Series 7000
Ultrasonic Power Supplies

Troubleshooting

SECTION 4 — MAINTENANCE

4.1 PREVENTIVE MAINTENANCE

To keep your Branson S-7000 Cleaning System in proper working order, we recommend that you do preventive maintenance on a regular basis.

WARNING: HIGH VOLTAGE!

To avoid an electrical shock hazard, do as follows BEFORE you inspect or do any maintenance to the S-7000 Cleaning System:

- **TURN OFF all electric power and UNPLUG everything on the S-7000 Cleaning System, and**
- **Place "OUT OF SERVICE" signs on the S-7000 Cleaning System.**

1. Periodically inspect the ventilation slots on the generator to make sure that nothing blocks the air flow.
2. Periodically inspect the entire S-7000 Cleaning System for possible leaks.
3. Periodically inspect the Junction Boxes and the Immersible Transducers to make sure there is no solution in them.
4. Periodically drain solution from the tank(s) and clean as follows:
   a) With detergent and water, scrub the inside of tank(s) with a long-handled, natural bristle brush.
   b) Flush out with clean water.

SECTION 4 – MAINTENANCE

4.2 GENERAL MAINTENANCE

Unless your maintenance technician is familiar with the operation and electronic characteristics of the S-7000 Cleaning System, we recommend that you call Branson with any problem you may have.

PROBLEMS	PROBABLE CAUSES
LOW activity in tank, generator ON/OFF indicator light up, and fan operates.	1. Solution needs degassing. 2. Solution contains excessive contaminates. 3. Solution has no saturation agent. 4. Input voltage to PC board is low. 5. Fuse on PC board needs replacement. 6. PC board needs replacement. 7. Transducers need repair. 8. Solution temperature is too low.
NO activity in tank, generator ON/OFF indicator lights up, and fan operates.	1. Ultrasonics switch needs replacement. 2. Transformer needs replacement. 3. EMC filter needs replacement. 4. Tank RF cable is unplugged or needs replacement. 5. Fuse on PC board needs replacement. 6. Generator fuse needs replacement. 7. Transducers need repair. 8. PC board needs replacement.
Solution is cold, tank ON/OFF switch is ON, and thermostat is set.	1. Electric outlet has no power. 2. Line cord needs replacement. 3. ON/OFF switch needs replacement. 4. Heater element needs replacement. 5. Thermostat needs replacement.
Power fuse or circuit breaker fails while either generator or tank with heater is plugged in, and generator is OFF.	• Line cord needs replacement.
Power fuse or circuit breaker fails while generator is on, but the generator fuse is okay.	1. Either one is underrated. 2. Heater element needs replacement.
Generator fuse fails when generator is turned on.	1. Generator fuse is underrated. 2. Line voltage is incorrect. 3. Generator switch needs replacement. 4. Fan motor needs repair. 5. Transformer needs replacement. 6. EMC filter needs replacement.

PROBLEMS	PROBABLE CAUSES
The ON/OFF indicator lights up, but fan does not operate.	• Fan motor needs replacement.
The ON/OFF indicator light does not light up, and fan operates.	1. Indicator light needs replacement. 2. ON/OFF Switch needs replacement.
The ON/OFF indicator does not light up, and fan does not operate.	1. Electric outlet has no power. 2. Line cord needs replacement. 3. Indicator fuse needs replacement. 4. ON/OFF Switch needs replacment.

SECTION 5 – TROUBLE-SHOOTING

WARNING: HIGH VOLTAGE!

To avoid an electrical shock hazard, do as follows BEFORE you inspect or do any maintenance on the S-7000 Cleaning System:

- **TURN OFF all electric power and UNPLUG everything on the S-7000 Cleaning System.**
- **Place "OUT OF SERVICE" signs on the S-7000 Cleaning System.**

IMPORTANT

These instructions are in the proper order for you to follow. If you do not follow this EXACT sequence—from 5.1 Printed Circuit Boards through 5.7 Transformer—the results of your trouble-shooting may be incorrect.

