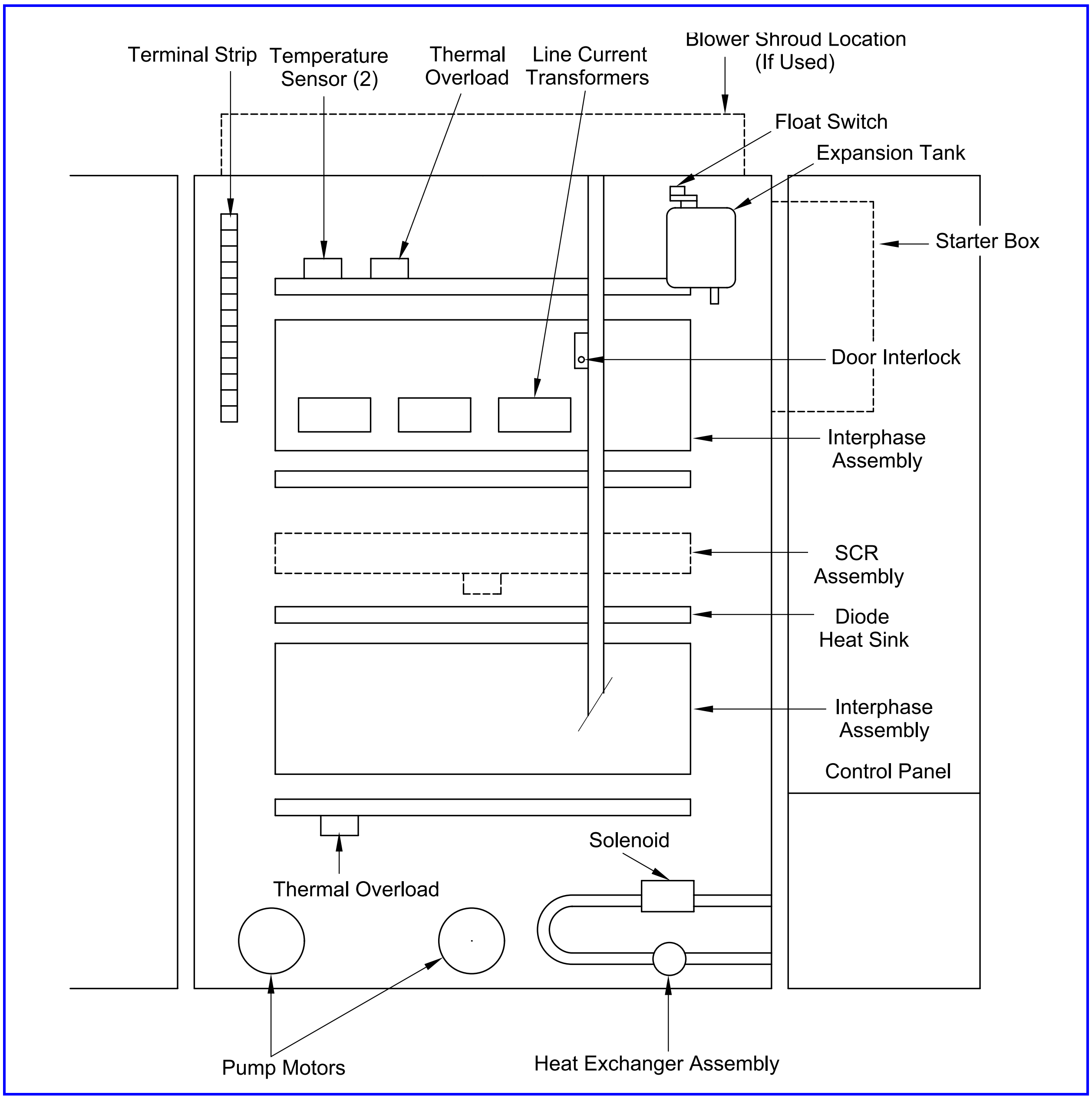


Figure 27-B *Large Cabinet Component Location*

4.3.1 Terminal Checkpoints

The terminal strip located just inside the front door (see **Figure 28**) provides a convenient point to check the operation of the converter and the control boards. See **Table 5**.

Terminal No.	Function
1, 2, 4, 5, 8	AC voltage and control terminals.
22	Average current density input terminal from pot.
21	Current adjust input. Accepts 0 to 5 DC. Reference voltage from controlling pot to the trigger/ amplifier board which controls the converter output. Measure between terminal 21 (+) and terminal 18 (-).
20	Voltage adjust input - accepts 0 to 5 DC. Reference voltage from controlling pot to the trigger/ amplifier board which controls the converter output. Measure between terminal 20 (+) and terminal 18 (-).
19	Reference output. Provides well-regulated 5 Volt DC for use with controlling and limiting pots. Measure between terminal 19 (+) and terminal 18 (-).
18	Common. Provides common tie point for measuring controlling and reference voltages.
A+, A-	Ammeter terminals.
V+, V-	Voltmeter terminals.

