



GLOBAL
power technologies

8550
THERMOELECTRIC GENERATOR
Operating Manual

#16, 7875 - 57th Street SE
Calgary, Alberta
Canada T2C 5K7
Main: +1 403 236 5556
Fax: +1 403 236 5575
www.globalte.com



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GLOBAL POWER TECHNOLOGIES MODEL CP8550 GENERATOR

WARNING: DO NOT ALLOW CURRENT TO CATHODIC PROTECTION LOAD TO EXCEED 30 AMPS.

THE MODEL CP8550 GENERATOR IS NOT RATED TO SUPPLY MORE THAN 30 AMPS OF CURRENT TO THE LOAD. IF TOTAL CIRCUIT RESISTANCE IS LESS THAN 0.5 OHMS THEN THE 1000 WATT VARIABLE RESISTOR IN THE CP BOX SHOULD BE WIRED IN SERIES WITH THE CIRCUIT AND ADJUSTED SO THAT CURRENT DOES NOT EXCEED 30 AMPS.

FOR FURTHER INFORMATION PLEASE CONTACT GLOBAL POWER TECHNOLOGIES CUSTOMER SERVICE DEPARTMENT AT THE NUMBER SHOWN BELOW.

#16, 7875 - 57TH STREET SE
CALGARY, ALBERTA
CANADA T2C 5K7
MAIN: +1 403 236 5556
FAX: +1 403 236 5575
WWW.GLOBALTE.COM

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1 GENERAL INFORMATION

1.1 Manual Identification

- 1.1.1 This manual provides installation, operation and maintenance instructions for the Global Power Technologies (GPT) Model 8550 Thermoelectric Generator. The generator must be used in conjunction with a Power Conditioner. The manual for the operation of this Power Conditioner is included following this manual. In addition, instructions for the operation of the Cathodic Protection Interface System is also included.

- 1.2 **Definition of Terms:** To correctly use this manual the reader must interpret the meaning of the following terms as herein defined:

Thermoelectric Generator. A device that produces electrical power through the direct conversion of heat energy to electrical energy including its burner and fuel system.

Power Unit. The hermetically sealed portion of the generator that contains the thermoelectric materials.

TEG. A Thermoelectric Generator.

Matched Load. A condition of load where the load voltage of the generator is one half of the open circuit voltage.

Optimum Load. A condition of load where the power output of the generator is maximized.

Precision Load: The precision resistor contained on the generator which provides the optimum load condition. The voltage across this resistor is defined as V_{set} and is used to analyze generator electrical performance.

Voltage Limiter: A broad term used to describe an electronic device attached in series or parallel with the generator that converts, adjusts, limits or otherwise conditions power.

Power Conditioner. A broad term used to describe an electronic device attached to the generator that converts, adjusts, limits or otherwise conditions the output power.

Converter-Limiter (C/L). A specific electronic device attached between the generator and load that converts one level of DC voltage to another, and limits the voltage level.

Converter. A specific electronic device attached between the generator and load that converts one level of DC voltage to another.

Limiter. A specific electronic device attached between the generator and load that limits the voltage level.

Heat Pipe. A hermetically sealed fluid filled heat transfer device and its associated cooling fins used to cool the cold junctions of the power unit.

Rated Power. The power which the TEG's power will produce at standard temperature and voltage.

Set Power. The power level to which the power unit is set up at non-standard temperatures in order that it will produce Rated Power when the temperature returns to standard.

Generator System: The system consisting of the generator including its factory options, the power conditioner and the special customer options.

1.3 Theory of Operation

1.3.1 A TEG produces electrical power through the direct conversion of heat energy into electrical energy. When two dissimilar materials which are joined together and are heated at one end (a thermocouple) a voltage will exist across the cooler end. Electrical power will be delivered to a load placed in the circuit. This process will continue provided that the temperature difference is maintained. A TEG is a system which provides the means to maintain these conditions.

1.3.2 Figure 1 illustrates how this is accomplished in the Model 8550 TEG. A thermocouple is formed by a P type and an N type thermoelectric element joined together electrically by a hot junction electrode. Adjacent thermocouples are joined electrically by cold junction electrodes. A total of 325 thermocouples, each producing 87mV, at standard conditions are connected in series to produce 590 Watts at 28 Volts and 21 Amperes.

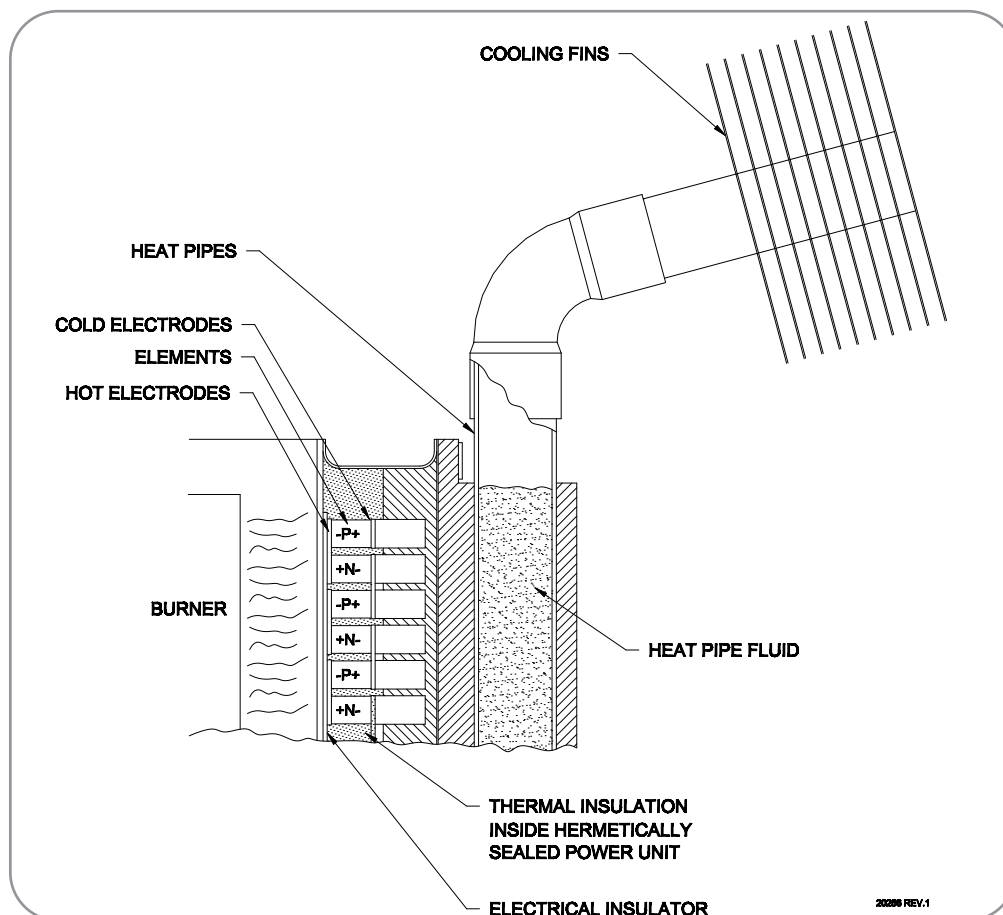


Figure 1 Design Illustration

The hot junction of the thermocouples is maintained at a high temperature (538°C or 1000°F) by a burner which operates on the gaseous fuels. The cold junction of the thermocouples is maintained at a lower temperature (163°C or 235°F) by an array of heat pipes which transfer the heat to the ambient air by natural convection. The thermocouples are contained in a hermetically sealed enclosure because they are adversely affected when exposed to air at operating temperatures. They are surrounded by thermal insulation to minimize heat loss.

- 1.3.3 The cold junctions of the Model 8550 TEG are cooled by series of heat pipes. Each heat pipe is hermetically sealed and contains a measured amount of fluid in equilibrium with its vapour. As heat is applied to the fluid it boils and then re-condenses in the upper portion due to the cooling effect of the cooling fins. In this way heat is transferred to the cooling fin in a very efficient manner.
- 1.3.4 The burner operates at moderate fuel pressures, approximately 124 kPa (18 psi) for propane and 62 kPa (9 psi) for natural gas. The fuel gas is expanded through an orifice and then flows through a venturi where it draws in air needed for combustion. The fuel gas flow is controlled by a pressure regulator and adjusted by the operator to obtain the required set power.
- 1.3.5 Remember from electrical theory that maximum power is delivered to a load when the load voltage is one half of the open circuit voltage of the source. This condition is called matched load. The TEG is similar except that due to a change in the internal resistance of the power unit with current, maximum power is delivered when the load voltage is slightly higher than one half of the open circuit voltage.
- 1.3.6 The power unit must always be in a loaded condition. This is because under extended open or high load voltage conditions the hot junction temperature may rise above the safe operating range. For this reason the power unit must always remain connected to a power conditioner which will limit the power unit voltage to less than 32.5 Volts.
- 1.3.7 In summary the TEG produces electrical power when a temperature difference is maintained between the hot and cold junctions of the thermoelectric materials. The temperature difference and therefore the amount of power produced, depends on both the rate at which fuel is supplied to the burner and the amount of cooling supplied by the ambient air. The operation of the TEG is controlled by the fuel pressure supplied to the burner.

1.4 Physical Description

- 1.4.1 Figure 2 shows the Model 8550 TEG in its normal operating configuration. Physical size data is given in Table 1.

Table 1

Physical Size Data		
Diameter of Top	155 cm	61 in.
Overall Height	102 cm	40 in.
Length of Lower Cabinet	46 cm	18 in.
Width of Lower Cabinet	46 cm	18 in.
Height of Lower Cabinet	44cm	17 in.
Weight (less Power Conditioner)	83 kg	183 lb

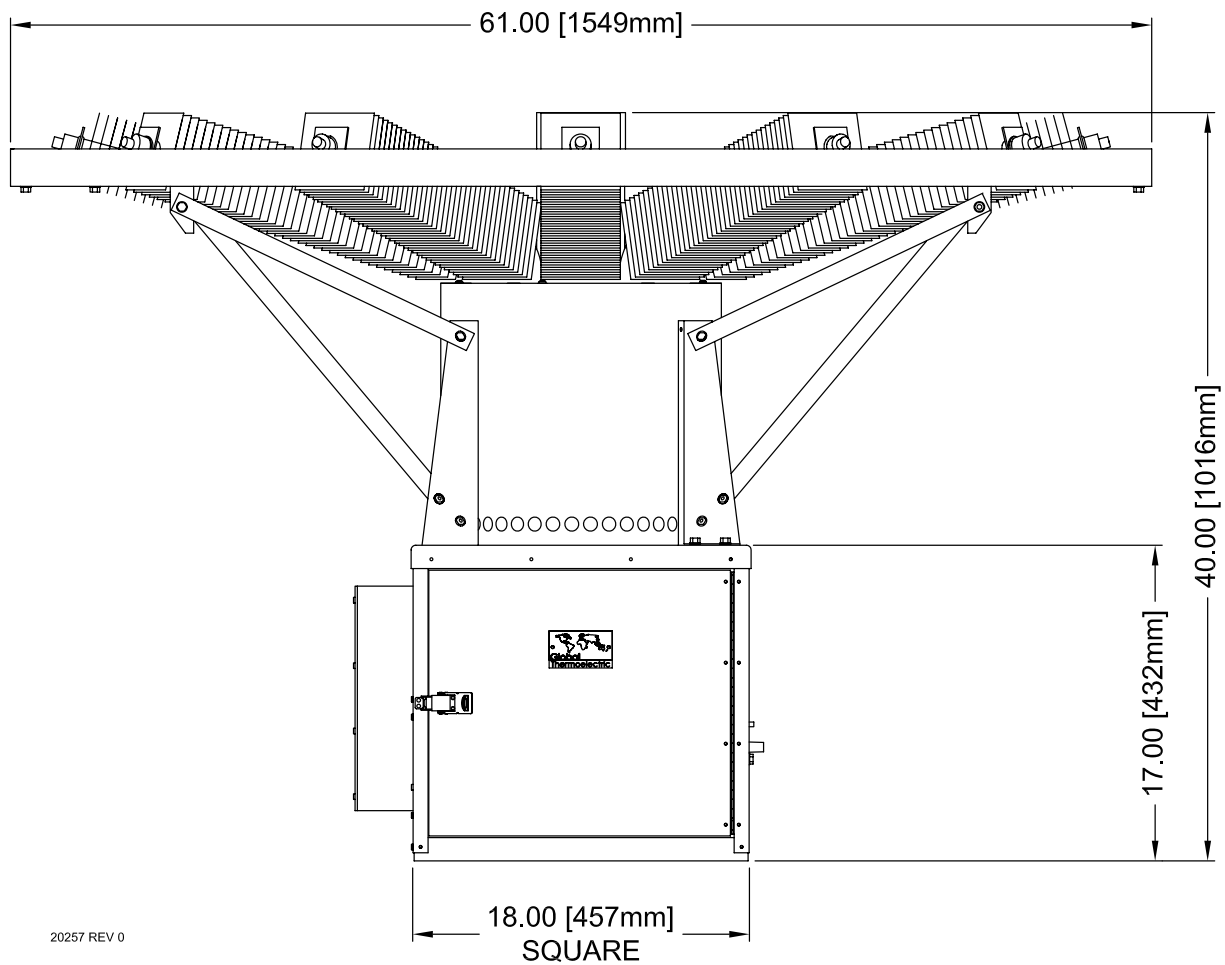


Figure 2 Model 8550 Dimensions

1.5 Electrical Output Characteristics

1.5.1 The typical electrical output characteristics at standard temperature of a Model 8550 power unit without the power conditioner are shown in Figure 3. The power, current and voltage are shown as a function of the power unit load resistance. Note that the output power curve goes through a maximum between 1.00 and 2.00 Ohms and that rated power can only be obtained at this point. In order to use Figure 3 consider the following example:

A load resistance of 25 Volts is required.