5.1 LINE CORD AND RF CABLE

1. Inspect the line cord and the RF cable for cracks, frays, discoloration, and burn spots.
   - Replace the line cord or the RF cable if there are cracks, frays, discoloration or burn spots.
2. Carefully remove the cover from the generator.
3. **Go to Section 5.2 Printed Circuit Boards.**

5.2 PRINTED CIRCUIT BOARDS (See Figure 18)

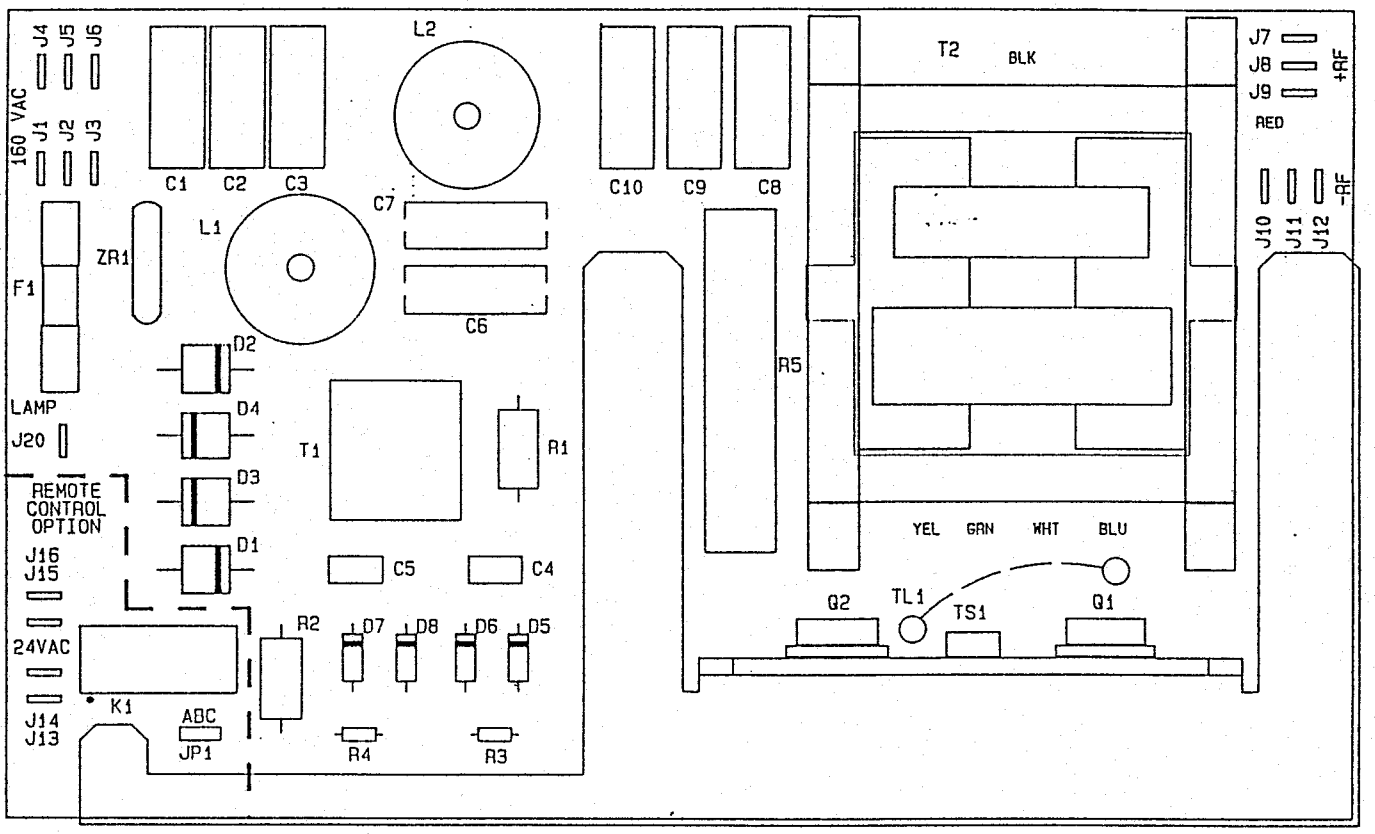
IMPORTANT

These instructions are in the proper order for you to follow. If you do not follow this EXACT sequence—from 5.1 Printed Circuit Boards through 5.7 Transformer—the results of your trouble-shooting may be incorrect.