Table 5 *Terminal Strip Number and Function Comparison*

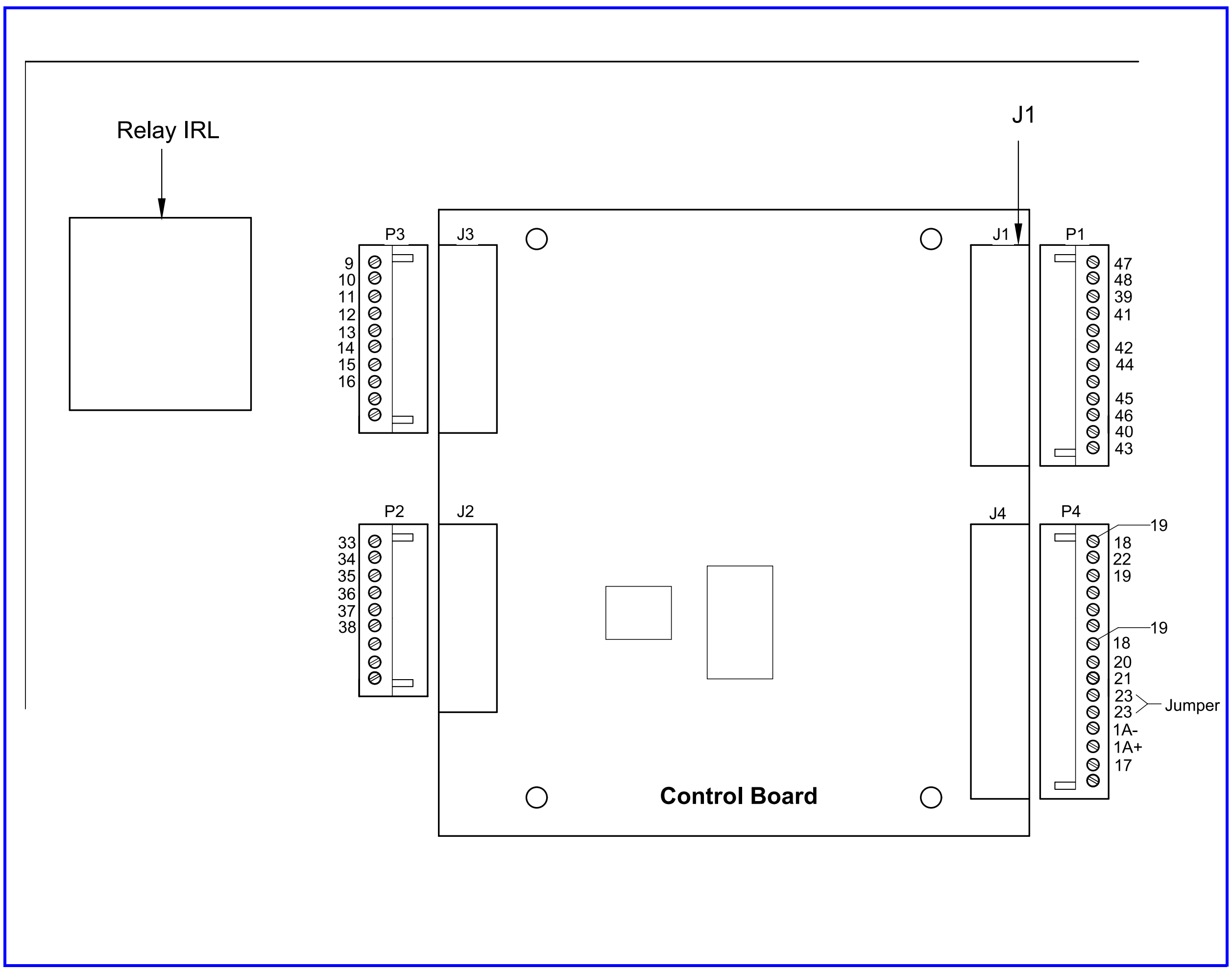


Figure 28 *Control Board*

4.4 Control Panel

The control panel contains the control transformers, solenoid control board, control relays, and fuses. It is located under the top cover of the small cabinet. See **Figure 29-A**.

For the large cabinet (see **Figure 29-B)** it is located on the inside of the right hand door.

4.5 Cooling System

4.5.1 Heat Exchanger

The heat exchanger (see **Figure 30**) can be cleaned by turning off the water supply and removing the end cap. Use a long stiff brush to clean the tubes and back flush the tubes to remove any deposits. The frequency of cleaning will be determined by the condition of the raw water used for cooling. If the heat exchanger cannot be cleaned, a replacement can be ordered from the PEC service/parts department.

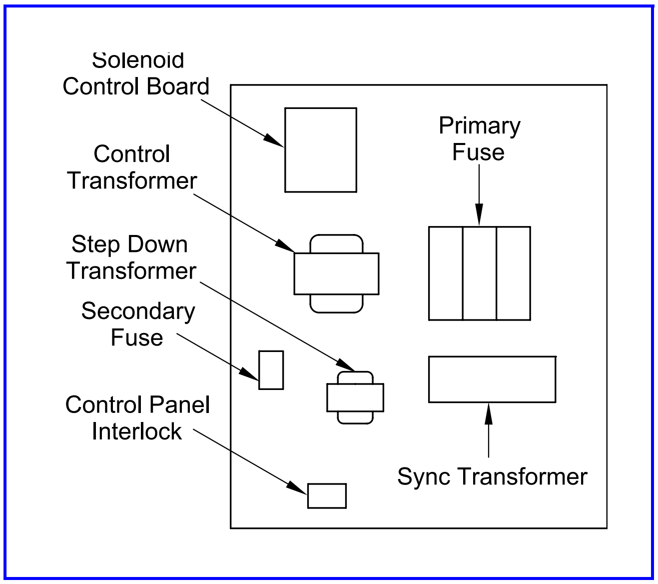


Figure 29-A *Small Cabinet Control Panel*

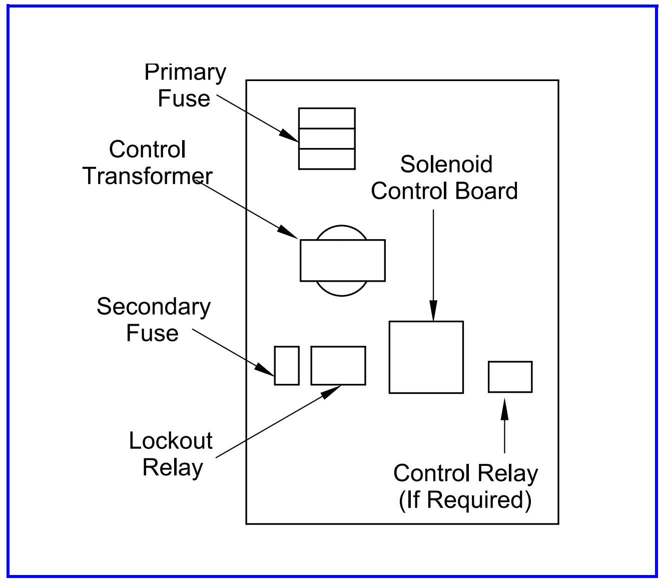


Figure 29-B *Large Cabinet Control Panel*

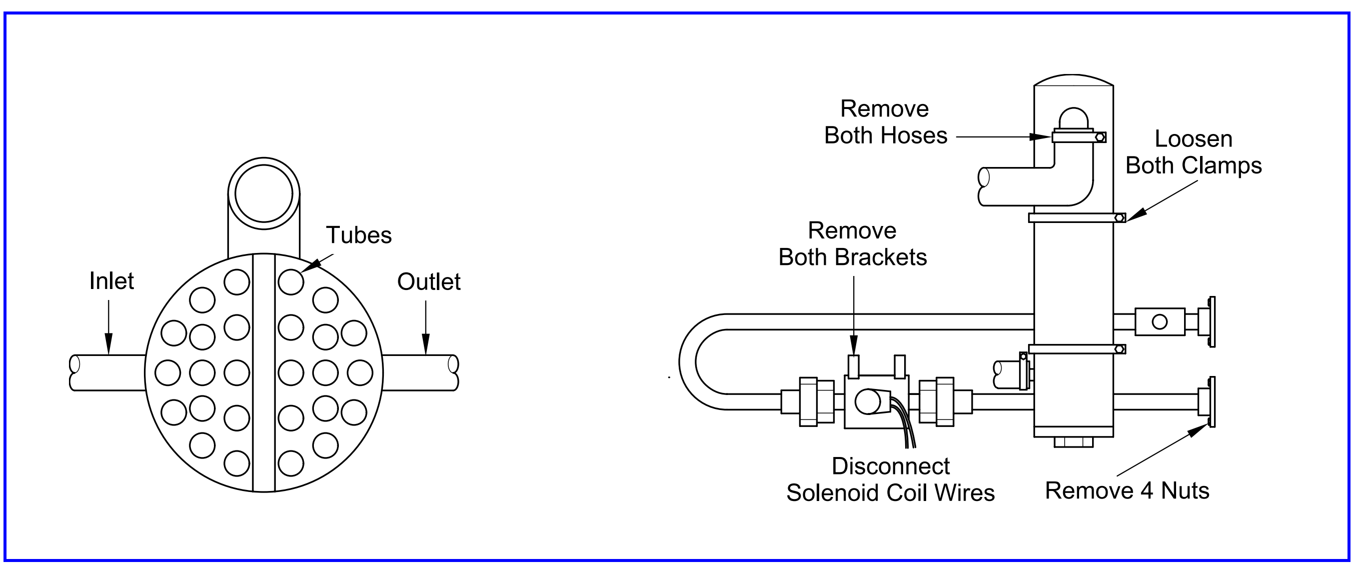


Figure 30 *Heat Exchanger*

The solenoid valve (see **Figure 31**) can be checked by applying 110 Volt, 60 hertz to the coil. The valve should snap in as 110 Volt is applied and external water will flow if it is operating properly. If defective, it can be replaced by loosening the two union couplings, removing the two bracket screws and disconnecting the power leads from the terminal strip.