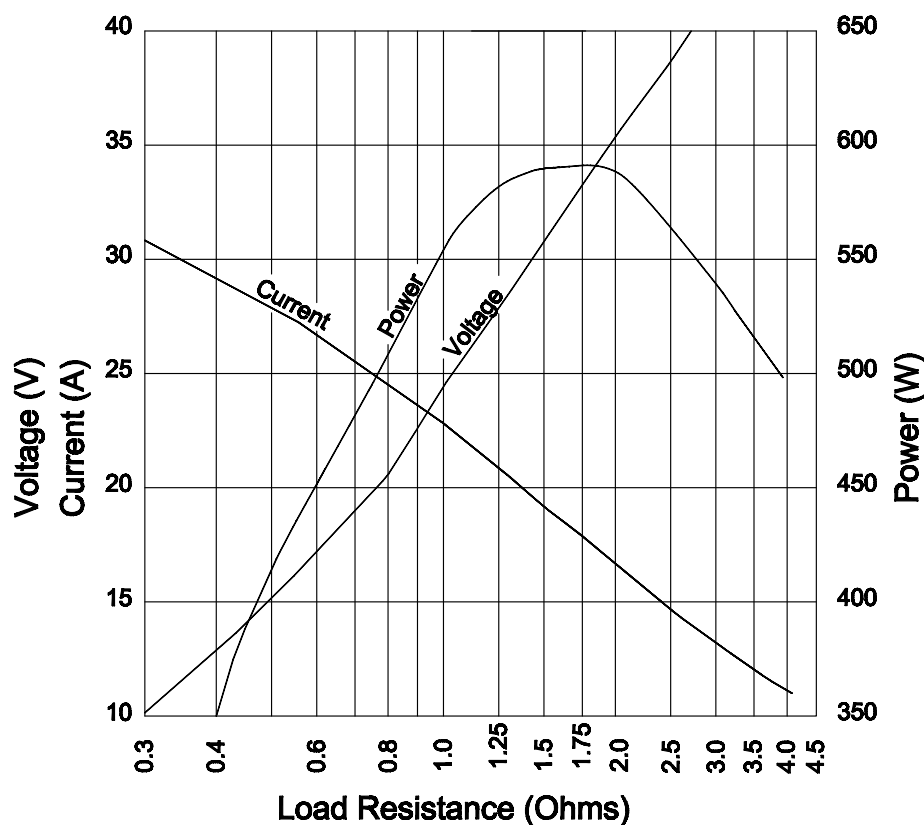
- Enter the graph at 25 Volts and read horizontally across to the voltage curve.
- Now read vertically to obtain the load resistance, available power and available current, 1.1 Ohms, 560 Watts and 22.4 Amps.

Note: That if the actual customer load requires less power, that is, has a higher resistance, the voltage would rise. Therefore, a voltage limiting power conditioner is used to dissipate the difference between the available power and actual customer load.

Figure 3 illustrates the importance of a power conditioner. As the load resistance increases so does the voltage. However, the power unit will not tolerate voltages above 35 Volts, therefore the power conditioner must limit the voltage to the customer and limit the voltage of the power unit by dissipating any excess power. Voltages outside the range of Figure 3 are achieved by series connection of multiple TEGs or by using a DC to DC converter type power conditioner. Consult Global Power Technologies for the system best suited to your application.

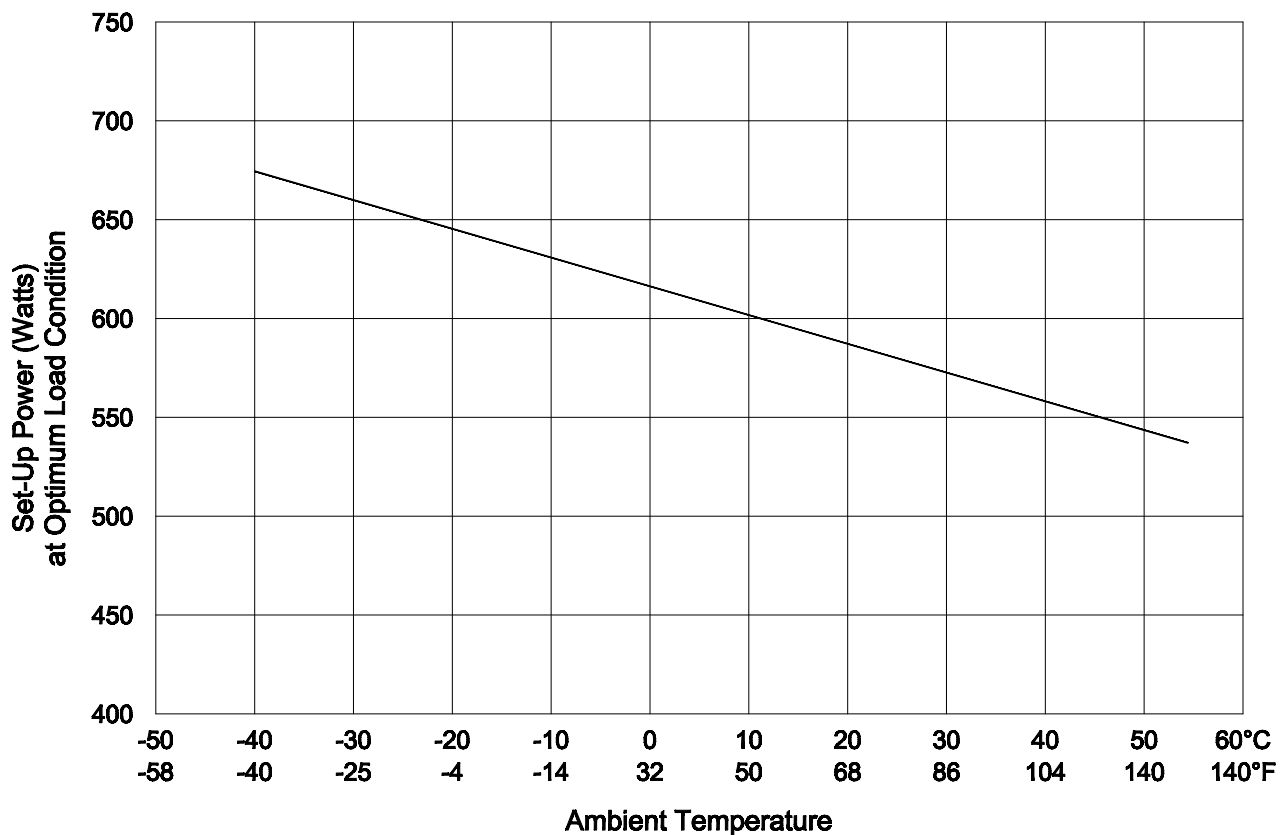
1.5.2 The available power of a Model 8550 TEG is also a function of the amount of cooling supplied by the heat pipes. The cooling is a function of both the ambient air temperature and the wind speed. Figure 4 shows the typical variation of output power as a function of ambient temperature for still air or low wind conditions, wind speed less than 5 km per hour (3 mph). The effect of wind will always be to increase the cooling and therefore increase the available power. When determining the set power, Figure 4 should be used along with the corrected air temperature from Table 3. Whenever possible, set up and testing the generator should be performed during periods of low wind as these readings will be more reliable than those using the corrected air temperature method.

1.5.3 The TEG should never be operated above the curve in Figure 4, as this may result in damage to the power unit.



Notes:
 1) These curves are based on a typical unit operating under standard conditions. Output characteristics of any power unit may vary slightly from these curves.
 2) Do not operate power unit at more than 35 Volts.

Figure 3 Gross Power Unit Electrical Output Characteristics at 20°C, Beginning of Life (without Power Conditioner)



Notes:

1. This curve is based on a typical power unit operating in calm air. Correction must be made for windy conditions.
2. Do no operate power unit above this curve. Always correct air temperature for wind.

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Figure 4 Power as a Function of Ambient Temperature

1.6 Fuel Information

1.6.1 The fuel consumption of a Model 8550 TEG operating at rated power under standard temperature conditions is given in Table 2. These values are subject to change without notice.

1.6.2 When operating on propane the vapour pressure of propane at low ambient temperatures must be considered. In order to operate reliably the fuel pressure regulator input pressure should be above 20 psig. This limits the operating temperature to above -20°C (-4°F). If operation below this temperature is desired a liquid withdrawal and vaporization system must be used. Consult Global Power Technologies for suitable designs of such systems.

Table 2

Fuel Consumption	
Propane	Natural Gas
3.50 lb/hr	70 SCFH
1.59 kg/hr	2m3/hr
0.83 US gal/hr (liquid)	-
3.13 liter/hr (liquid)	-

Table 3

Corrected Air Temperature for Wind															
Wind Speed	Air Temperature (°C) (°F)														
(km/hr)	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50
(mile/hr)	-4	5	14	23	32	41	50	59	68	77	86	95	104	113	122
0	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50
0	-4	5	14	23	32	41	50	59	68	77	86	95	104	113	122
5	-27	-21	-16	-11	-6	-1	5	10	16	21	27	32	37	42	47
3.1	-17	-6	3	12	21	30	41	50	61	70	81	90	99	108	117
10	-34	-27	-21	-15	-9	-3	2	9	13	18	24	29	35	40	46
6.2	-29	-17	-6	5	16	27	36	48	55	64	75	84	95	104	115
15	-40	-32	-24	-18	-12	-6	-1	4	10	15	21	26	32	37	42
9.3	-40	-26	-11	0	10	21	30	39	50	59	70	79	90	99	109
20	-41	-35	-29	-21	-14	-8	-3	2	8	13	19	24	30	35	41
12.4	-42	-31	-20	-6	7	18	27	36	46	55	66	75	86	95	106
25	-44	-37	-31	-23	-16	-10	-5	0	6	11	17	22	28	33	38
15.5	-47	-35	-24	-9	3	14	23	32	42	52	63	72	82	91	100
30	-46	-39	-33	-25	-18	-12	-7	-1	4	9	15	20	26	31	37
18.6	-51	-38	-27	-13	0	10	19	30	39	48	59	68	79	88	99
35	-47	-40	-34	-26	-19	-13	-8	2	3	8	14	19	25	30	36
21.7	-53	-40	-29	-15	-2	9	18	28	37	46	57	66	77	86	97
40	-49	-42	-35	-22	-20	-14	-9	-3	2	7	13	18	24	29	35
24.8	-56	-44	-3	-8	-4	7	16	27	35	45	55	64	75	84	95

2 INSTALLATION AND OPERATION

2.1 Unpacking and Mounting

2.1.1 The following tools are required in order to set up and operate the 8550 TEG:

- A voltmeter or meters with leads and clips able to measure the following ranges:
 - 0-30 ± 0.1 V
 - 0-30 ± 0.1 mV
 - Customer Load Voltage
- Two small adjustable wrenches that will open to 16mm (5/8 in.).
- A medium flat blade screwdriver.
- A fine flat blade screwdriver.
- Wire strippers or knife.
- Teflon thread sealant tape.

2.1.2 Unpack the TEG from its shipping crate. Retain the crate until the TEG is operational. Check the TEG for any damage which may have occurred during shipping. Such damage should be reported as soon as possible. Some types of damage may make the TEG inoperable. Consult Global Power Technologies (GPT) before operating an 8550 TEG with damage.

2.1.3 Locate the installation kit containing the following:

- One fuel line kit.
- One spark ignitor electrode.
- 4 each 1/4 in. x 1 in. mounting bolts c/w nuts.

Identify and locate the Power Conditioner. The Power Conditioner may have been attached to the TEG at the factory or it may have been shipped separately, in the same or other crate, depending on the make and model.

2.1.4 Before removing the TEG, check and re-tighten any bolts which may have come loose during shipping. **Remove the black tie wraps which clamp the ends of the heat pipe to the support ring.** Failure to do this could cause the heat pipes to crack when they expand. It is recommended that lifting of the TEG be done by two or more persons. The upper ring around the heat pipes or the frame to which this ring is mounted should be used as lifting points. If lifting will be done by slings, they should be secured to the upper ring in at least three points so that the TEG will not swing or rock during lifting.

2.1.5 The TEG must be mounted to a firm and stable base. The base must be level and may not deviate more than 3° (50 mm per meter) (0.5 in. per foot). The TEG should be mounted at a height sufficient to prevent direct flooding or heavy snowfall from interfering with the flow of cooling or intake air. It is convenient for the operator if the mounting base is about 900 mm (36 in.) off the ground.