1. Remove each printed circuit board (PCB) one at a time, from the generator. Notice that each PCB has an identification number that represents the unit of frequency and the number of elements.
2. Use an ohmmeter* to measure the continuity of each fuse and the forward and reverse resistance of diodes. Set the meter to the diode check function.
   - Replace any fuse or diode if the measurement falls outside of the limits shown in Figure 18.

   * We use a Fluke Model 87 Multimeter. If you use a different ohmmeter, your measurements may vary from those shown in Figure 18.
3. Inspect each PCB for wires with breaks or frays and clads that are loose, or have cracks or burn spots.
   - Replace any PCB that has breaks, frays, loose clads, cracks, or burn spots.
4. Put the PCB back into the generator. Make sure that:
   - All wire and cable connections are correct.
   - The pins in the jumper cable plug are in proper alignment.
5. Repeat steps 2-4 for each fuse and diode.
6. **Go to Section 5.3 Transistor Check.**

PRINTED CIRCUIT BOARD



OHMMETER POLARITY		FORWARD VOLTAGE (V)
+	-	
Anode	Cathode	.40 to .70
Cathode	Anode	Open

DIODE

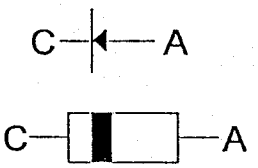
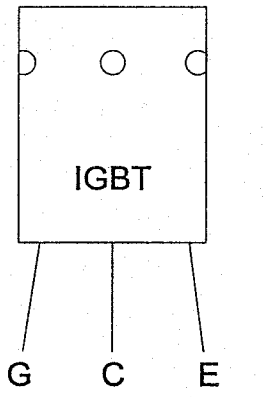


Figure 18

5.3 S-7000 TRANSISTOR CHECK

1. The S-7000 transistors can be checked while in the circuit. They do not have to be removed.
2. Using the Fluke Model 87 (or equivalent) set to the diode check function, perform the measurements as specified in the table of Figure 19. Record the voltage readings and compare them to the limits in the table. Note that the (-) lead on the meter is normally labeled "com". Measure both Q1 and Q2.
3. Readings outside the limits indicate that the transistor needs to be replaced.

TRANSISTOR (FRONT VIEW)
TO-247



G = GATE
C = COLLECTOR
E = EMITTER

OHMMETER POLARITY		FORWARD VOLTAGE (V)
+	-	
GATE	COLLECTOR	NONE—OPEN
	EMITTER	NONE—OPEN
COLLECTOR	GATE	NONE—OPEN
	EMITTER	NONE—OPEN
EMITTER	GATE	NONE—OPEN
	COLLECTOR	.300 TO .500

Square pad on the PCB is the GATE.

Figure 19

5.4 JUNCTION BOX

WARNING:

To avoid an electrical shock, remove any static charge that may remain on the transducers as follows:

- Connect Pin F to Pin H on the RF cable for a moment.
- Connect Pin A to Pin H on the RF cable for a moment.

IMPORTANT

These instructions are in the proper order for you to follow. If you do not follow this EXACT sequence—from 5.1 Printed Circuit Boards through 5.7 Transformer—the results of your trouble-shooting may be incorrect.

1. Open and inspect each junction box, one at a time, for broken cables, loose wires, and loose fittings.
   - Tighten any wires and fittings that are loose.
   - Replace any wire, cable, or fitting that is defective.
2. Go to Section 5.5 RF Cable.

5.5 RF CABLE (See Figure 20.)

IMPORTANT

These instructions are in the proper order for you to follow. If you do not follow this EXACT sequence—from 5.1 Printed Circuit Boards through 5.7 Transformer—the results of your trouble-shooting may be incorrect.