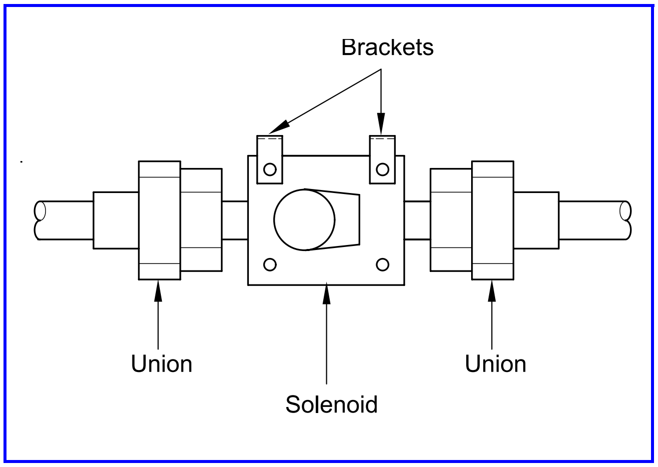


Figure 31 *Heat Exchanger Solenoid Valve*

4.5.2 Pump Motor

The pump motor(s) requires oiling once every six months. The oil holes are located at the front and rear top of the motor. See **Figure 32**.

The motor(s) can be replaced by removing the bolts from the mounting plate, disconnecting the inlet and outlet hose and disconnecting the motor wiring.

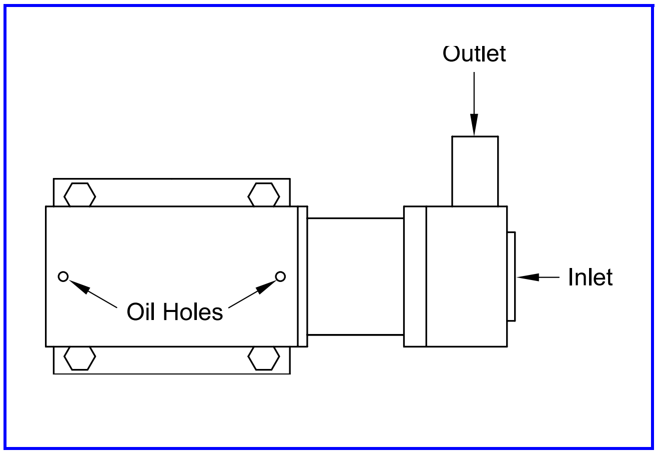


Figure 32 *Pump Motor Oil Holes*

4.5.3 Cooling System (Internal)

The coolant level of the internal cooling system should be checked at regular intervals. Use of other coolant mixtures will result in damage to the equipment and void the warranty. Use only **PEC Coolant AR40800** to refill the system. All tube fittings should be checked for possible loosening. A clear tube color indicates that the cooling passage is blocked. The tube fittings should be removed and the passage blown free of the blockage.

A. Coolant Draining and Refilling Procedure

WARNING

Safety glasses should be worn at all times. Personal injury can occur.

To drain the system of coolant:

1. Remove coolant from expansion tank. See **Figure 33**.
2. Clamp off inlet and outlet hoses with vise grip pliers and remove from tee.

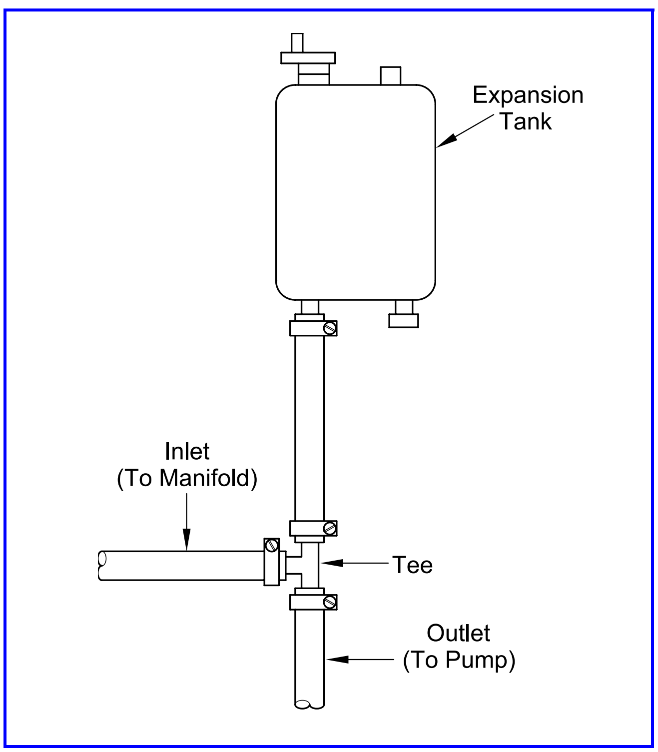


Figure 33 *Coolant System Expansion Tank*

3. Insert extension hoses on both inlet and outlet hoses.

4. Place both extension hoses in a 5 gallon (20 liter) can and remove pliers to drain system of coolant.

5. Blow out remainder of fluid with air hose.

B. Refilling and Purging the Air

1. Replace the inlet hose, outlet hose, and Expansion tank hose to the tee.

2. Slowly fill the expansion tank to 1" from its top with clean coolant. Do not overfill. Allow several seconds for gravity to pull the coolant into the rectifier's cooling system and refill the tank if necessary.

3. Replace the expansion tank lightly, so air can escape but coolant will not splash into the starter panel.

4. Remove the pump wires from the small terminal block at the bottom of the unit. See **Figure 27-A**.

5. From an external source, apply 110 V ac across the pump wires for three seconds then disconnect the power. Allow the expansion tank to bubble and reduce the coolant level.

6. Add coolant and lightly replace the lid.

CAUTION

Do not fill the expansion tank while the pump is running.

7. Repeat steps 2 - 6 until the entire system has no air.

8. Replace the pump wires onto the terminal strip and clean all spills. If any coolant has dropped or splashed onto electrical components, clean them before energizing the main.

4.5.4 Replacement of Diodes and Thyristors (SCR's)

All diodes and thyristors are accessible from the front of the converter. The stud devices are mounted in self-locking heat sinks so it is only necessary to loosen and remove the stud nut to remove the device.

Each defective device must be replaced by the same device. In replacing any defective device, a good thermal compound (**Wakefield Type 120**) and Belleville washers must be used. The stud nut must be installed with a torque wrench. See **Table 6** for values. Use the assembly procedures as outlined for replacing these devices.

Device	Part Number	Torque Value	
		Inch-Pounds	Nm
Diode	BN-8--Series CR-38148 (3/4-inch Stud)	275 - 325	32 - 38
Thyristor (SCR)	CR-38119	130 - 150	15 - 17
	CR-38120		
	CR-38109		
	CR-38103		
	CR-38110	250 - 300	29 - 35
	CR-38104		
	CR-38105		
	CR-38106		

Table 6 *Diode and Thyristor Torque Values*

A. Method of Checking Diodes

Any good quality ohmmeter can be used to check if a diode is open or short circuited. The diode to be checked must be removed from the circuit. A good diode will read a resistance in both directions, forward (15-50 Ohms) and reverse (100K-10M Ohms). An open diode will indicate infinite resistance in both directions. A short circuited diode will have a zero resistance in both directions. The resistance reading value of a good diode may vary from one diode to another. This variance is no indication of the quality of the diode.