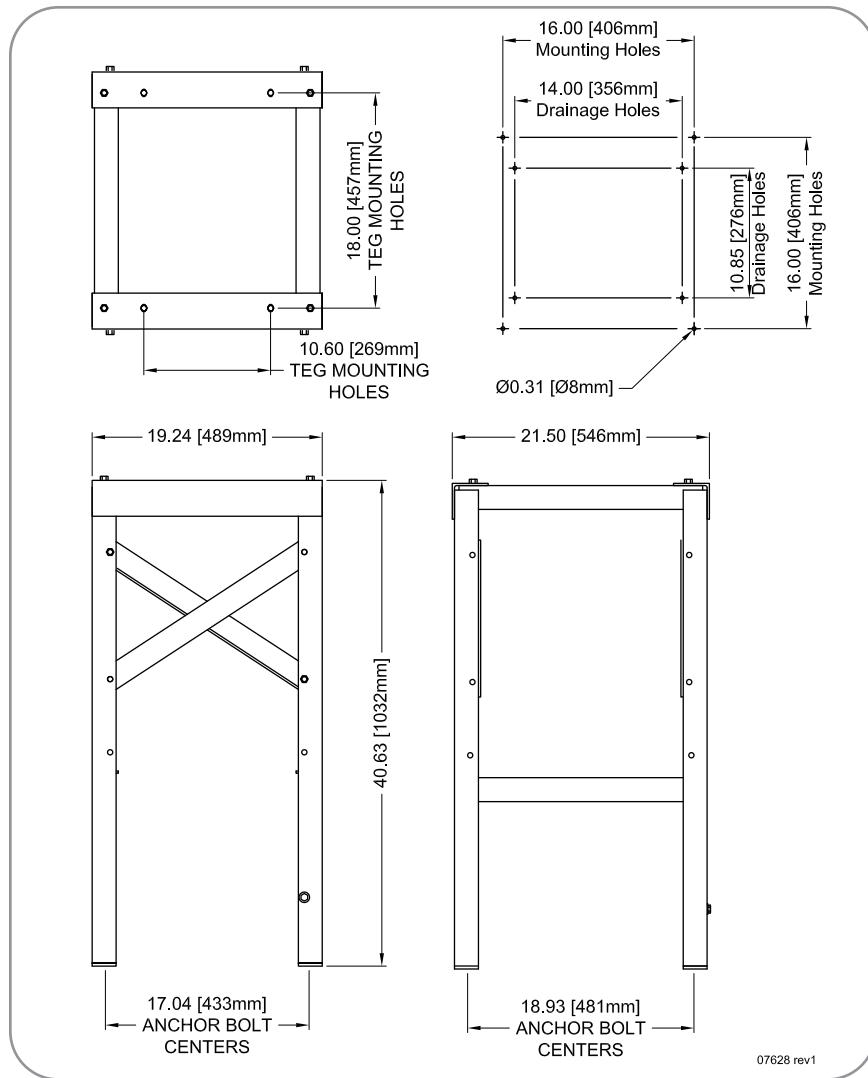


Figure 5 TEG Mounting

If the TEG is installed near a building or other large object that may obstruct the flow of wind, experience indicates that a good location is on the windward side, a minimum of 15 meters (45 feet) from the object or on the roof if possible. Be sure that the TEG's location relative to buildings and fuel tanks are in accordance with local regulations.



WARNING: Operation of TEG on an unstable or non-level base or in locations where cooling air flow may be obstructed will cause overheating of the TEG.

2.1.6 A field proven mounting base arrangement is shown in Figure 5.

2.1.7 Install the fuel line kit by connecting one end to the bottom of the "T" fitting on the fuel system and the other end to the orifice at the bottom of the venturi. Leak check both joints prior to use.

2.1.8 Install the spark igniter electrode by sliding it through the fitting on the bottom side of the burner. Slide it in until it touches inside, then pull back approximately 1/4" [6mm]. This should leave 2.20" to 2.35" [56 to 60mm] extruding beyond the fitting, see Figure 6. Gently tighten the nut on the fitting to maintain the position of the electrode. Connect the terminal lug to the high voltage cable to the end of the spark igniter rod.

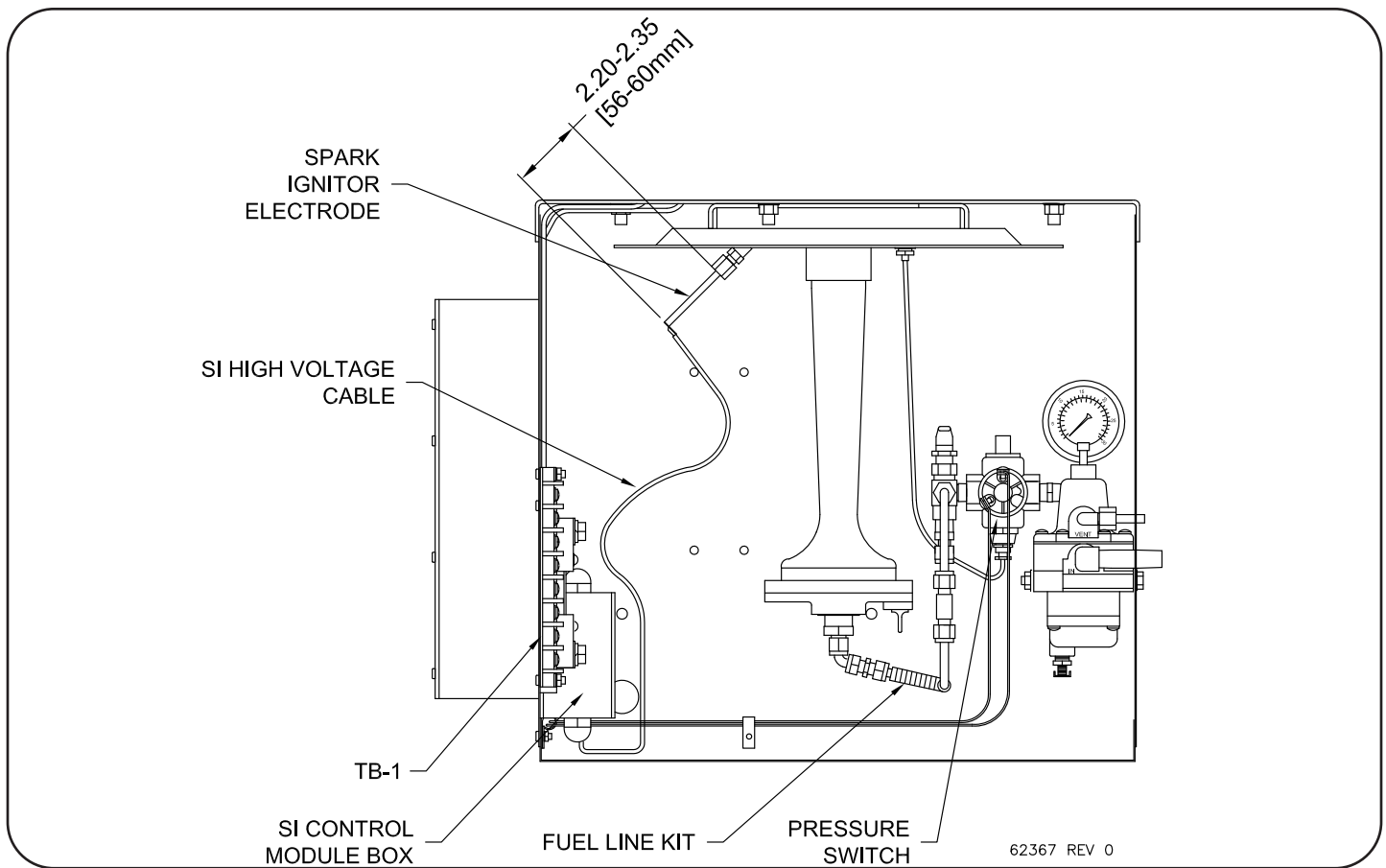


Figure 6 Installation of Spark Igniter and Fuel Line

2.2 Data Plate Information

2.2.1 The data plate is located on the inside of the cabinet door. The data plate indicates the following information:

- Fuel type: Each of these fuels uses several different fuel system components, therefore, the TEG should only be used with the fuel indicated.
- Model Number: The model number on the data plate is interpreted as follows:

8550 - () - () - ()

FUEL TYPE

L = PROPANE

N = NATURAL GAS

POWER CONDITIONER VOLTAGE:

12 V, 24 V OR 48 V

Factory Options:

SI = Spark Ignition

SO = Automatic Shut-Off

- c) Fuel Pressure, Power, Voltage: The data plate indicates the fuel pressure, power and voltage that were measured during the factory performance test. The operating fuel pressure, voltage and Set Power must be determined and adjusted as per section 2.4 and 2.5.
- d) Serial Number: The serial number is a unique number assigned by GPT to provide traceability.

Please indicate both the complete Model number and Serial number when contacting GPT

2.3 Fuel Supply

2.3.1 The fuel pressure regulator maximum inlet pressure is 172 kPa (25 psi). Make sure that the supply pressure will never exceed this value. If it is expected that the supply fuel pressure will vary greatly, the use of an additional primary regulator is suggested so that the input pressure to the internal fuel pressure regulator is relatively constant.

2.3.2 Check that the fuel pressure is still close to where it was set at the factory. This pressure is marked on the inside of the door of the cabinet. The fuel pressure supplied may need to be adjusted for altitude. Figure 7 shows the correction for variation from the factory altitude of 750m (2460 ft).

2.3.3 If propane is used at temperatures below -20°C (-4°F) the vapour pressure may not be sufficient, see section 1.6.2. If propane is used at temperatures below 5°C (41°F) freezing of moisture in the propane may occur. It is recommended that pure Methyl Hydrate be added in the ratio of 1 to 800 by volume as an antifreeze additive.

2.3.4 A fuel shut-off valve must be installed between the TEG and the fuel supply. All fuel piping should be done in accordance with local regulations. Inspect fuel lines and fittings to ensure that they are free of foreign material. Apply teflon tape sealant as illustrated in Figure 7 to minimize fuel line contamination. Purge fuel lines of all air.

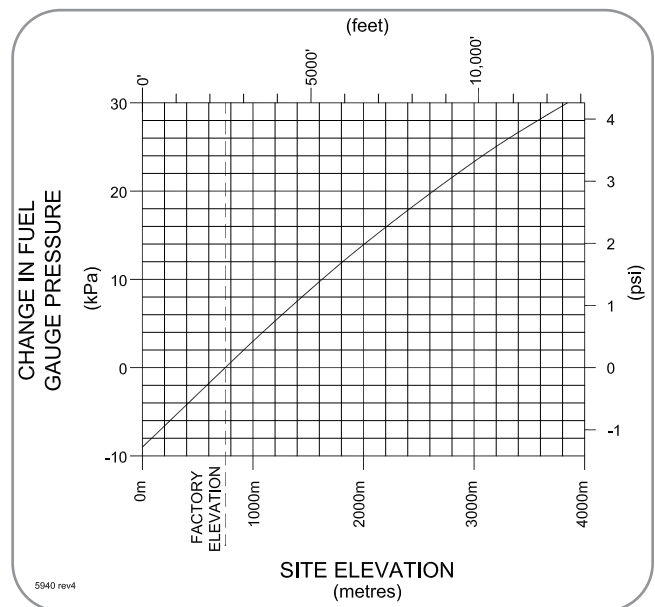


Figure 7 Altitude Adjustment

2.3.5 If it is expected that the fuel may contain moisture or other contamination, a filtering or fuel conditioning system must be used. Consult Global Power Technologies for more information.

2.3.6 The TEG is equipped with a 1/4 in. NPT male connector. Remove the plastic protective cap and connect the fuel line. Leak check the complete fuel system.



WARNING: Use only the type of fuel indicated on the data plate, see section 2.2. The maximum inlet fuel pressure must never exceed 172 kPa (25 psi).

2.4 Ignition and Start Procedure

2.4.1 Before attempting start the Model 8550 TEG, the operator should ensure that the fuel system has been properly installed as per section 2.3. The operator should also understand the Electrical Output Characteristics in Figure 3, definition of terms in section 1.2, and the operation of the Power Conditioner supplied for this TEG.

2.4.2 Before starting the TEG familiarize oneself with the basic wiring diagram Figure 9. Identify the various components and find their location on the TEG system. Also familiarize oneself with the operations of the power conditioner and how to adjust the voltage.

2.4.3 The customer load must be disconnected for start up and power adjustment. It is best to remove both the positive and negative load wires at terminals 2 and 4 of Terminal Block TB-1.



WARNING: Before starting, make sure that the Power Unit output wires are connected to Power Conditioner input.

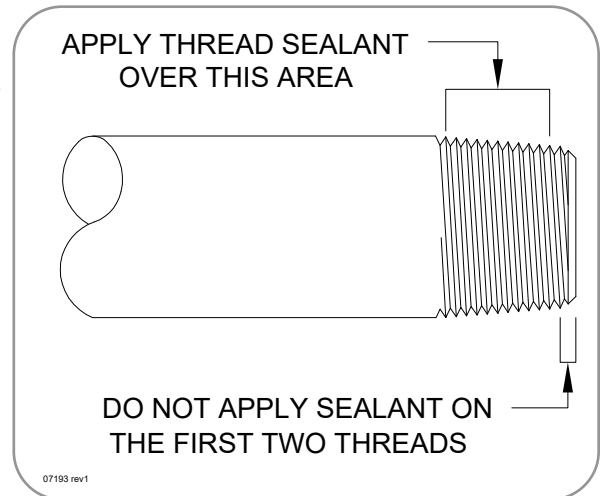


Figure 8 Applying Thread Sealant

2.4.4 Starting, heat up and power adjustment are made easier by the use of the Start-Up Data Sheets in the back of this section. It is suggested that these sheets be used during start-up.

First determine the required Set Power for the current ambient air temperature and wind speed. Enter these in the Start-Up Data Sheet. See Table 3 for the corrected air temperature and enter it in the Start-Up Data Sheet. Use this corrected air temperature with Figure 4 to find the required Set Power and enter it in the Start-Up Data Sheet. This is the power to which the TEG must be set at your ambient conditions so that rated power will be generated when the ambient conditions return to standard.

2.4.5 Starting procedure for TEG with Spark Ignition (SI) and Automatic Shut-Off (SO) options, see Figure 10. Turn on the fuel supply to the TEG and observe the fuel pressure at the pressure gauge. The pressure should be in the range of 110 to 150 kPa (16 to 22 psi) for propane or 41 to 69 kPa (6 to 10 psi) for Natural Gas. If the pressure is lower, increase it by turning the screw on the pressure regulator clockwise. If the pressure is higher, decrease it by turning the screw on the pressure regulator counterclockwise and venting the pressure through the burner by momentarily pressing the button on the Auto Shut-Off Valve.