Use a dielectric breakdown tester that is capable of 2.5 kV generation and 500 µA current leakage measurement to test for insulation breakdown as follows:

1. Connect the tester's positive lead to Pin F on the RF cable.
2. Connect the tester's negative lead to Pin H on the RF cable.
3. Turn ON the tester.
4. Gradually increase the voltage from 0 kV to 2.5 kV.
5. Keep at 2.5 kV for 30 seconds. Look for a breakdown, arc, and current leakage in excess of 500 µA.
6. Decrease the voltage to 0 kV.
   - If there is no breakdown, arc, or current leakage, then go to Step 7.
   - If there is a breakdown, arc, or current leakage, then turn OFF and disconnect the dielectric breakdown tester, and replace the RF cable.
7. Turn OFF the dielectric breakdown tester.
8. Disconnect the tester's positive lead from Pin F on the RF cable and connect the lead to Pin A on the RF cable. Repeat Steps 3-7.

9. Disconnect the tester's positive lead from Pin A on the RF cable and connect the lead to the body of the connector plug. Repeat Steps 3-7.
10. Disconnect the dielectric breakdown tester.
11. Go to Section 5.6 Transducers.

RF CABLE CONNECTOR

MODEL	COLOR BANDS:		CHECK CAPACITANCE AT THESE PINS	
	BAND #1	BAND #2		
L1	White		A to H	
L2		Yellow		
L3		Red		F to H
L4		White		
L5	Yellow	Yellow		
A1	Black			F to H
A2		Yellow		
A3		Red	A to H	
A4		Black		
A5	Red	Red		

Figure 20

5.6 TRANSDUCERS (See Figure 20.)

IMPORTANT

These instructions are in the proper order for you to follow. If you do not follow this **EXACT** sequence—from 5.1 Line Cord and RF Cable through 5.7 Transformer—the results of your trouble-shooting may be incorrect.

1. Use a capacitance meter to measure the total capacitance of each set of transducers:

   NOTE: The capacitance of a single transducer (element) is: 0.0040 uF ± 7% (25 kHz)
   0.0044 uF ± 7% (40 kHz)

   - Multiply the uF by the total number of transducers (elements) to measure the total capacitance ± 7%.

     For example, if you have a 40 kHz system with a 12-element transducer, then:
     0.0044 × 12 = 0.0528 uF ± 7%.

2. Use Figures 3 and 20 to make sure you measure the capacitance at the correct pins on the end of the RF cable connector that leads to a junction box.
3. If the total capacitance is outside of the ± 7% limit, replace the set of transducers.
4. **Go to Section 5.7 Transformer.**

5.7 TRANSFORMER (See Figures 21-24)

IMPORTANT

These instructions are in the proper order for you to follow. If you do not follow the EXACT sequence—from 5.1 Line Cord and RF Cable through 5.7 Transformer—this results of your troubleshooting may be incorrect.

1. Use Figures 21-22 to make sure the wire connections on the transformer taps are correct.
   - Rewire the tap connections if necessary.
2. Plug in the:
   a. RF cable to the generator.
   b. Generator line cord to an electric outlet.

WARNING

The S-7000 generator PCB operates on 160 VAC. This is an electrical shock hazard.

3. Turn ON the S-7000 generator.
4. Use Figure 21 and an ac voltmeter to measure the voltage of each connection between the printed circuit boards as follows:
   - If the voltage is 160 V ± 10 V, then turn both the generator and the ultrasonic OFF/ON switches to OFF, and go on to Step 5.
   - If the voltage falls outside of these limits and your AC line voltage is within the specifications for your generator (see tag on generator), then turn both the generator and the ultrasonic OFF/ON switches to OFF, and call Branson.
5. Use Figures 23-24 and a dual channel oscilloscope for each PCB to measure the saturation voltage and the crossover current:
   a. Connect the current probe to the current loop (TL1). (See Figure 18.)
   b. Connect the voltage probe between the collector and emitter leads on the transistor case (ground lead to emitter lead). (See Figure 19.)
   c. Turn both the generator and the ultrasonic OFF/ON switches to ON.
   d. Read the measurements for the crossover current and the saturation voltage.
   e. Turn both the generator and the ultrasonic OFF/ON switches to OFF.
   f. Replace the PCB if either of the measurements are not within the proper limits.
6. Disconnect the oscilloscope and put the cover back on the generator.
7. Unplug the RF cable from the generator.
8. Unplug the line cord from the electric outlet.