B. Method of Checking Thyristors (SCRs)

In-Circuit Check

1. Disconnect the power supply to the converter.
2. Build test fixture as illustrated in **Figure 34**.

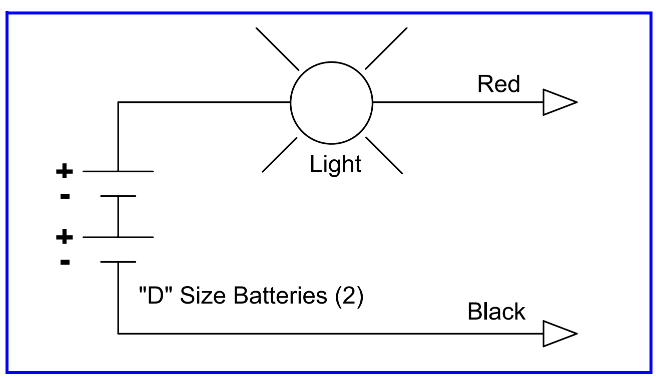


Figure 34 *Checking SCR on Test Fixture*

3. Identify SCR terminals. See **Figure 35**.

4. Place the red lead and black lead in circuit back-to-back across the SCR combination as shown in **Figure 36**. This tests SCR1.

   NOTE: No light should register. If the light comes on, one of the two SCR's is shorted.

5. If the light does not come on, momentarily short the gate lead of SCR1 to the anode stud of SCR1 and remove. The light should come on, and in many cases stay on. If the light comes on, the SCR is good.

6. Reverse the leads as noted below in order to test SCR2. See **Figure 37**.

   NOTE: No light should register. If the light comes on, one of the two SCR's is shorted.

7. If the light does not come on, momentarily short the gate lead of SCR2 to the anode stud of SCR2. The light should come on and in many cases stay on. If the light comes on, the SCR is good.

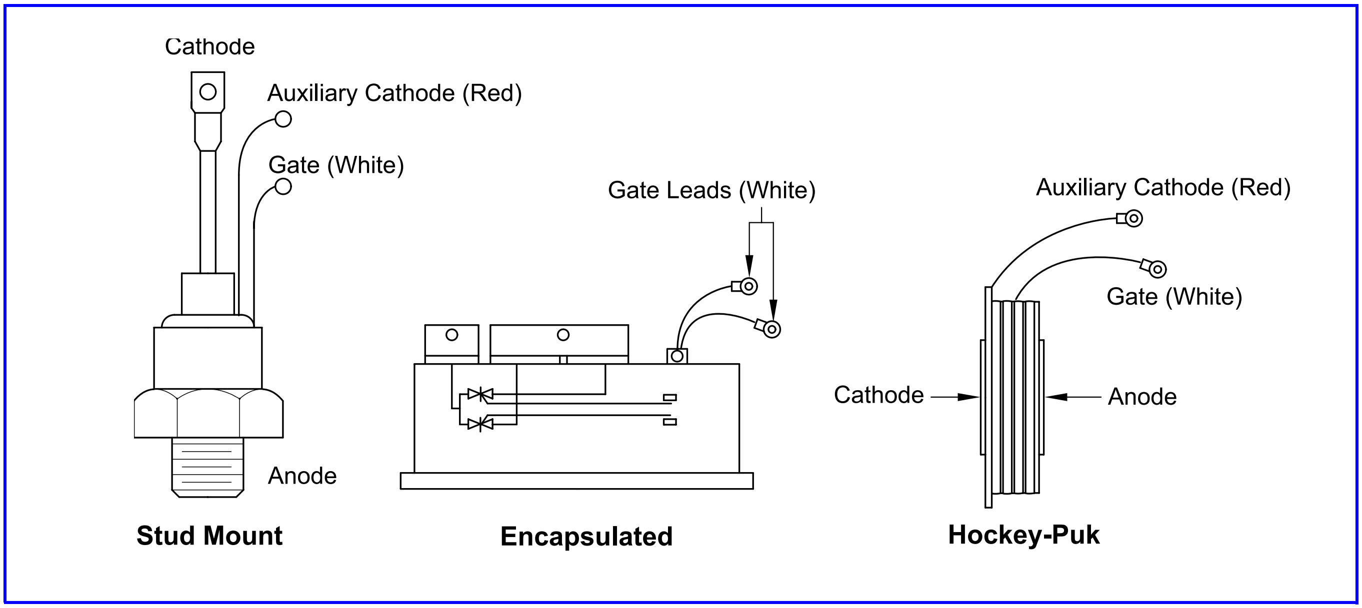


Figure 35 *SCR Terminal Identification*

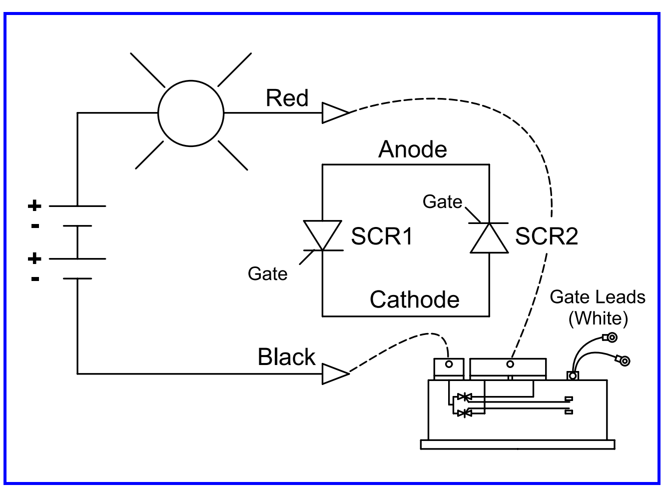


Figure 36 *Testing SCR1*

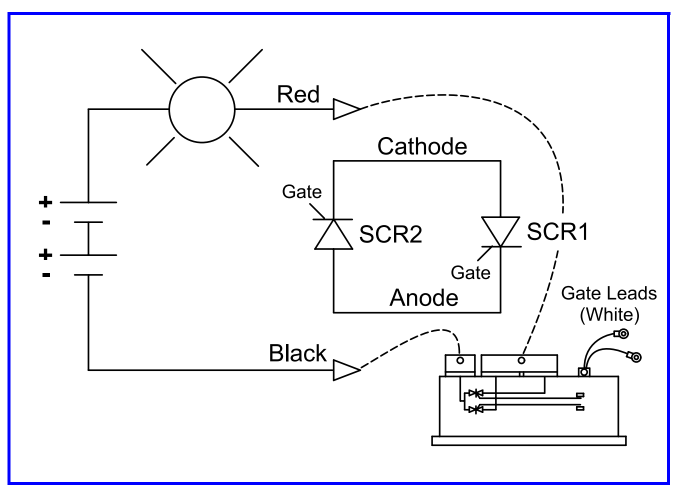


Figure 37 *Testing SCR2*

4.5.5 Assembly Procedure for Diodes and Stud Mounted SCR's

1. Remove bolt connection on diode (SCR) pigtail.
2. Remove hex nut and Belleville washer from diode (SCR) base and remove diode (SCR) from heat sink. See **Figure 38**.
3. Thoroughly clean the contact surfaces of the heat sink and the diode (SCR) pigtail connection. Inspect the surface for corrosion. Pitted surfaces can be refinished with No. 600 grit paper. Use a hard wood or steel block as a backing to prevent grooving of the surface and keep contact surfaces flat.
4. Coat the mounting surface of the diode SCR (not the stud) with **Burndy Penetrox 'A'** so the entire surface is evenly covered with a thin transparent coating.