Check the operation of the ignition system by shorting the terminals of the Pressure Switch. The spark ignitor clicking sound should be heard, if not, trouble shoot the system as indicated in section 3.6. The clicking sound should be rapid and strong.

Install a voltmeter to read the Power Unit voltage measured at terminals 6(+) and 4(-) of TB-1.

Close the air plate on the venturi completely (see Figure 12). Shut off the fuel supply at the external valve.

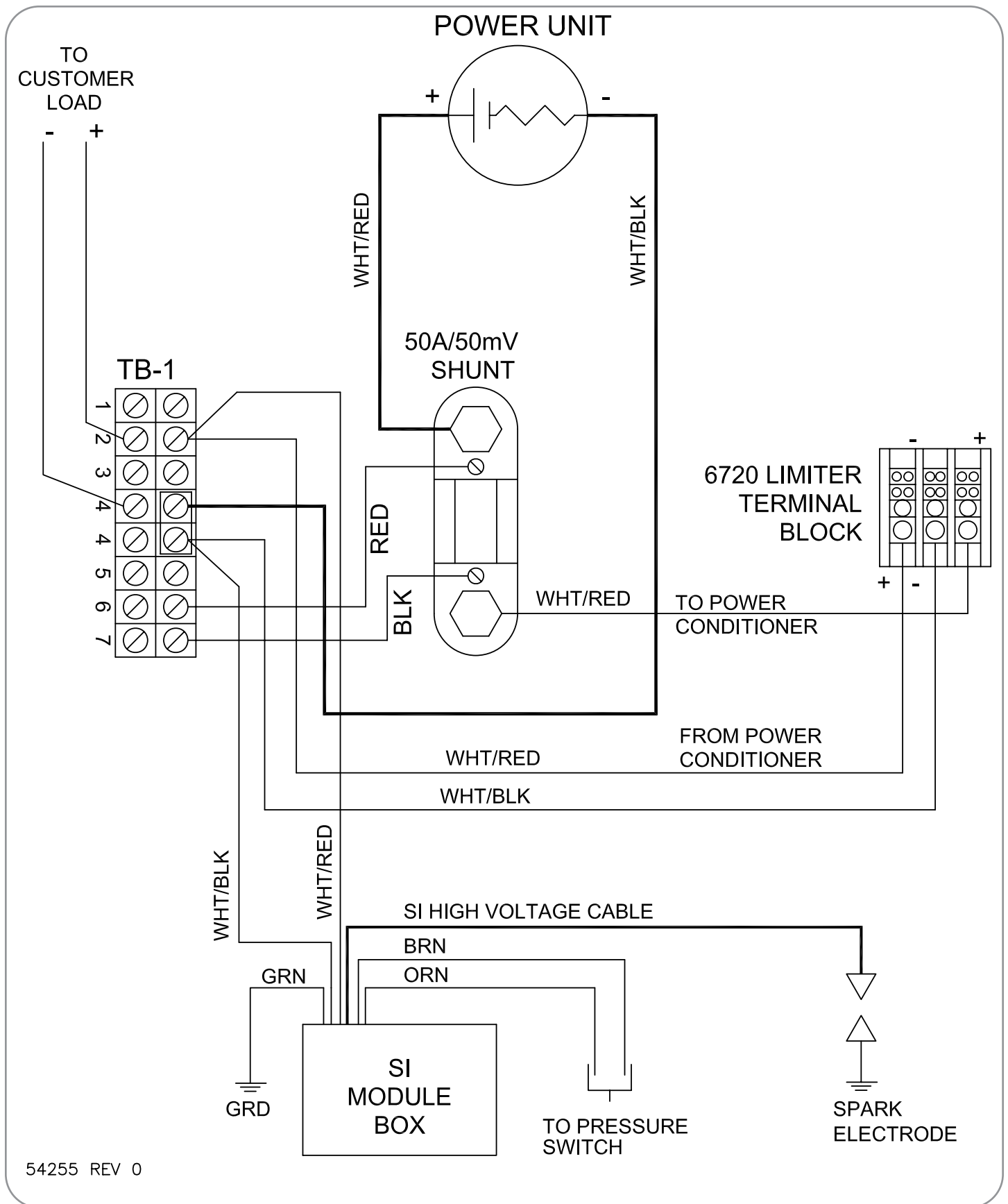


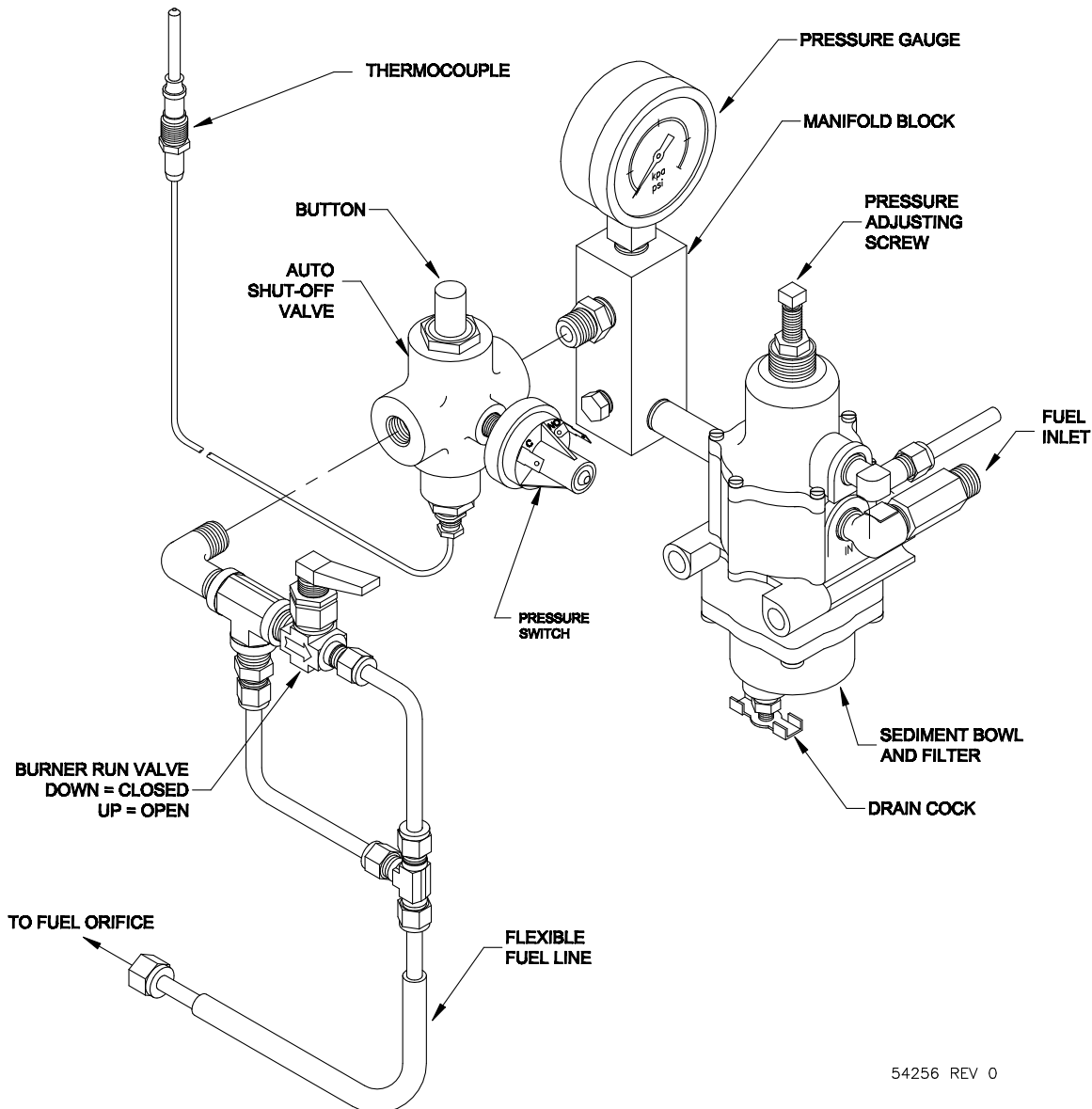
Figure 9 Wiring Diagram, 8550 TEG

Check that the Burner Run Valve is closed (down). Open the Auto Shut-Off Valve by pressing the button with one hand to keep the button depressed. Open the external valve, the clicking sound of the spark ignitor should be heard. Ignition will occur with a series of banging sounds. Combustion will be indicated by a small rise in the Power Unit voltage and change in the sound. Continue to hold down the button. If ignition does not occur within 5 seconds, release the button and check to make sure that fuel is reaching the burner, i.e. that the fuel lines are purged of air. If fuel is reaching the burner, trouble shoot the ignition system, see section 3.6.

As soon as combustion is noted slowly open the Burner Run Valve. Open the air plate to its full Open position. A change in the burner sound will be noted. Continued combustion will be indicated by a continued rapid rise in the power unit voltage. Continue to hold down the button. If a flame outage is noted close the Burner Run Valve to re-establish the flame and then reopen the valve.



WARNING: Do not allow the burner to operate with only the Auto Shut-Off valve open for more than 5 minutes. The Burner Run Valve should be opened as soon as the flame is burning.



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Figure 10 Fuel System Components, SI and SO

Five minutes after opening the Burner Run valve fully press the button and slowly release the button. The internal electromagnet should now hold the Auto Shut-Off valve open. If the valve does not stay open, immediately press the button again and hold for one more minute, then try to release it again. If the valve again does not stay open, trouble shoot the Automatic Shut-Off system, see section 3.7.

Once the burner is started proceed to section 2.5, Heat Up and Power Adjustment.

If the operation of the burner must be stopped, turn off the fuel supply at the external valve. Then close the Burner Run Valve, the Auto Shut-Off valve will close when the burner cools down and its internal electromagnet no longer holds the valve open.



WARNING: Once the burner is started, you must proceed to the Heat Up and Power Adjustment (section 2.5). Failure to do so may overheat the power unit.

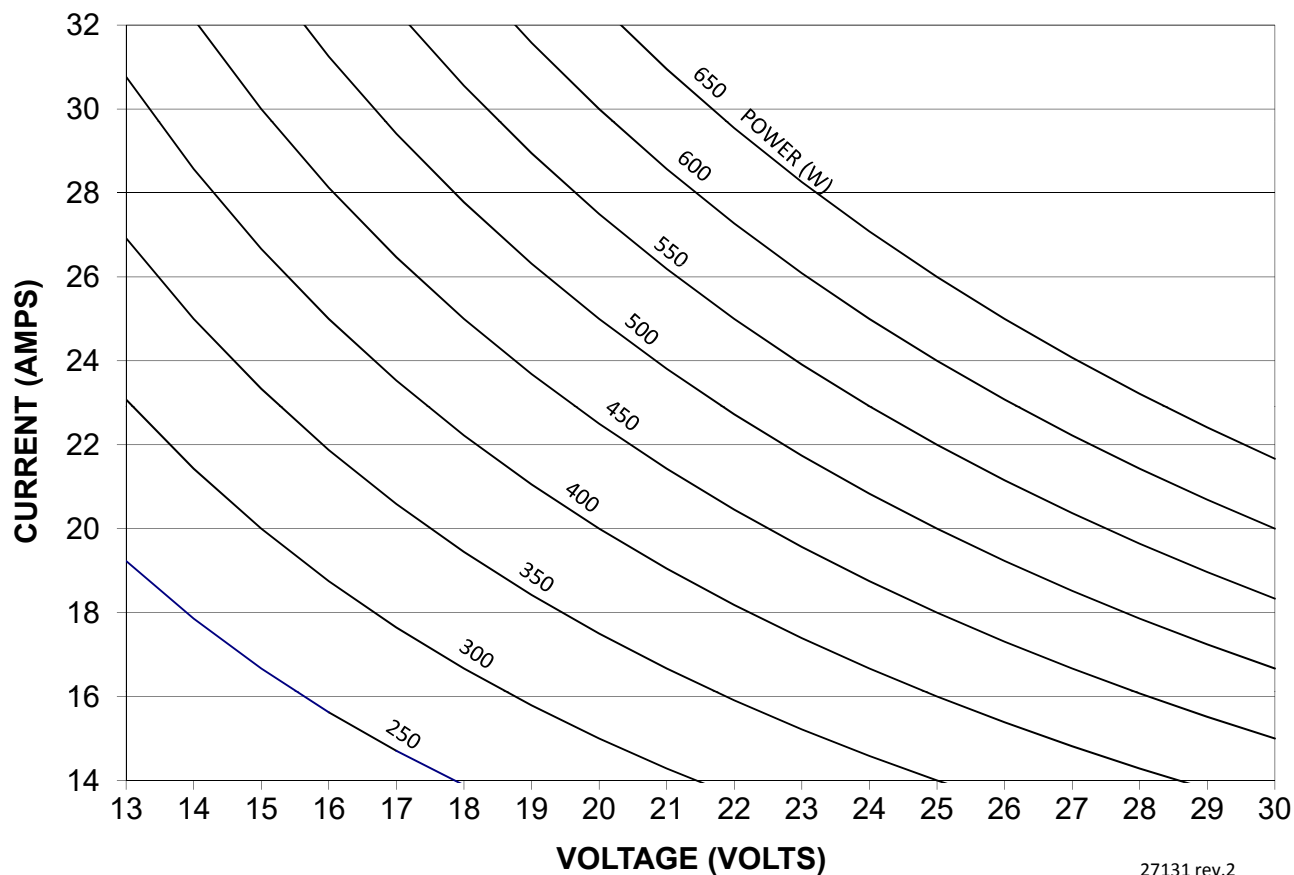


Figure 11 Power Calculation

2.5 Heat Up and Power Adjustment

2.5.1 Once the burner is operating the Power Unit output voltage should climb rapidly to about 25 Volts. If the voltage levels off below 25 Volts or climbs above 25 Volts adjust the power conditioner as per its manual.