TRANSFORMER TAPS

LINE VOLTAGE	LINE CONNECTION	POWER SETTING	PRIMARY JUMPER(S)	B/B CONN. TO SECONDARY	PCB CONNECTION	PCB LINE VOLTAGE
100Vac 50/60 HZ	L—2 N—6	MINIMUM NORMAL MAXIMUM	2—5 • 3—6 2—5 • 3—6 2—5 • 3—6	2—8 2—7 2—8	10 • 6 10 • 6 11 • 6	147 V 157 V 167 V
120Vac 50/60 HZ	L—1 N—6	MINIMUM NORMAL MAXIMUM	1—4 • 3—6 1—4 • 3—6 1—4 • 3—6	1—8 1—7 1—8	9 • 6 9 • 6 10 • 6	150 V 160 V 170 V
200Vac 50/60 HZ	L—2 N—6	MINIMUM NORMAL MAXIMUM	3—5 3—5 3—5	2—10 2—9 2—9	8 • 6 7 • 6 8 • 6	150 V 158 V 166 V
✳ 208Vac 50/60HZ	L—2 N—6	MINIMUM NORMAL MAXIMUM	3—5 3—5 3—5	2—10 2—10 2—9	7 • 6 8 • 6 7 • 6	149 V 158 V 168 V
✳ 220Vac 50/60 HZ	L—2 N—6	MINIMUM NORMAL MAXIMUM	3—5 3—5 3—5	2—11 2—10 2—10	8 • 6 7 • 6 8 • 6	147 V 159 V 167 V
230Vac 50/60 HZ	L—1 N—6	MINIMUM NORMAL MAXIMUM	3—4 3—4 3—4	1—11 1—11 1—10	7 • 6 8 • 6 7 • 6	153 V 163 V 172 V
240Vac 50/60 HZ	* L—2 L—1 N—6	*MINIMUM NORMAL MAXIMUM	* 3—4 3—4 3—4	* 2—11 1—11 1—11	* 7 • 6 7 • 6 8 • 6	*155 V 160 V 170 V

NOTES:

1. WHEN CHANGING TRANSFORMER TAP CONNECTIONS INSURE THAT FAN VOLTAGE IS BETWEEN 110V TO 125V. RE-TAP IF NECESSARY.
* CHANGE FAN CONNECTION FROM T4 TO T5 TO INSURE PROPER FAN VOLTAGE.