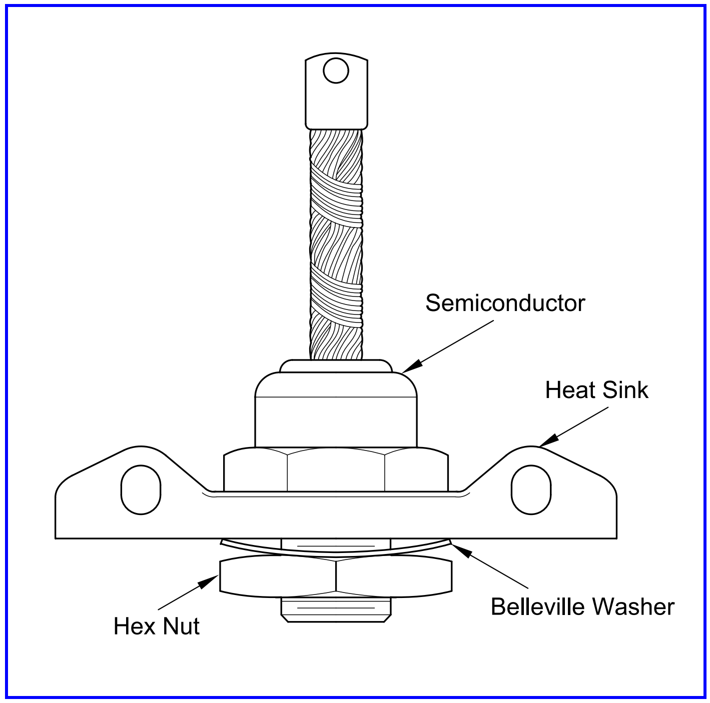


Figure 38 *Typical Diode and Stud Mounted SCR*

5. Mount the diode (SCR) on the heat sink using a belleville washer and hex nut.
6. Tighten the hex nut with a torque wrench to the proper torque value. See **Table 6**.
7. Position the diode (SCR) pigtail and bolt it to the collector bus.

4.5.6 Assembly Procedure for 'Hockey-Puk' SCR's

A defective SCR can be replaced as follows. See **Figure 39**.

1. Disconnect gate (white) and cathode (red) leads from the control board.
2. Loosen and remove the two stud bar nuts while holding the stud bar in place to prevent it from falling out of the assembly.
3. Pull up slightly on the upper heat sink and remove the defective device. Tie the gate and cathode leads in a knot so as not to confuse it with a good device.
4. Thoroughly clean the contact surfaces of the upper and lower heat sinks. Inspect the surfaces for corrosion. Pitted surfaces can be refinished with No. 600 grit paper. Use a hard wood or steel block as a backing to prevent grooving of the surface and keep the contact surfaces flat.
5. Coat both contact surfaces of the replacement SCR with **Burndy Penetrox 'A'** thermal joint compound so that the surfaces are covered with transparent coating. Use correct part number as a replacement device.
6. Center the replacement SCR on the lower heat sink, making sure the protruding pin picks up the centering hole of the SCR.

CAUTION

Make sure the proper pole face of the SCR is positioned against the lower heat sink.

7. Rotate the device so that its leads will not interfere with the stud bar and connection can be made to the control board.

8. Coat the threads of the stud bar with **Never-Seez** lubricating compound, if not already coated. Check to see that the indicator of the spring assembly (see **Figure 40**) reads zero against the spring clip. Place the leaf assembly over the upper heat sink with the assembly pin protruding 1/16" through the heat sink hole. (See Inset on **Figure 39**).

9. Assemble the stud bar around the lower heat sink and place the upper heat sink, with the leaf subassembly, over the studs, making sure that the protruding pin picks up the centering hole in the SCR.

   IMPORTANT: Care must be taken so that while tightening the clamp, the pin remains in the centering hole.

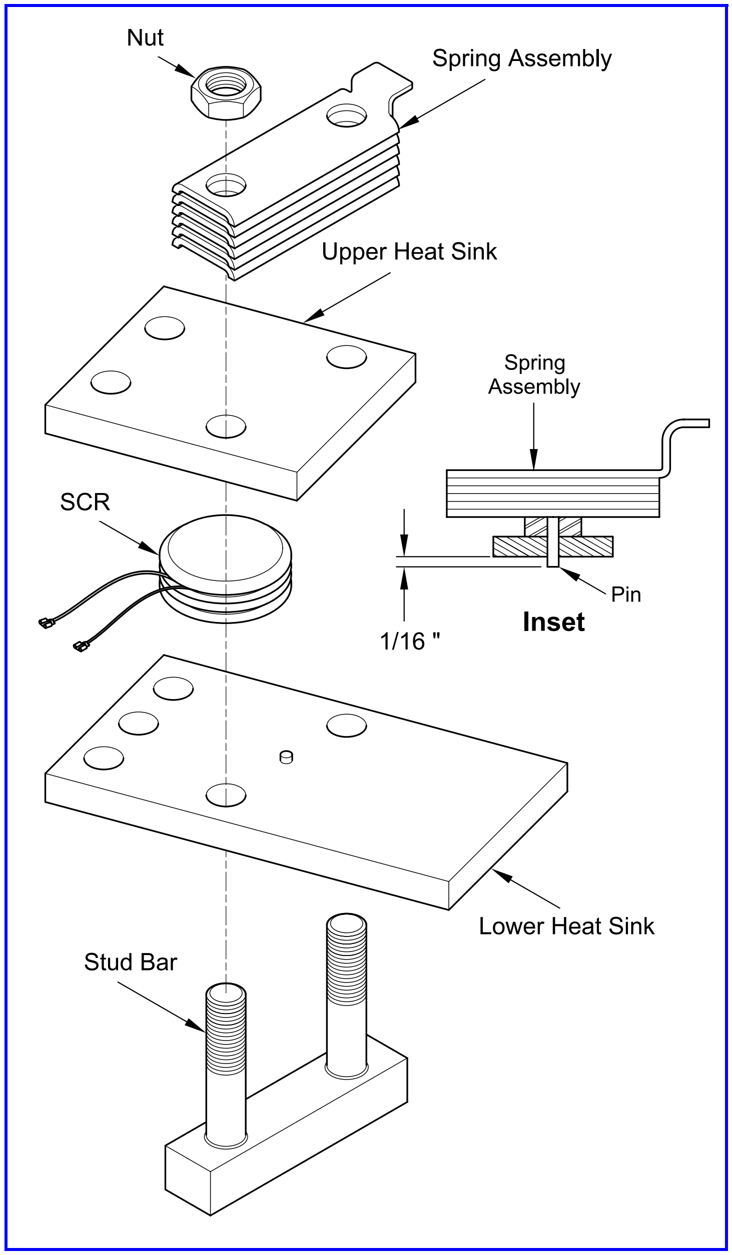


Figure 39 *Typical SCR Assembly*

10. Finger tighten the two nuts evenly.

11. Tighten the two nuts evenly, one half turn at a time until the force indicator reads the desired force per spring. See **Tables 8** and **9**.