WARNING: Do Not allow the power unit voltage to exceed 35 Volts. If the power conditioner fails to control the voltage, turn off the burner.

2.5.2 Once the voltage is about 25 Volts observe the Power Unit current by measuring the voltage across the Current Shunt at terminals 6(+) and 7(-) of TB-1. The shunt is rated 50 Amp/50 mV; 1 mV across the shunt equals 1 Amp. The current will initially rise rapidly and then slow down as the current reaches its operation point. Continue to monitor the Power Unit voltage at terminals 6(+) and 7(-) of TB-1. This voltage should remain at 25.0 Volts. Adjust the Power Conditioner if needed.

2.5.3 Output Power is the product of the Power Unit voltage multiplied by the Power Unit current, ie. 25.0 Volts and 22.2mV (Amps) gives $25.0 \times 22.2 = 555.0$ Watts. Figure 11 may be used to perform the multiplication. Find the voltage on the bottom axis and draw a line vertically up. Find the current (or mV measured across the shunt) on the side axis and draw a line horizontally across. The power is indicated by the power line nearest the intersection of the two lines, interpolate if necessary.

- 2.5.4 Refer back to the Start-Up Data Sheet as noted in section 2.4.4. The Power Unit output power must be adjusted to the Set Power as determined in section 2.4.4. As much as possible, keep the cabinet door closed during the warm up period. It takes about one full hour for the power to stabilize. Monitor and record the power at the 15, 30, 40, 50 and 60 minute intervals on the Start-Up Data Sheet.
- 2.5.5 As the heat pipes start to operate they may make some crackling sounds. This is normal. About 15 minutes after ignition check the tip of each heat pipe to see if they are getting warm. If one or more heat pipe is not getting warm, recheck them after an additional 10 minutes. If one or more heat pipe continues to remain cold up to 2 in. (50 mm) from the tip, trouble shoot the cooling system as per section 3.5. Note, during cold or windy conditions, it may be hard to notice any warming of the heat pipes. If all the fins are about the same temperature, then the heat pipe is working well.
- 2.5.6 As the Power Unit output power climbs, ensure that the Set Power level is not exceeded. The power level should be at about 70 to 80% of Set Power within 30 minutes after ignition. If the power is above 80% after 30 minutes, continue to monitor the Power Unit output power and be prepared to reduce the fuel pressure if the power rises above the Set Power level. If the power level rises more than 10 watts above Set Power, initially reduce the pressure by 1 psi and wait 3 minutes, then determine if further adjustment needed. Remember that it will take up to 10 minutes for the full effect of the fuel pressure change to stabilize. Record any changes in fuel pressure on the Start-Up Data Sheet. If the power level is less than 70% after 30 minutes, the fuel pressure is too low but, do not adjust it until the power level has stabilized.
- 2.5.7 Compare the Power Unit output power at 60 minutes with that at 50 minutes. The two readings should be within 5 Watts of each other. If the power level is not yet stabilized, wait another 10 minutes. Once the power level has stabilized determine if the Power Unit output power is within about 5 Watts of the Set Power.

If the power is within 5 Watts of Set Power, proceed section 2.5.8, Air Shutter adjustment.

If the power is more than 5 Watts above Set Power, decrease the fuel pressure by approximately 1.7 kPa (0.25 psi), no more than 3.4 kPa (0.50 psi), and wait 10 minutes. After 10 minutes determine if further adjustment is needed. Once the Power Unit output power has stabilized to within 5 Watts of Set Power and stayed there for at least 15 minutes, proceed to section 2.5.8, Air Shutter adjustment.

If the power is more than 5 Watts below Set Power, increase the fuel pressure by approximately 1.7kPa (0.25 psi), no more than 3.4 kPa (0.50 psi), and wait 10 minutes. If the power is more than 20 Watts below Set Power, increase the fuel pressure approximately 3.4 kPa (0.50 psi), no more than 6.8 kPa (1.00 psi). After 10 minutes determine if further adjustment is needed. Once the Power Unit output power has stabilized to within 5 Watts of Set Power, and stayed there for at least 15 minutes, proceed to section 2.5.8, Air Shutter adjustment.

2.5.8 Once the air shutter is set to full open, the unit should run properly, and no further adjustments should be necessary. However, perform the following test to determine if the air shutter is correctly adjusted for the site conditions. Identify the air shutter parts in Figure 12. The position of the cabinet door will affect the air shutter adjustment reading. For this reason, open the door only to adjust the air shutter and keep the door closed as much as possible. Take an initial power reading after the cabinet has been shut for at least 15 minutes and record this reading on the Start-Up Data Sheet. Now close the air shutter by 3 mm (1/8 in.) and close the cabinet door. After 10 minutes take a power reading.

If this reading is higher than the initial reading, close the Air Shutter another 3 mm (1/8 in.) and wait 10 minutes. Repeat this until the power no longer rises. The air shutter must then be opened another 6 mm (1/4 in.) to allow for changes in the ambient site conditions. Again wait 10 minutes and check that the Power Unit output voltage is within 5 Watts of Set Power, adjust the fuel pressure as per section 2.5.7 if needed. Further Air Shutter adjustment will not be required.

If this reading is lower than the initial reading, open the Air Shutter 3 mm (1/8 in.) past the initial setting, close the cabinet door and wait 10 minutes. If after 10 minutes the power reading is the same or lower than the initial reading, the Air Shutter is now correctly adjusted. If after 10 minutes the power is higher than the initial reading, open the Air Shutter another 3 mm (1/8 in.) and wait 10 minutes. Repeat this until the power no longer rises. The Air Shutter must then be opened another 5 mm (3/16 in.) to allow for changes in the ambient site conditions. The Air Shutter may reach its maximum open position before the power reaches its maximum, in this case, leave the Air Shutter at its maximum setting. Wait 10 minutes and check that the Power Unit output power is within 5 Watts of Set Power, adjust the fuel pressure as per section 2.5.7 if needed. Further Air Shutter adjustment will not be required.

If this reading is the same as the initial reading, open the Air Shutter 6 mm (1/4 in.) and close the cabinet door. After 10 minutes check that the Power Unit output power is within 5 Watts of Set Power. Adjust the fuel pressure as per section 2.5.7 if needed. Further Air Shutter adjustment will not be required.

2.5.9 If the TEG is factory new or has just undergone a major overhaul, the Power Unit output power may drift slightly over the first few weeks of operation. It may be necessary to adjust the fuel pressure slightly to obtain Set Power after this time.

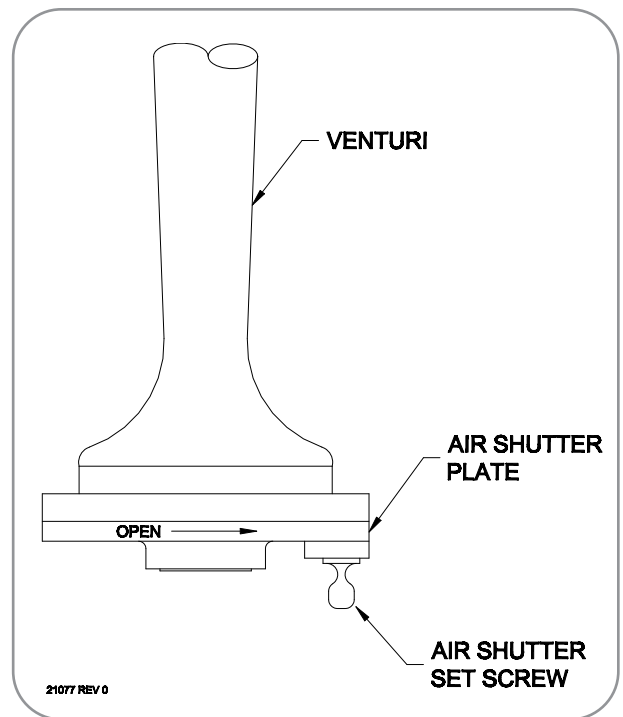


Figure 12 Air Shutter Adjustment

2.6 Applying Customer Load

- 2.6.1 The TEG should now be operating at the correct power level. Before applying the customer load, ensure that all wire connections are tight.
- 2.6.2 Adjust the Power Conditioner output to the desired customer voltage as per the Power Conditioner manual.
- 2.6.3 Connect the customer load to the Power Conditioner at terminals 2(+) and 4(-) of terminal block TB-1. Be sure that the Power Unit remains connected to the Power Conditioner.
- 2.6.4 Turn the circuit breaker on the Power Conditioner to the ON position. Close and latch the cabinet.



WARNING: The Power Unit output must always remain connected with the Power Conditioner.

2.7 System Performance Log

- 2.7.1 A System Performance Log is located at the back of section 3. It is recommended that this log be used to monitor system performance each time the site is visited. This information is valuable for future reference. If this site is a multiple TEG installation, it may be desirable to keep the log in a common maintenance book for the site.

8550 Thermoelectric Generator Start-Up Data Sheet

Start-UP By:		Date:			
Model #:		Serial #:		Fuel Type:	
Temperature:		Wind Speed:			
Corrected Temperature:		Ignition Fuel Pressure:			
Set Power at Corrected Temperature		Operating Fuel Pressure			
Power Levels					
Time		Orifice Fuel Pressure	Voltage (V)	Current (A)	Power (W)
	(Start)				
	(15 minutes)				
	(30 minutes)				
	(40 minutes)				
	(50 minutes)				
	(60 minutes)				

8550 Thermoelectric Generator Start-Up Data Sheet

Start-UP By:		Date:			
Model #:		Serial #:		Fuel Type:	
Temperature:		Wind Speed:			
Corrected Temperature:		Ignition Fuel Pressure:			
Set Power at Corrected Temperature		Operating Fuel Pressure			
Power Levels					
Time		Orifice Fuel Pressure	Voltage (V)	Current (A)	Power (W)
	(Start)				
	(15 minutes)				
	(30 minutes)				
	(40 minutes)				
	(50 minutes)				
	(60 minutes)				

3 SERVICE AND MAINTENANCE



WARNING: Throughout this manual you will notice paragraphs preceded with the word “WARNING”. It is important that the advice in these paragraphs be adhered to, as failure to do so may result in damage to the generator and/or other property and/or personal injury. Before attempting to service the Model 8550 TEG, you should be thoroughly familiar with the operation of this generator. It is suggested that you review sections 1.2, 1.5, 2.4 and 2.5 and the operation of the Power Conditioner before attempting to service this TEG.

3.1 Suggested Periodic Maintenance

3.1.1 The 8550 TEG is a solid-state, highly reliable device that requires very little maintenance. However, it requires periodic service checks in order to provide the years of trouble free service of which it is capable. The maintenance interval depends on the site conditions (fuel purity, weather, etc.) and must be established on site experience. Field experience indicates that a properly installed 8550 TEG usually requires maintenance only once a year. For maximum reliability the following series of service checks are recommended.

3.1.2 At least once a year, perform a Power Check, see section 3.2. This should be the first procedure during any service visit and will determine what further service may be needed.

If the Power Unit output is more than 10 Watts above Set Power the fuel pressure must be reduced. Proceed with the basic service as per section 3.1.4, but remember to adjust the fuel pressure during restart or before leaving the site, see section 2.5.7. DO NOT continue to operate above Set Power.

If the Power Unit output is within 10 Watts of Set Power the TEG is functioning well and needs only the basic service indicated in section 3.1.4.

If the Power Unit output power is more than 10 Watts below Set Power the cause must be evaluated. Refer to the last entry in the System Performance Log. From the log determine if the TEG was left operating at Set Power during the last service visit, remember that Set Power changes with ambient conditions. If the TEG was not left operating at Set Power during the last visit determine the reason for this, the TEG will therefore not now operate at Set Power. If the TEG was left operating at Set Power during the last visit and is now not producing Set Power, the following possible causes should be considered.

3.1.2.1 Change in fuel pressure: Refer back to the last entry in the log and determine if the fuel pressure has changed. If so, readjust the fuel pressure to the last entry. If this returns the Power Unit output power to within 10 Watts of Set Power, you can proceed with the basic service as per section 3.1.4.

3.1.2.2 Obstructed air flow: Check for obstructions at the Heat Pipe fins, Air Inlet Screens and Air Shutter. Perform the Air Shutter test, see section 2.5.8. If this returns the output power to within 10 Watts of Set Power proceed with basic service as per section 3.1.4.

- 3.1.2.3 Change in fuel quality: In order to maintain a constant output power, it is essential that the TEG be supplied with a fuel of constant heating value.
- 3.1.2.4 Poor cooling by Heat Pipes: Check to make sure that the Heat Pipe fins are not obstructed by debris or dust. Check that the Heat Pipe ends are warm. Test the cooling system as per section 3.5.2.

If the above causes have been ruled out, the TEG may require more than just the basic service. Refer to section 3.1.3 for further procedures to isolate the cause of low Set Power condition, keep the TEG operating for now.

- 3.1.3 The procedures in this section are designed to isolate the cause for the Power Unit to have low Set Power after the causes in section 3.1.2 have been ruled out. Proceed with these tests only if previous tests in section 3.1.2 indicate that they are required, otherwise proceed to section 3.1.4.

There are three basic reasons for the Set Power to be low. These are: low or inefficient heating by the burner and fuel system, poor or inefficient cooling, or a faulty or damaged Power Unit. In order for the following test to be accurate, the TEG must have been operating continuously at 24 to 26 Volts for the last 12 hours. Take a reading of the momentary open circuit as per the procedure in section 3.8. Calculate the open circuit voltage (V_{oc}) and internal resistance (R_{INT}) of the Power Unit as described in section 3.2.