Figure 21

TRANSFORMER TAP MAP

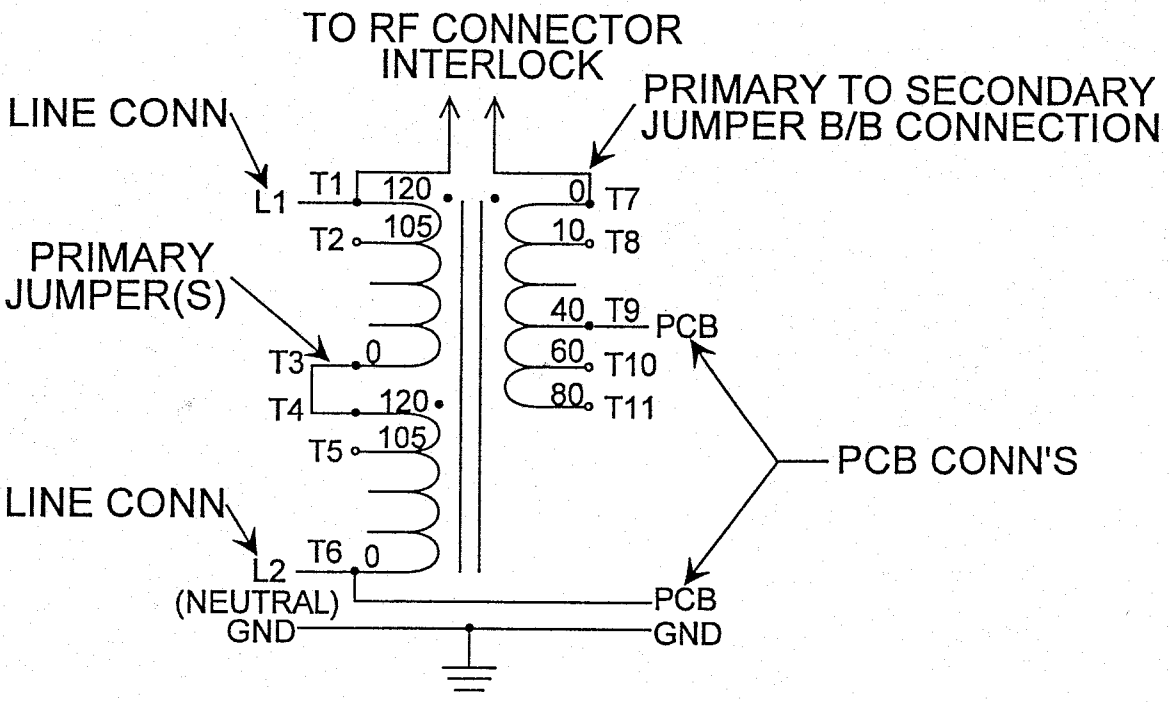


Figure 22

TYPICAL WAVEFORMS

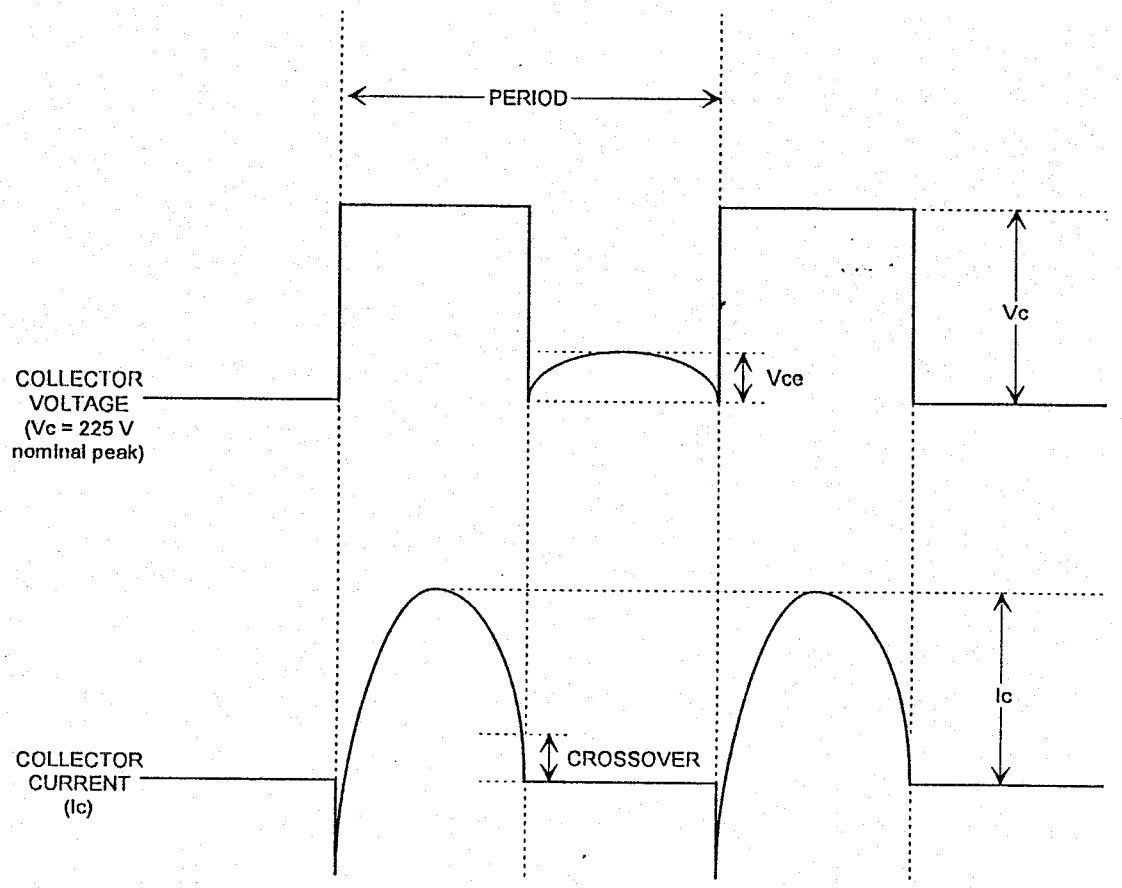


Figure 23

OPERATION PARAMETERS

TYPE OF CIRCUIT	INPUT CURRENT AMPS/RMS	INPUT POWER WATTS/NOM	COLLECTOR CURRENT (IC) AMPS/PEAK	COLLECTOR VOLTAGE (Vc) VOLTS/PEAK	PERIOD IN MICRO-SECONDS	Vce SAT. VOLTS	CROSS-OVER AMPS
S40- 6	1.25	200	4-7	225	23 - 24.5	2	2-4
S25- 6					36 - 37.5		
S40- 8	1.47	250	6-9	240	23 - 24.5		
S25- 8					36 - 37.5		
S40-12	2.50	400	8-12	225	23 - 24.5		4-7
S25-12					36 - 37.5		
S40-18	3.75	600	10-16		23 - 24.5		4-7
S25-18					36 - 37.5		

Figure 24

S7000

APPENDIX B
GENERATOR INPUT POWER

POWER RANGES BASED ON SOLUTION TEMPERATURE

# OF ELEMENTS	MAX POWER (Liquid @ 70° F) (35 watts / element)	NOMINAL POWER (Liquid @ 140° F) (30 watts / element)	MINIMUM POWER (Liquid @ 180° F) (25 watts / element)	GENERATOR LABEL (Max. Watts)
6	200 - 250	175 - 225	145 - 195	275
8	260 - 320	225 - 285	185 - 245	350