12. Reconnect the gate (white) and cathode (red) leads of the replacement SCR to the correct terminals Gate Driver board (R-34210).

13. Physically inspect the whole SCR assembly for corrosion and clearances before putting the unit back on line. Check connections of DV/DT boards to make sure they have not loosened.

Notes

A. Recommended Compounds

Compound	Address	Notes
Burndy Penetrox A	Burndy Co.	Electrical Application Only
Never Seez Type NS	Never Seez Compound Corp Broadview , Illinois	Lubricating Application Only

Table 7 *Recommended Compounds for SCR Assembly*

B. For PEC thyristor numbers CR-38144 and CR-38145, the force applied is equal to the indicated force readout on the indicator times the number of springs used. For example, an indication of 400 with 5 springs will provide 2,000 pounds of clamping force.

PEC Thyristor (SCR) Number	Desired Mounting Force	
	Ft. Lbs.	Nm
CR-38144	2,000	2,712
CR-38145		

Table 8 *Recommended Force for Thyristors CR-38144 and CR-38145*

C. For the PEC thyristor numbers below, the desired force is measured on the spring assembly indicator. See **Figure 40**.

PEC Thyristor (SCR) Number	Desired Mounting Force (As Shown on Indicator Dial)
CR-38395 *	2-1/2
CR-38396 *	
BR-36086	
BR-36086	
BR-36086	
BR-36086	
BR-36090	
* For PEC "Super SASSC" type water cooled power supplies using CR-38395 or CR-38396 thyristors, see Procedure P-SM3 "Assembly for Disk type SCR's used on Super SASSC Only."	

Table 9 *Recommended Force for Thyristors Measured with Indicator Dial*

4.5.7 Assembly Procedure for 'Hockey-Puk' SCR's - Super SASSC Only

A defective SCR can be replaced as follows. See **Figure 40**.

1. Disconnect gate (white) and cathode (red) leads from the control board.
2. Loosen and remove the two stud bar nuts while holding the stud bar in place to prevent it form falling out of the assembly.
3. Remove the plastisol coated spring leaf and stud bar from the assembly. Set aside for future use after inspection.

   NOTE: Check the plastisol coating and stud bar insulation for cracks and chips which may result in a high voltage arc-over. Replace parts as necessary.

4. Pull up slightly on the upper heat sink and remove the defective device. Tie the gate and cathode leads in a knot so as not to confuse it with a good device.
5. Thoroughly clean the contact surfaces of the upper and lower heat sinks. Inspect the surfaces for corrosion. Pitted surfaces can be refinished with No. 600 grit paper. Use a hard wood or steel block as a backing to prevent grooving of the surface and keep the contact surfaces flat.
6. Coat both contact surfaces of the replacement SCR with **Burndy Penetrox 'A'** thermal joint compound so that the surfaces are covered with transparent coating. Use correct part number as a replacement device.

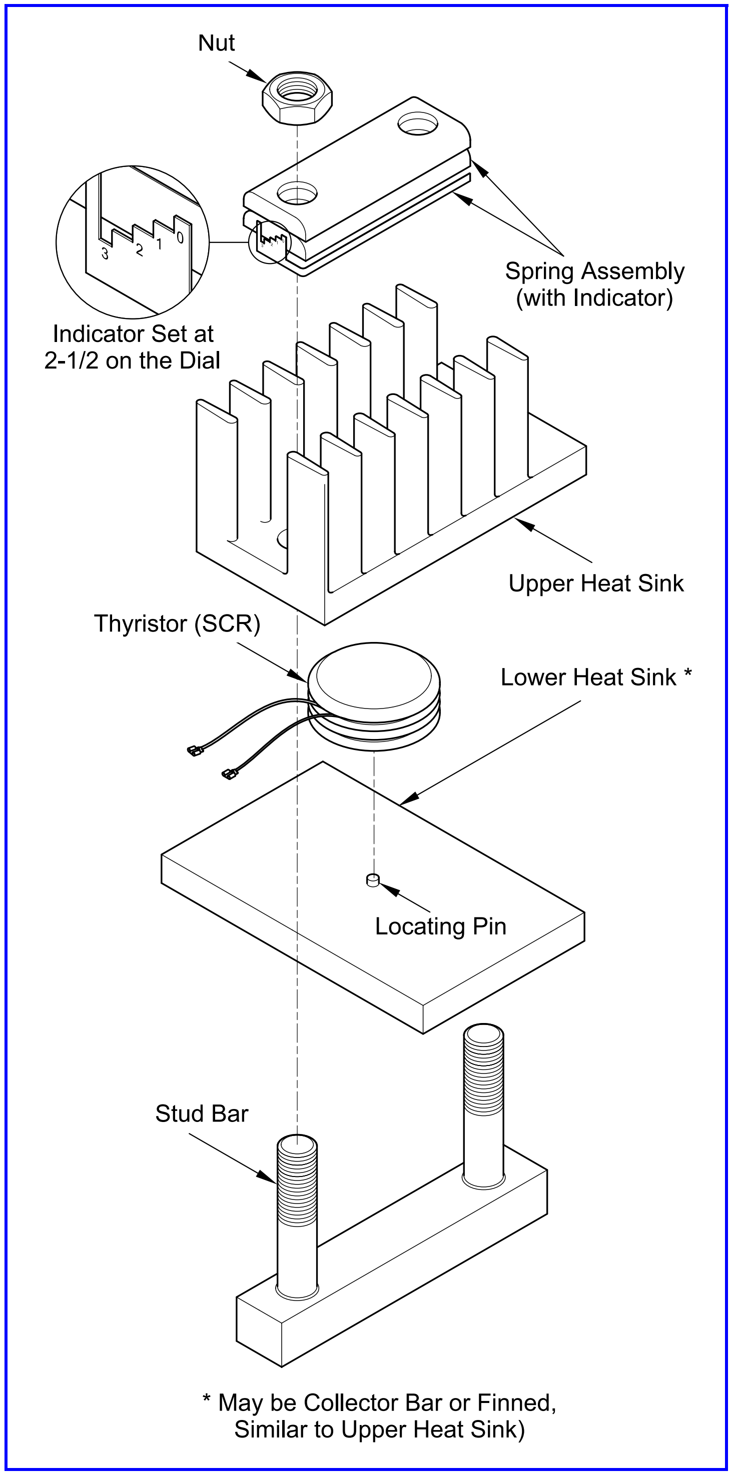


Figure 40 *Typical Thyristor Assembly (Showing Indicator Dial)*

7. Center the replacement SCR on the lower heat sink, making sure the protruding pin picks up the centering hole of the SCR.

CAUTION

Make sure the proper pole face of the SCR is positioned against the lower heat sink.

8. Rotate the device so that its leads will not interfere with the stud bar and connection can be made to the control board.

9. Coat the threads of the stud bar with **Never-Seez** lubricating compound, if not already coated. Place the leaf assembly over the upper heat sink with the assembly pin protruding 1/16" through the heat sink hole. Make sure 5/8" diameter cut-out in microsol coating is facing up. (See inset in **Figure 41**).