If the V_{oc} is above 56 Volts and R_{INT} is above 1.40 Ohms the Power Unit is likely faulty. The Power Unit may still be able to operate at reduced output. Consult Global Power Technologies to determine the safe operating level for the Power Unit under your conditions.

If the V_{oc} is below 56 Volts and R_{INT} is above 1.30 Ohms the Cooling System is likely faulty, see section 3.5 for further tests.

If the V_{oc} is below 56 Volts and R_{INT} is below 1.00 Ohms the Burner or Fuel System is likely not providing enough heating. In addition to the basic service in section 3.1.4 check and replace the fuel orifice and check the complete Burner System for obstructions and damage, see sections 3.3 and 3.4. If after servicing and restarting, the Power Unit does not come to Set Power, a change in the fuel quality is likely the cause. The fuel pressure may be increased to obtain Set Power, provided the absolute maximum V_{OC} and R_{INT} as determined in section 3.8.4 is not surpassed.



WARNING: Never increase the fuel pressure without checking the maximum V_{oc} and R_{INT} limits in section 3.8.4.

- 3.1.4 Unless other service is indicated above the following basic service is all that will be needed.

- 3.1.4.1 Replace the fuel filter in the pressure regulator once a year, see section 3.3.
- 3.1.4.2 Drain the pressure regulator sediment bowl, see section 3.3.

- 3.1.4.3 Check the fuel orifice for clogging, replace if needed, see section 3.3.
- 3.1.4.4 Remove debris, sand and dust from the Heat Pipe fins, cabinet air intake screens and cabinet interior.
- 3.1.4.5 Check all bolts and wire connections for tightness.
- 3.1.4.6 Restart the TEG as per section 2.4 and 2.5.
- 3.1.4.7 Record the service and current operating parameters in the System Performance Log.

3.2 Power Check

- 3.2.1 The purpose of performing a power check is to determine if the TEG is operating at the correct Set Power for the current ambient conditions. First determine the Set Power for your ambient conditions as per section 2.4.4. Then check the Power Unit voltage at terminals 6(+) and 4(-) of TB-1.
- 3.2.2 If the Power Unit voltage is between 24 and 26 Volts, the Power Unit output power may be calculated by multiplying the voltage by the current (measured in millivolts) at terminals 6(+) and 7(-) of TB-1, see sections 2.5.2 and 2.5.3.
- 3.2.3 If the Power Unit voltage is outside the range of 24 to 26 Volts, remove the customer load from the Power Conditioner. Adjust the Power conditioner to obtain a Power Unit voltage of 25 Volts, and allow the Power Unit to stabilize. Then calculate the Power Unit output power as per section 2.5.3.



WARNING: Ensure that the Power Unit output wires always remain connected to the Power Conditioner input. Do not allow the Power Unit to operate in an open circuit condition for more than a few seconds.

3.3 Fuel System

- 3.3.1 The basic components of the fuel system are shown in Figure 13, note that some details may be different depending on fuel system options. Identify the components and their location on the TEG.
- 3.3.2 The fuel system consists of a pressure regulator which regulates the fuel pressure to the fuel orifice. The regulator contains both a fuel filter and integral sediment bowl with a manual drain cock. The outlet of the pressure regulator is connected to a manifold and pressure gauge to monitor the fuel pressure to the fuel orifice. Between the manifold and fuel orifice there are a series of control valves and a fuel line assembly. The combination of control valves will depend on the fuel system options and usually include an Auto Shut-Off valve, Burner Run valve, Burner Start valve and Burner Start restrictor. The fuel orifice is a precision jewelled orifice which will control the fuel flow to the burner depending on the up stream pressure.
- 3.3.3 To service the fuel system turn off the fuel supply at the external valve.

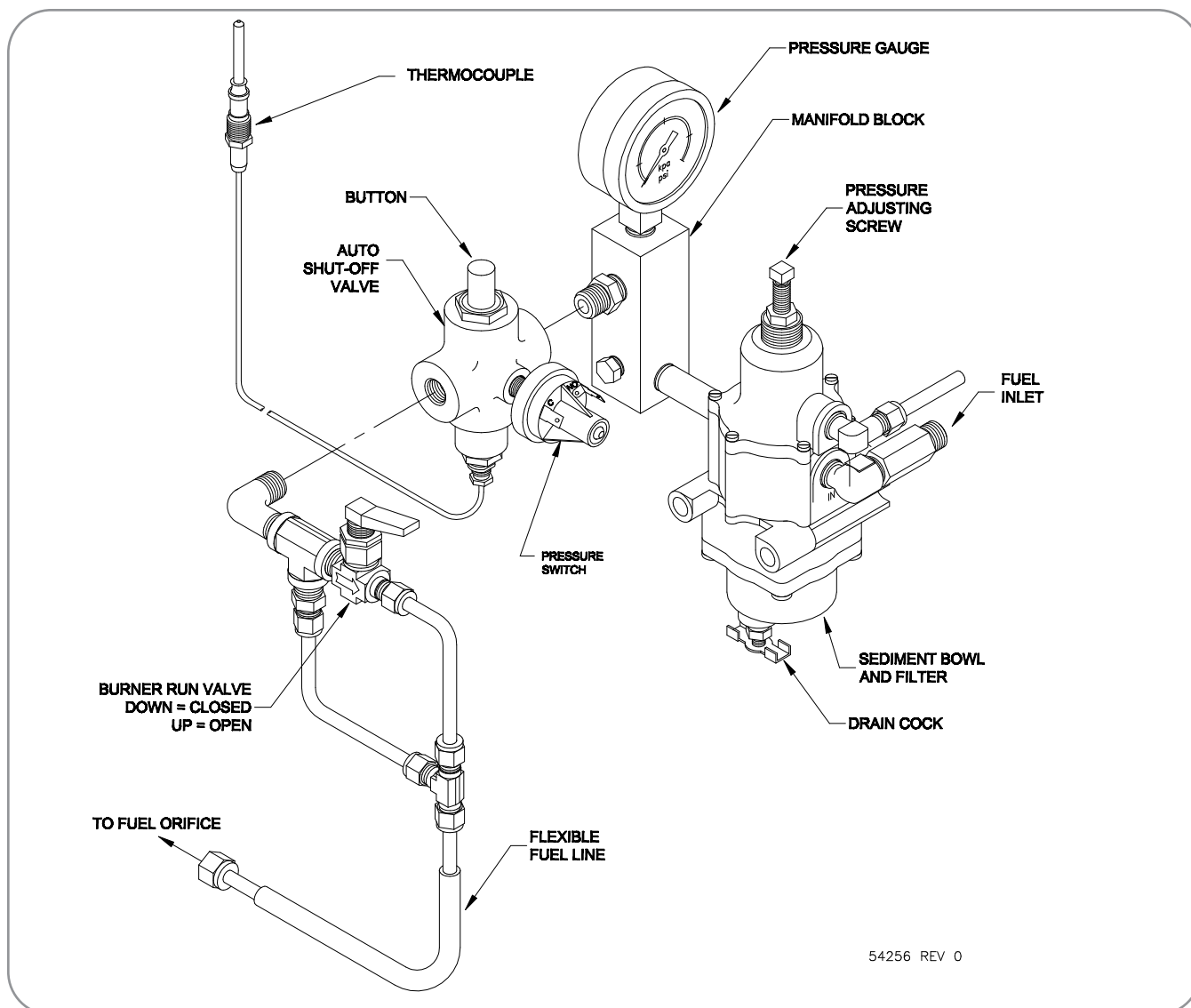


Figure 13 Fuel System Components, SI and SO

- 3.3.3.1 To drain the pressure regulator sediment bowl, open the drain cock located under the pressure regulator. Use a small container to collect any liquid impurities that may have collected in the bowl. After the bowl has drained, close the drain cock.
- 3.3.3.2 To change the fuel filter, remove the 4 socket cap screws that hold the bottom bowl on the pressure regulator. Remove the bottom bowl and replace the filter element. Check and replace the gasket if needed. Carefully reassemble the regulator ensuring that the needle valve spring is properly placed over the needle valve centering cup in the regulator body. Check for proper operation and leak check all joints for fuel leaks.
- 3.3.3.3 To change the fuel orifice, disconnect the flexible fuel line from the solid fuel line which enters the burner venturi. Remove the solid fuel line and orifice assembly by turning the orifice mounting base. Remove the orifice body from the assembly, see Figure 14. Check the orifice hole. It should be free and clean of debris. Replace the orifice body if needed. Reassemble and check for leaks.



WARNING: After any fuel system service, check for leaks.

3.4 Burner System

3.4.1 The Burner System consists of the following components:

- The Burner Venturi and Air Shutter assembly which mixes combustion air and fuel.
- The Burner Plate assembly where combustion takes place.
- The Exhaust Stack assembly which collects and exhausts the exhaust gases.

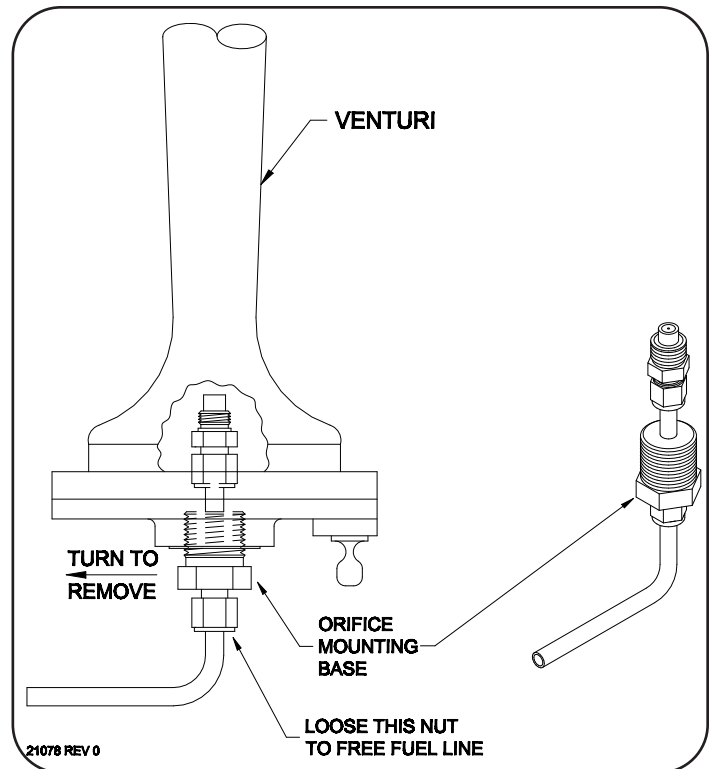


Figure 14 Orifice Assembly Removal

- 3.4.2 The Burner System should be disassembled only if there is reason to suspect a problem with the burner operation. First remove the fuel orifice as per section 3.3.3. Allow the burner to cool down before proceeding to disassemble the Burner System. Identify and locate the components from Figure 15. Remove the Venturi and Air Shutter assembly from the Burner Plate by turning the Venturi which is threaded into the Burner Plate assembly. The Air Shutter may be removed from the Venturi by closing the Air Shutter completely and removing the four screws which are located in the openings in the Air Shutter plate. The Burner Plate assembly is removed by removing the four Burner Plate mounting screws, the Burner Plate assembly can then be pulled down out of the Power Unit.
- 3.4.3 Check the Air Shutter assembly and Venturi for corrosion or obstructions. Check the Flame Holder Screen, located in the Venturi mounting fitting on the Burner Plate assembly, and the Burner Mantle for corrosion or obstructions. If these parts are obstructed, clean them with a stiff wire brush. If these parts are corroded, the Burner must be repaired or replaced.
- 3.4.4 With the Burner Plate assembly removed, examine the Exhaust Stack through the Power Unit. Remove any obstructions and check for corrosion. If the Exhaust Stack is corroded, it must be replaced as follows. Remove the Converter Shroud which covers the lower portion of the Heat Pipes. Note that it is not necessary to remove the Heat Pipe support frame to do this. Then remove the four nut and spring assemblies which hold down the Converter Mounting Ring. Before removing the Converter Mounting Ring, mark its position so that it will be replaced in the same position. The Exhaust Stack can now be lifted off. When replacing the Exhaust Stack, check that high temperature Exhaust Gasket is in good condition, replace if necessary. The spring assemblies which hold the Converter Mounting Ring should be tightened until the springs are solid, then backed off about 5 turns (1/4 in. or 6 mm).
- 3.4.5 Always apply high temperature anti-seize compound to the threads on the Venturi before installing it. It is not necessary to tighten the Venturi more than hand tight.