12	380 - 470	370 - 460	355 - 445	500
18	595 - 715	550 - 670	500 720	780
24	790 - 950	740 - 900	690 - 850	1050
36	1135 - 1385	1075 - 1325	1020 - 1270	1500
48	1530 - 1850	1430 - 1750	1330 - 1650	1930

APPENDIX C
GENERATOR INPUT CURRENTS
(FOR FIELD USE ONLY)

GENERATOR INPUT VOLTAGE / CURRENT TABLE

GENERATOR MODEL	100 VAC	120 VAC	200 VAC	208 VAC	220 VAC	230 VAC	240 VAC
S70XX-6	2.0 A	1.7 A	1.0 A	1.0 A	0.9 A	0.9 A	0.8 A
S70XX-8	2.6 A	2.1 A	1.3 A	1.2 A	1.2 A	1.1 A	1.1 A
S70XX-12	4.2 A	3.5 A	2.1 A	2.0 A	1.9 A	1.8 A	1.7 A
S70XX-18	6.1 A	5.1 A	3.1 A	2.9 A	2.8 A	2.7 A	2.5 A
S70XX-24	8.2 A	6.8 A	4.1 A	3.9 A	3.7 A	3.6 A	3.4 A
S70XX-36	N/A	N/A	6.0 A	5.7 A	5.5 A	5.2 A	5.0 A
S70XX-48	N/A	N/A	8.0 A	7.6 A	7.2 A	7.0 A	6.6 A

APPENDIX D
GENERATOR FUSE CHART

GENERATOR AC INPUT VOLTAGE RANGES

	FUSE SIZES	
GENERATOR	(200 - 240 VAC)	(100 - 120 VAC)
S70XX-6	3 A	4 A
S70XX-8	3 A	4 A
S70XX-12	3 A	5 A
S70XX-18	4 A	8 A
S70XX-24	5 A	10 A
S70XX-36	8 A	N/A
S70XX-48	10 A	N/A