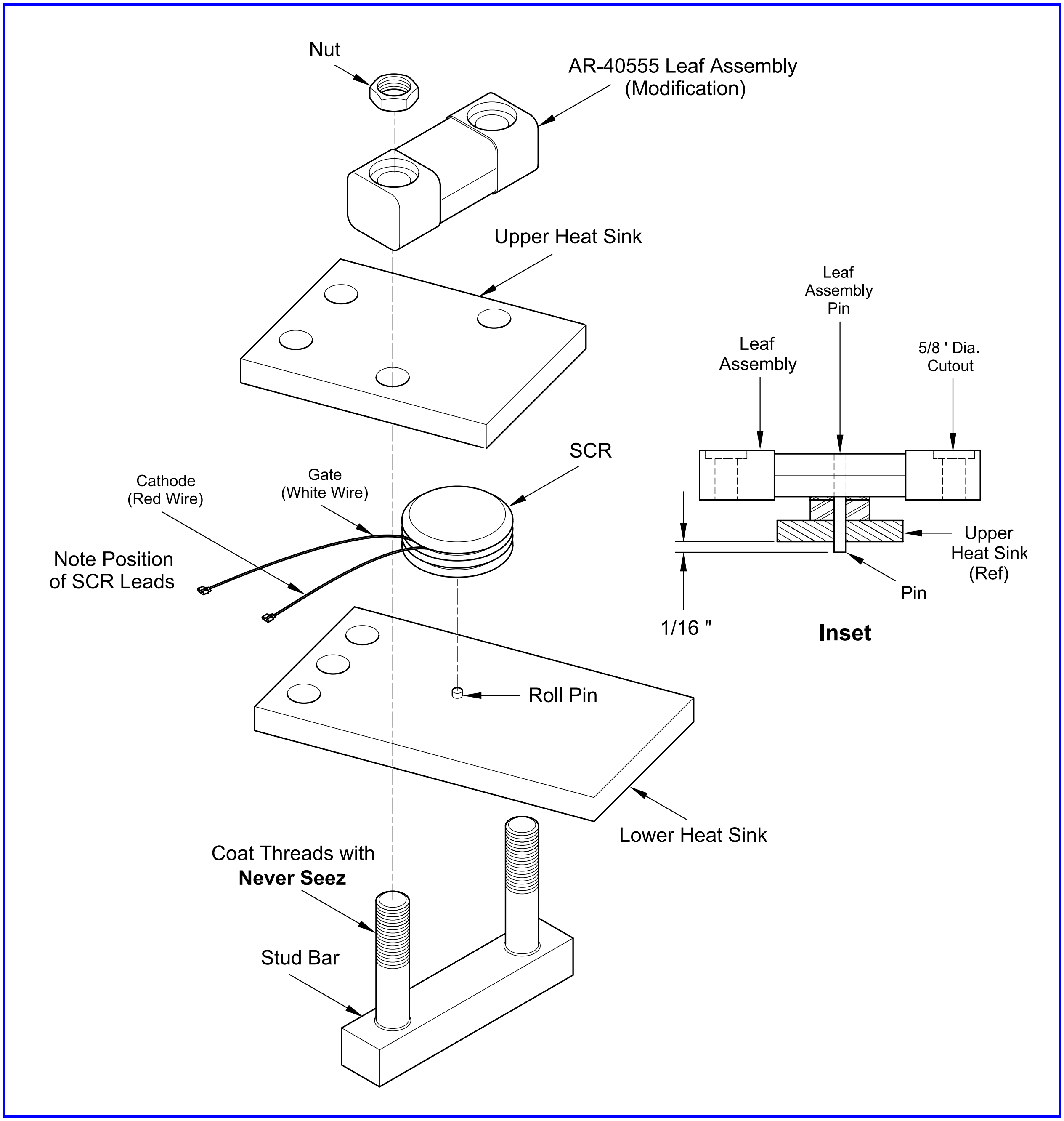


Figure 41 *Typical Thyristor Assembly (Showing Modified Leaf Assembly)*

10. Assemble the stud bar around the lower heat sink and place the upper heat sink, with the leaf subassembly, over the studs, making sure that the protruding pin picks up the centering hole in the SCR. This is important and care must be taken so that while tightening the clamp, the pin remains in the centering hole. (See inset in **Figure 41**).
11. Finger tighten the two nuts evenly. Turn the stud bar counterclockwise until it rests against the cooling plates.
12. With a torque wrench, tighten the two nuts evenly on each stud, one half turn at a time to 150 in. lbs.(17 Nm). Do not exceed 175 in. lbs. (20 Nm) or damage to the SCR may occur.
13. Reconnect the gate (white) and cathode (red) leads of the replacement SCR to the correct terminals of the control board.
14. Physically inspect the whole SCR assembly for corrosion and clearances before putting the unit back on line. Check connections of DV/DT boards to make sure they have not loosened.

Notes

A. Recommended Compounds

See **Table 7**.

4.6 Troubleshooting

The maintenance personnel should be acquainted with the electrical diagrams and the physical location of components within the SASSC unit before troubleshooting the equipment.

WARNING

There are dangerously high voltages present within the power supply enclosure. The SCR assembly has up to 480 Volts present on the heat sink. Extreme caution should be used in this area of the cabinet. Under no circumstances should any person reach within the enclosure, for the purpose of servicing the equipment, without the immediate presence or assistance of another person capable of rendering aid.

4.6.1 Troubleshooting Chart

Problem	Probable Causes
General	
Unit will not start. Pilot light does not come on when the button is pushed.	1. Check for 115 V ac from X1 to X2 on control transformer. 2. Check for 115 V ac across a open protective device. (NC contact) 3. Check interlock circuit in series with control circuit. 4. Faulty push button.
Unit Starts but drops out immediately. Pilot light comes on.	1. Loose connection in start hold circuit. 2. Short on primary or secondary power circuit. 3. Check for 115 V ac across starter coil. 4. Excessive D.C. load
Unit shuts off after a period of operation. Cannot be immediately restarted (5-15 minutes).	1. Thermal overload. a. Loss of cooling water b. Loss of coolant c. Defective diode d. Defective thermal device e. Defective pump f. Operating unit over rated output 2. AC heater overload. a. Excessive current through heater element b. Defective overload device
Cooling	
Temperature warning light comes on.	1. Check coolant level - add if necessary. 2. Check for loss of sufficient cooling water. 3. Coolant loop blockage. See Section 4.5. 4. Defective solenoid valve. 5. Defective solenoid control board.
Loss of coolant.	Check for leaks in cooling system (blue color around fittings left by the dye used in the coolant.)
Output Control Problem *	
No output in any mode of operation.	1. SCR control switch in the "Off" position. 2. Check if limit pot is set fully clockwise. 3. Check for 5 Volt reference at terminals 18 and 19. A reading other than +5 Volts DC indicates that the most probable cause is a defective control board. 4. Check for proper voltage and current adjust voltages at terminals 20 and 18 and 21 and 18. An incorrect reading indicates a defective control potentiometer or wiring problem. 5. Check for voltage at control board. Voltage readings are AC and must be 25 Volts AC from terminal No. 5 to terminal 3 and 4 on the control terminal strip.
Output with little or no control.	1. Defective control pot. 2. Check feedback circuits (voltage and current.) 3. Defective control board.
Unit shuts off when the output control is turned up.	1. Defective control board. 2. Defective DV/DT pulse board. 3. Defective SCR (Refer to **Section 4.5.4** for proper testing procedure.)
* Refer to Section 4.3.1 for normal control voltage readings.	