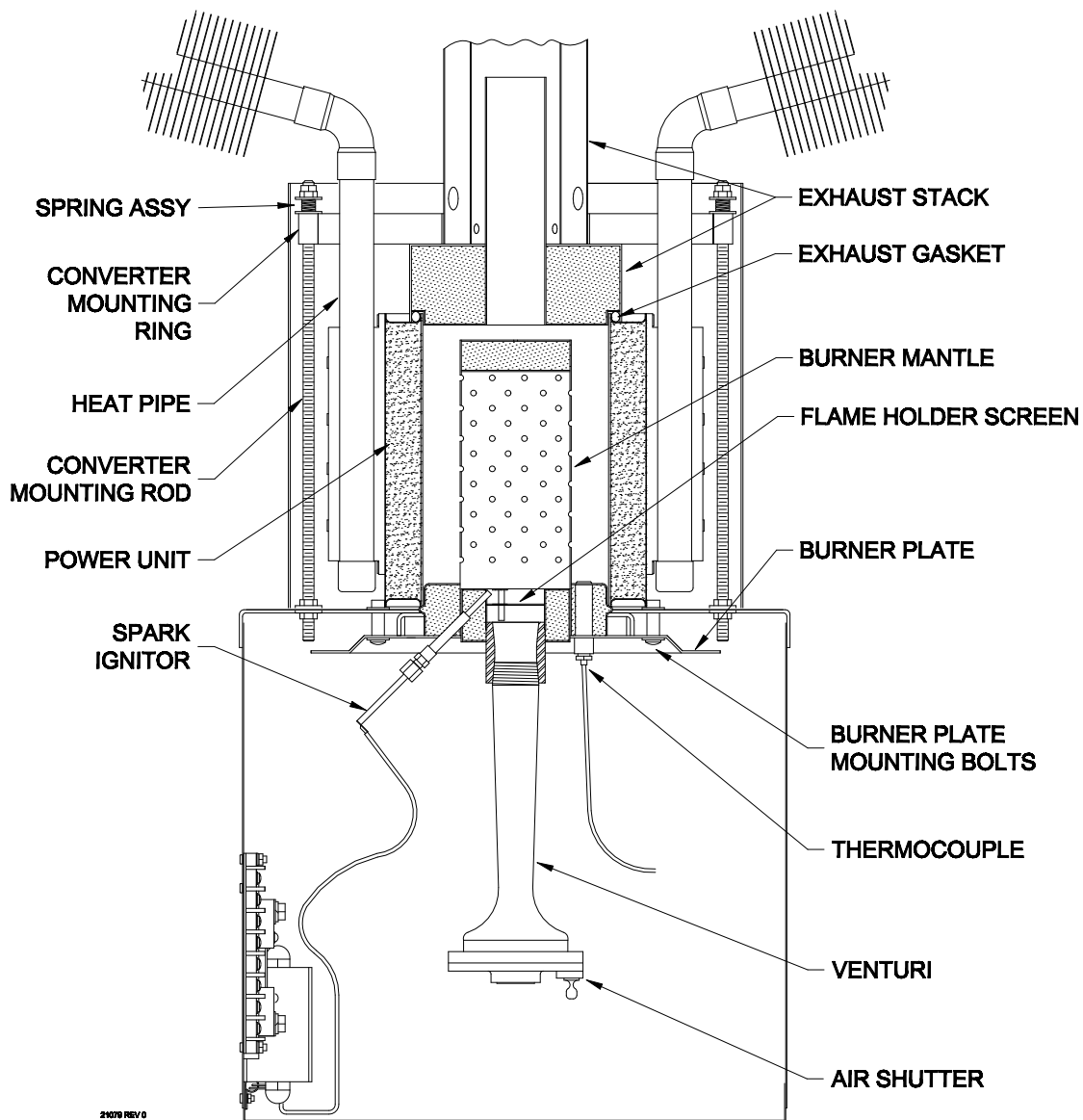


Figure 15 Burner System Components

3.5 Cooling System

3.5.1 The Cooling System consists of a set of twelve Heat Pipes. Each Heat Pipe is hermetically sealed and contains a measured amount of fluid in equilibrium with its vapour. As heat is applied to the fluid, it boils and then re-condenses in the upper portion due to the cooling effect of the fins. In this way, heat is transferred to the cooling fins in a very efficient manner.

In order to test the operation of the Heat Pipes the TEG must be operating. There are two ways to test the Heat Pipes. The first method described in section 3.5.2 is not as accurate but requires no additional equipment. The second method described in section 3.5.3 gives more accurate results, but requires more time and equipment. Any Heat Pipe which has been physically damaged and/or has a hole in the hermetic pipe is no longer operable and must be replaced. Do not operate the TEG if it has a damaged Heat Pipe.

- 3.5.2 With the TEG in operation check that the Heat Pipe tips are warm. Any Heat Pipe which is not warm up to 50 mm (2 in.) from the tip should be checked using the procedure in section 3.5.3. Note that during cold or windy conditions, it may be hard to notice any warming of the Heat Pipe. Feel along the fins of the Heat Pipe. If all the fins are about the same temperature, the Heat Pipe is working well. If one or more Heat Pipes feels much colder than the rest of the Heat Pipes, it should be checked using the procedure in section 3.5.3.
- 3.5.3 For this procedure, a thermocouple meter with a 50 mm (2 in.) long surface probe no more than 5 mm (0.2 in.) in diameter is required. The meter should be able to read temperatures up to 150°C (300°F), and should be accurate to $\pm 1^\circ\text{C}$ (2°F).

This procedure involves taking a temperature profile of the Heat Pipe Condenser Tube (the part of the Heat Pipe which passes through the cooling fins). It is important that the surface temperature of the tube is taken and not the temperature of the fins or the air around the tube. A good Heat Pipe should have a Condenser Tube temperature profile which is constant until the very tip of the Condenser Tube. Before taking the Condenser Tube temperature profile, the TEG should be operating for at least one hour in calm weather conditions.

It is suggested that you start the temperature profile between the third and fourth fin from the inside, Power Unit end of the Condenser Tube at the bottom surface of the tube. Take readings about every 50 mm (2 in.) along the Condenser Tube. All readings should be within 5°C (9°F) of each other up to the end of the finned section of the Condenser Tube. If the temperature profile drops by more than 5°C (9°F) along the finned section, take more readings to locate the point where the temperature drops. If this point is within 7 fins of the last fin on the Condenser Tube, or all the readings were within 5°C (9°F) of each other, the Heat Pipe is working well. If this point is more than seven fins away from the last fin on the Condenser Tube, the Heat Pipe has deteriorated and should be replaced. A problem should be suspected with any Heat Pipe which is operating at a temperature much lower than the rest of the Heat Pipes.

- 3.5.4 Replacement of Heat Pipes should only be done by a factory trained technician, consult Global Power Technologies for this type of work.

3.6 Spark Ignition (SI)

- 3.6.1 The Spark Ignition system consists of three major components:

- The Spark Electrode which ignites the gas.
- The Pressure Switch which turns on the system when there is fuel gas pressure in the fuel system.
- The Control Module which generates the high voltage pulse for the Spark Electrode and controls the function of the system.

Whenever there is adequate fuel pressure in the Fuel System, the Pressure Switch is closed. With the Pressure Switch closed, the Control Module will generate 12 kV pulses which will arc from the Spark Electrode. The Control Module will continue to generate the high voltage pulses until it senses the presence of high temperature gas at the Spark Electrode or until the Pressure Switch is opened.

The Control Module contains a 2 Volt, 2.5 Amp Hour rechargeable battery and a constant potential battery charger. A new fully charged battery provides about 16 hours of continuous starting capability without recharging. Twenty minutes of recharging is sufficient for one start cycle, 15 hours of charging are required to fully recharge a full discharged battery. The Control Module also contains a capacitive discharge high voltage generator and EMI filter.

Figure 16 shows the Spark Ignition system wiring and Figure 17 shows the location of the Spark Ignition system component locations.

3.6.2 If the Spark Ignition System is malfunctioning follow the procedure below to isolate the problem.

- 3.6.2.1 TCheck that the spark gap is correct. Loosen the fitting on the bottom side of the burner and slide the Spark Igniter Rod in until it touches, then pull back approximately 1/4" [6mm]. This should leave 2.20" to 2.35" [56 to 60mm] extruding beyond the fitting, see Figure 17. Once this is confrimed proceed as follows:
- 3.6.2.2 To prevent high voltage shock remove the orange wire from the Pressure Switch and isolate it so that it cannot come into contact with the other electrical connections.
- 3.6.2.3 Carefully remove the Spark Ignitor Electrode assembly loosening the fitting and sliding out the electrode.

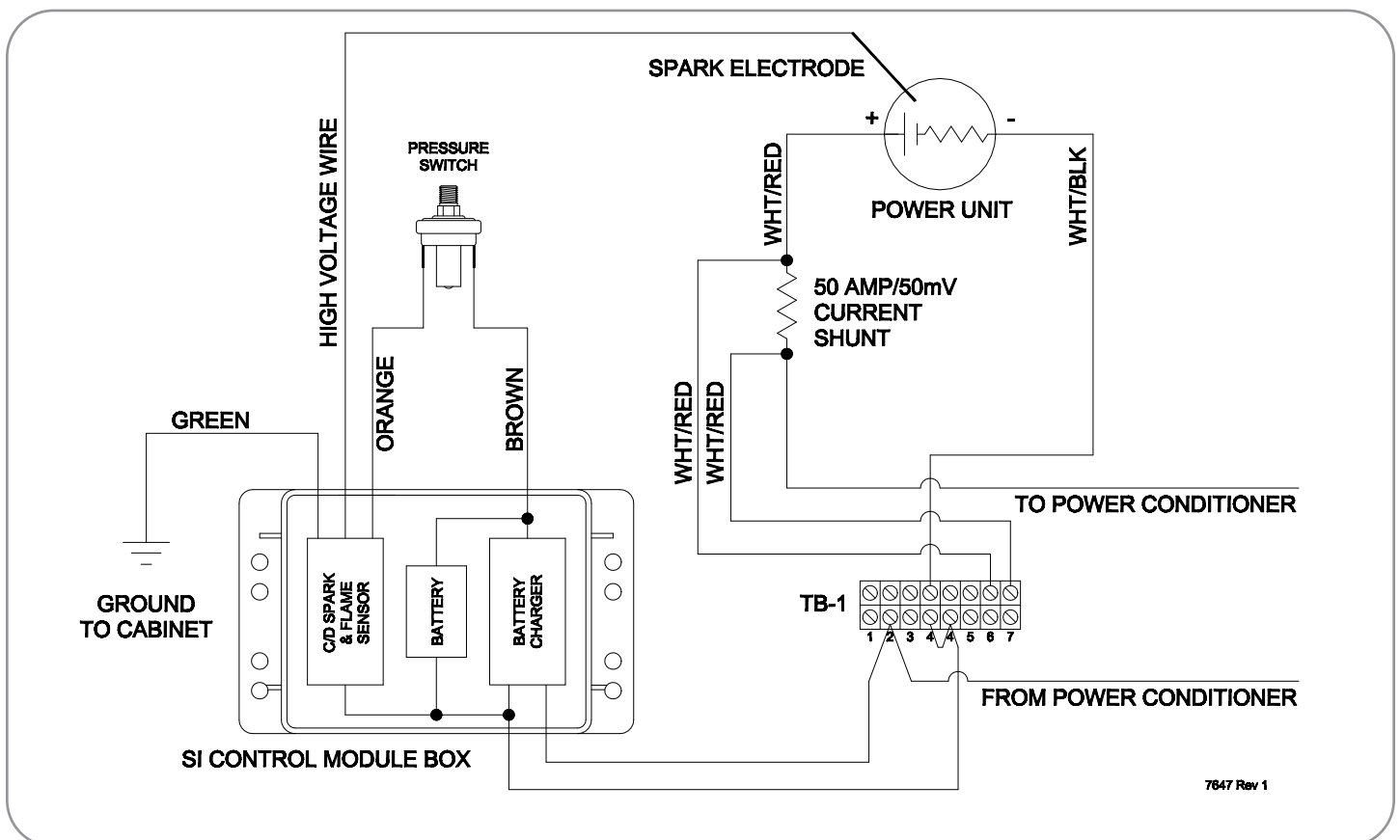


Figure 16 Spark Ignition System Wiring

- 3.6.2.4 Inspect the Spark Ignitor Electrode for cracks in the ceramic tube. Check the wire which runs through the ceramic tube for continuity. Replace the Spark Ignitor Electrode if it is damaged.
- 3.6.2.5 To test the function of the SI Control Module, position the Spark Ignitor Electrode tip such that there is a 3 mm (1/8 in.) gap to the TEG cabinet. Then touch the orange wire connector to the Pressure Switch. Arcing should occur at the gap at the rate of about one per second. If arcing occurs the system is functioning well.
- 3.6.2.6 Check the Pressure Switch. The switch should close at fuel pressures greater than 16 kPa (2.5 psi). Replace the Pressure Switch if necessary.
- 3.6.2.7 Check the battery voltage by measuring the voltage between the brown wire at the Pressure Switch and the thin white/black wire at terminal 4 on TB-1. The voltage should be greater than 2.0 Volts. If the voltage is less than 2.0 Volts, the battery needs recharging. In order to start the TEG with a low battery, remove the thin white/red and white/black wires from terminals 2 and 4 on TB-1 and apply a 30 Volt source to the wires. The TEG may then be started, reconnect the wires and wait for the battery to recharge. If after recharging, the battery does not hold voltage, replace the battery and/or the SI Control Module.