4.6.2 Control Output Operation and Error Display

A 7-segment display continuously shows the operating status of the trigger. A list of possible display characters and their meanings is shown in **Table 10**.

Character (Numeral)	Meaning
A	0A Synchronization signal missing
b	0B Synchronization signal missing
L	Lockout. Terminal 9 shorted to common
F	Line frequency out-of-range
P	Peak limit trip activated. Power must be removed to reset
0	Zero. Circuit operating, amplifier calling for lower output. Pulses shut off
1 - 9	High-phase angle fully advanced, but control amplifier not satisfied. Relative indication of degree of phase advance, roughly 20 ° for each unit.
8	Random flashing pattern, no output. Probable wrong relationship between 0A and 0B sync signals. Possibly due to no ground on Y of AC source, or lack of cabinet ground.

Table 10 *AC1 Electronic Control Board Operating Status Characters*

4.6.3 Output Voltage Setup

To set the voltage limit, operate the rectifier in voltage control with the "Limit Adjust" pot fully clockwise, and the "Current Density Adjust" pot fully counterclockwise. With no load (open circuit), turn the output adjust fully clockwise. The output voltage will be near the rated output of the rectifier. Adjust P2 to get rated voltage. We recommend using a digital voltmeter to verify the analog voltmeter accuracy during this set up.

4.6.4 Output Current Setup

To set the current limit, operate the rectifier in current control with the "Limit Adjust" pot fully clockwise, and the "Current Density Adjust" pot fully counterclockwise. With the unit fully loaded (full current) adjust P3 to get rated output current. We recommend using a digital millivolt meter to verify the analog ammeter. The input voltage to the ammeter will be 50mv at full rated output.

4.6.5 AC Peak Limit Setup

The Peak Limit Section monitors the AC line current of the equipment by means of current transformers connected to J2. These current transformers are scaled to supply between 1/10 and 1/3 Amps at rated line current. This current is rectified, summed, and compared to a reference level set by the position of the switch S1. If the peak current exceeds this reference, the comparator activities, pulling the reset line low. If the microprocessor is reset more than about 18-20 times in sequence, a peak limit trip is generated. The normal current trip points for the standard CT's as a function of S1 setting is shown in **Table 11**.

S1	Binary Number	Small CT's (4 Taps)			Large CT's 2 Taps 300 - 1000
		Tap 1 to 2 Up to 30 A	Tap 1 to 3 100 - 300 A	Tap 1 to 4 100 - 300 A	
0 0 0 1	1	5.0	15.0	50	150
0 0 1 0	2	9.6	28.4	95	285
0 0 1 1	3	14.4	43.6	145	435
0 1 0 0	4	19.0	57.0	190	570
0 1 0 1	5	23.6	70.4	236	704
0 1 1 0	6	28.0	84.0	280	840
0 1 1 1	7	32.4	97.6	324	976
1 0 0 0	8	37.0	111.0	370	1110
1 0 0 1	9	41.0	123.0	410	1230
1 0 1 0	10	45.6	136.4	456	1364
1 0 1 1	11	49.6	148.4	496	1484
1 1 0 0	12	54.0	162.0	540	1620
1 1 0 1	13	58.0	174.0	580	1740
1 1 1 0	14	62.0	186.0	620	1860
1 1 1 1	15	65.6	196.4	656	1964
0 = Open 1 = Closed					

Table 11 *Normal Current Trip Points for Standard CT's Comparison to S1 Settings*

The trip action of the Peak Limit is accomplished through the microprocessor, by de-energizing the permit/lockout relay, which is mounted external to the board. This relay is energized by two driver stages, and is monitored by LED D6. This tripped condition may only be removed by interruption power to the board.

5. REPLACEMENT PARTS

When ordering replacement parts, give the model number and serial number of the unit as shown on the data nameplate, a description of the parts and the quantity desired. If further information is desired, contact your PEC salesman, the service department, or write to:

Process Electronics Corporation.

100 Brickyard Road
Mount Holly, North Carolina 28120
704-827-9019 or 1-800-421-9107 (Outside North Carolina)

5.1 Recommended Spare Parts

Although all parts are stocked at Process Electronics, it is recommended that the customer maintain a minimum spare parts supply in one's plant.

The parts listed in **Section 5.2** are recommended for customer stock as follows:

A. **Group I** - Parts in this group are considered normal replacement items and should be stocked for even one SASSC.

B. **Group II** - Parts in this group should be stocked by the customer who desires more complete backup for a single unit or normal backup for four or more units.

C. **Group III** - Parts in this group should be stocked by the customer only when one has several units or desired near total backup.

5.2 Parts List

This parts list includes the major items for all standard converter sizes. Specify model number and serial number. (See specific parts list for each individual unit).

Part Number	Description	Notes
	Group I	
BFG205	5 Amp Fuse	
FF504	10 Amp Fuse	
AR40327-1	5 Amp Fuse	
AR40760-1	10 Amp Fuse	
FG210	8 Amp Fuse	
Ar40362	Coolant	

Part Number	Description	Notes
		Group II
BR40277	Ammeter	Specify current when ordering
R34169	DV/DT and Pulse Board	
R34177	DV/DT and Pulse Board	
R34189	Solenoid Control Board	
R34240-B	Trigger/Amplifier Board	
CR90018	Heat Exchanger Assembly	For regular SASSC units only. Complete with solenoid
CR90434	Heat Exchanger Assembly	6000 Amp @ 6, 9, & 12 Volts only. Complete with solenoid
CR90699	Heat Exchanger Assembly	6, 8, 10, & 12000 Amp Super SASSC only. Complete with solenoid
AR40623	Potentiometer (1P)	
AR40336	Potentiometer (2, 3P)	
CR38148	Diode	
BR40308	Pump	
AR40474	Pump	Super SASSC only
BR40310	Solenoid	
AR40317	Temperature Sensor	50T Temperature Control
AR40588	Temperature Sensor	40T Warning
AR40732	Thermal Overload	1 & 20T Diode Trip
AR40732	Thermal Overload	30T SCR Temperature
AR45282-3	Thyristor (SCR)	90 Amp 1200 Volt
CR38110	Thyristor (SCR)	235 Amp 600 Volt
CR38104	Thyristor (SCR)	235 Amp 1200 Volt
CR38395	Thyristor (SCR)	700 Amp 1200 Volt
CR38396	Thyristor (SCR)	700 Amp 600 Volt
AR45432	Module (SCR)	250 Amp. For 430 series SASSC only.
AR45435	Module (SCR)	500 Amp. For 430 series SASSC only.
BR40278-1	Voltmeter	15 Volt maximum reading
BR40278-2	Voltmeter	30 Volt maximum reading
BR40278-3	Voltmeter	50 Volt maximum reading
		Group II
BR40192-6	Control Transformer	230/460 Volt. 500 KVA
BR40192-7		230/460 Volt. 750 KVA
BR40224-6		208 Volt. 500 KVA
BR40224-7		208 Volt. 750 KVA
AR40244	Control Switch	1SW
BR40309	Current Transformer	1, 2, 3 CT
BR40373		1, 2, 3 CT
AR40866-01	Starter	Size '00'
AR40866-02		Size '0'
AR40866-03		Size '1'
AR40866-04		Size '2'
AR40866-05		Size '3'
AR40616		Size '200'
AR40687		Size '400'
AR40972		Size '6'