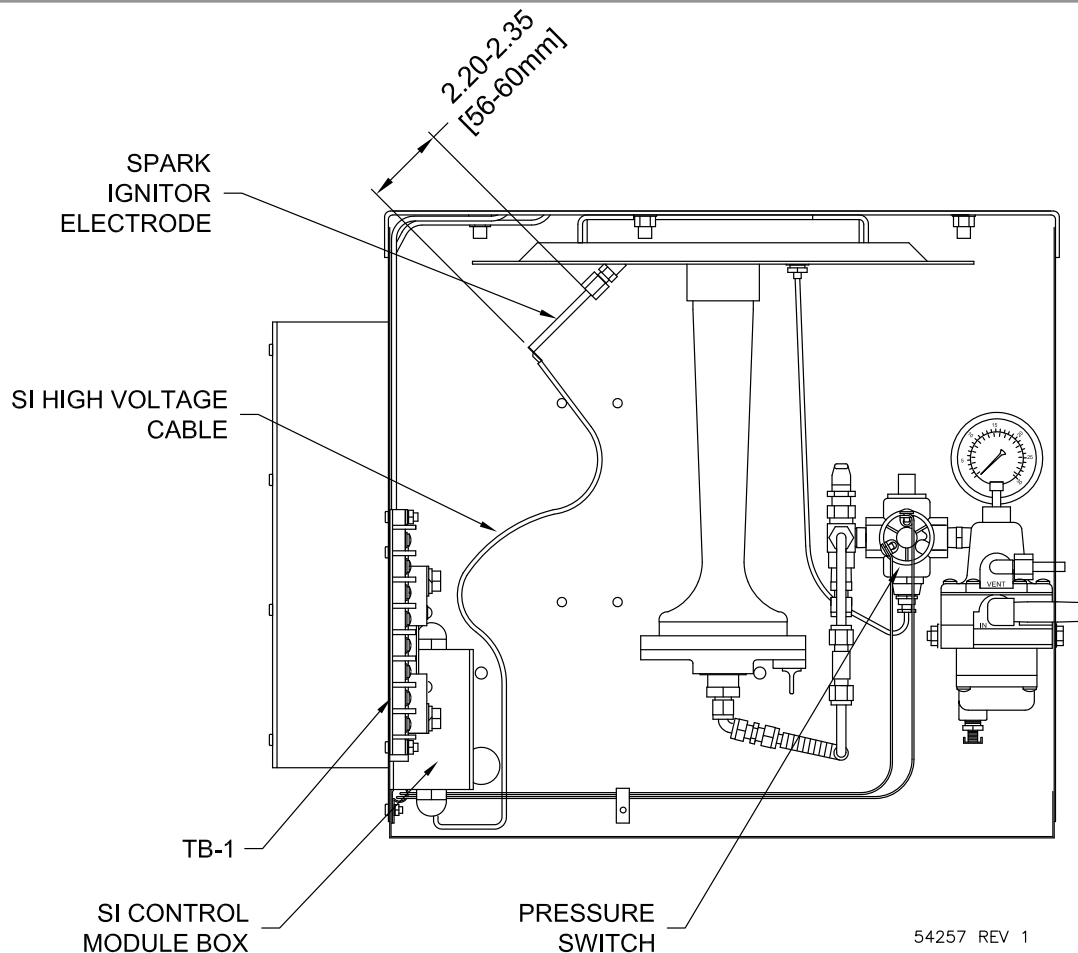


Figure 17 Spark Ignition Components

3.7 Automatic Shut-Off (SO)

3.7.1 The Automatic Shut-Off system is designed to turn off the fuel supply to the TEG in the event of a flame outage. The Shut-Off Valve contains an electromagnet that is powered by a thermocouple mounted in the Burner Plate assembly. When the thermocouple is no longer heated by the flame, the current will drop to zero, causing the electromagnet to allow the valve to close. The system is the same as that found in most gas appliances. Figure 18 shows the location of the system components.

3.7.2 If the Automatic Shut-Off system malfunctions proceed as follows:

3.7.2.1 Check that the thermocouple sensor is installed correctly in the Burner Plate assembly. Check that the thermocouple fitting is installed tightly in the Shut-Off Valve. Always use high temperature anti-seize compound on the Burner Plate fitting.

3.7.2.2 Check the thermocouple sensor function. Remove the thermocouple fitting from the valve. If the sensor is hot, check for a voltage between the cap in the center of the fitting and the sensor case, there should be about 15 to 30 mVolts. If there is not voltage or continuity of the sensor, replace the sensor. Always use high temperature anti-seize compound on the Burner Plate fitting.

Table 4

Spark Ignition Control Module Specifications		
Electrical	Input Voltage	Minimum 4.0 Volts
		Maximum 30.0 Volts
	Input Current	Maximum 150 mAmps with TEG operating
	Output Voltage:	Minimum 12 k volts
	Spark Rate:	1 - 3 Hz
	Noise Conducted	40 m volts P-P
		28 m volts RMS
Operating Temperatures	Control Module:	-55 °C a +65 °C
		-67 °F a +149 °F
	Wire Assemblies:	-55 °C a +200 °C
		-67 °F a +392 °F
	Spark Electrode:	metal conductor (Haynes 214)1490 °C or 2700 °F
		Ceramic Tube (alumina) 1926 °C or 3500 °F
Control Module Life		5 x 10 ⁶ Sparks Minimum
Continuous Operating Time without Charge		16 hours with Full Charged Battery @ 23°C (73°F)

Table 5

Spark Ignitor Battery Specifications		
Type	Sealed Lead Acid	
Nominal Cell Voltage	2.0 Volts	
Capacity Rating: @ 23°C (73°F)	125 mA Rate	2.7 Amp Hr
	250 mA Rate	2.5 Amp Hr
Cell Temperature	Storage	-40 °C to +45 °C -40 °F to +113 °F
	Discharge	-40 °C to +45 °C -40 °F to +113 °F
	Charge	-40 °C to +45 °C -40 °F to +113 °F
Storage Time	At 0 °C (32 °F)	7200 days
	At 23 °C (73°F)	1200 days
	At 65 °C (149 °F)	60 days
Expected Float Life	8 years	

- 3.7.2.3 If the sensor is functioning and the system still does not hold the Shut-Off Valve open with a hot burner, then the valve must be replaced. Note that in order for the Shut-Off Valve to engage, it is necessary to fully depress the button on the valve. When installing the new valve, ensure that you do not introduce any pipe thread sealing compound or other contaminants into the piping and also check for fuel leaks.

3.8 Power Unit Testing

- 3.8.1 The Power Unit contains the thermoelectric materials which actually produce the electrical power. This unit is hermetically sealed because the thermoelectric materials are adversely affected by exposure to air at operating temperatures. Because of this hermetic seal the Power Unit cannot be repaired after leaving the factory. The procedures below are designed to evaluate the conditions of the Power Unit and to determine its operating point. These procedures should only be done if a problem with the Power Unit is suspected, they serve no other purpose.
- 3.8.2 Open circuit voltage and internal resistance test: The purpose of this test is to determine the momentary open circuit voltage (V_{oc}) of the Power Unit from which the internal resistance (R_{INT}) can be calculated. In order for this test to be accurate, the TEG must have been operating for the past 12 hours at 24 to 26 Volts.
- 3.8.2.1 Measure and record the Power Unit current (I) at terminals 6(+) and 7(-) of TB-1.
- 3.8.2.2 Attach a voltmeter to read the Power Unit voltage at terminals 6(+) and 4(-) of TB-1. The voltmeter leads must be attached to these terminals because you will need both hands free to do the open circuit test.

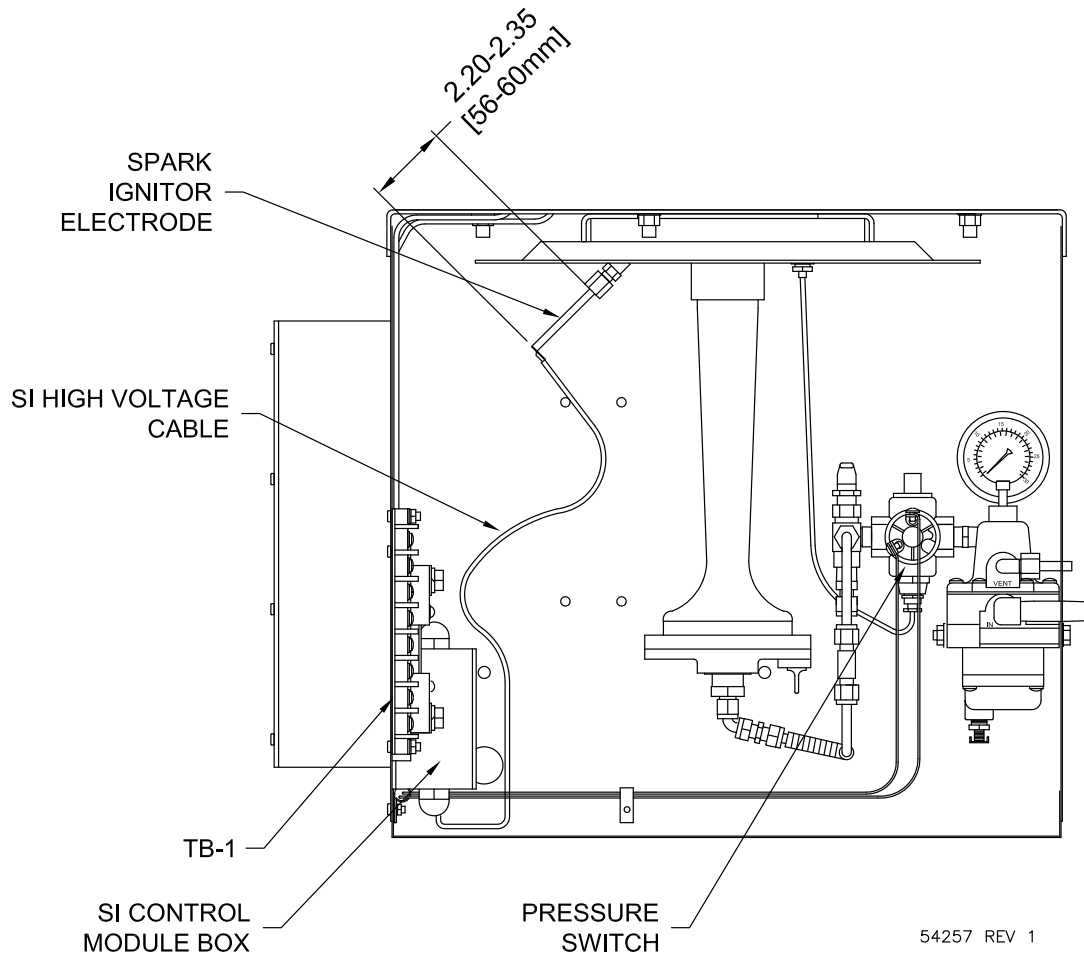


Figure 18 Automatic Shut-off Components

3.8.2.3 Measure and record the Power Unit loaded voltage (V_L).

3.8.2.4 Record the momentary open circuit Power Unit voltage (V_{oc}). This is best done by removing the positive lead (Wht/Red) from the bottom of the shunt. With one hand, hold the connector firmly to the shunt until you have removed the screw, then remove the connector and take the voltage reading. The reading must be taken within 3 seconds. Immediately reconnect the wire to the shunt. See Figure 9. DO NOT allow the Power Unit to remain in open circuit for more than 20 seconds. Record the open circuit voltage. If it is necessary to take reading again, wait at least 10 minutes with the Power Conditioner connected so that the Power Unit can stabilize.

3.8.2.5 Calculate the internal resistance (R_{INT}) using the equation:

$$R_{int} = \frac{(V_{oc} - V_L)}{I}$$

Where:

R_{INT}	=	internal resistance in Ohms
V_{OC}	=	Power Unit open circuit voltage
V_L	=	Power Unit loaded voltage
I	=	Power Unit load current



WARNING: Do Not allow the Power Unit to operate in the open circuit condition for more than 20 seconds. Turn off the fuel supply if you cannot reconnect the Power Conditioner.

If this test was conducted because the Power Unit power was below Set Power, see section 3.1.3 for test result diagnostic.

3.8.3 If the Power Unit is producing Set Power the open circuit voltage (V_{oc}) should be in the range of 52 to 56 Volts, and the internal resistance (R_{INT}) should be in the range of 1.10 to 1.35 Ohms. Note that if the TEG has just been started less than 10 hours ago or has been stopped and restarted several times in the past days, its internal resistance may be somewhat higher.

3.8.4 The maximum operating limits are 56.5 Volts for open circuit voltage and 1.45 Ohms for internal resistance. If the Power Unit will not produce Set Power and problems with the Burner System, Fuel System, and Cooling System have been ruled out, the fuel pressure may be increased until one of the above limits or Set Power is reached. Remember that it will take at least 15 minutes for a change in fuel pressure to take full effect. See also sections 2.5.7 and 2.5.8.

If the Power Unit will not produce Set Power without exceeding these limits, or does not respond to increasing fuel pressure, the Power Unit may be damaged. Note that in some cases the Power Unit can operated at derated power, consult Global Power Technologies for further information.



WARNING: Do not operate the Power Unit above Set Power, maximum open circuit voltage or maximum internal resistance.

3.9 Trouble Shooting Guide

3.9.1 When the TEG is not operating correctly it is necessary to determine which part is faulty. First ensure that all wires are making good contact and are connected correctly. Then isolate the customer load from the Power Conditioner. Refer to Table 6 as a guide to trouble shooting the TEG and consult the indicated sections of this manual for further information.

Table 6

Trouble Shooting Guide		
Symptom	Cause/Remedy	Section
Burner does not ignite	Air in fuel line	2.3
	No fuel at orifice	
	a) low gas pressure	2.3
	b) regulator setting	2.4.5
	c) dirty fuel filter	3.3.3
	d) plugged orifice	3.3.3
	e) Burner run valve open	2.4.5
	With Spark Ignition Option SI	
	a) Check Function of SI system	3.6
Burner does ignite but will not continue to burn	Burner Run Valve closed	2.4.5
	Fuel System	
	a) Low Gas pressure	2.3
	b) Regulator setting	2.4.5
	c) Dirty Fuel	3.3.3
	d) Plugged Orifice	3.3.3
	With Auto Shut-off Valve	
	a) Check SO Thermocouple	3.7.2
	b) Faulty Shut-off valve	3.7.2
Power Unit output power low	Incorrect power unit voltage, output power low	3.2
	Check that you are using the correct set power for current conditions.	1.5.2
	Follow evaluation procedure in sections 3.1.2 and 3.1.3	3.1.2 y 3.1.3
	Test Power unit	3.8
	Check function of Power conditioner	Separate Manual
Power Unit Output Power High	Incorrect Fuel pressure	3.1.2
	Check Function of Power Conditioner	Separate Manual

3.11 8550 TEG Parts List

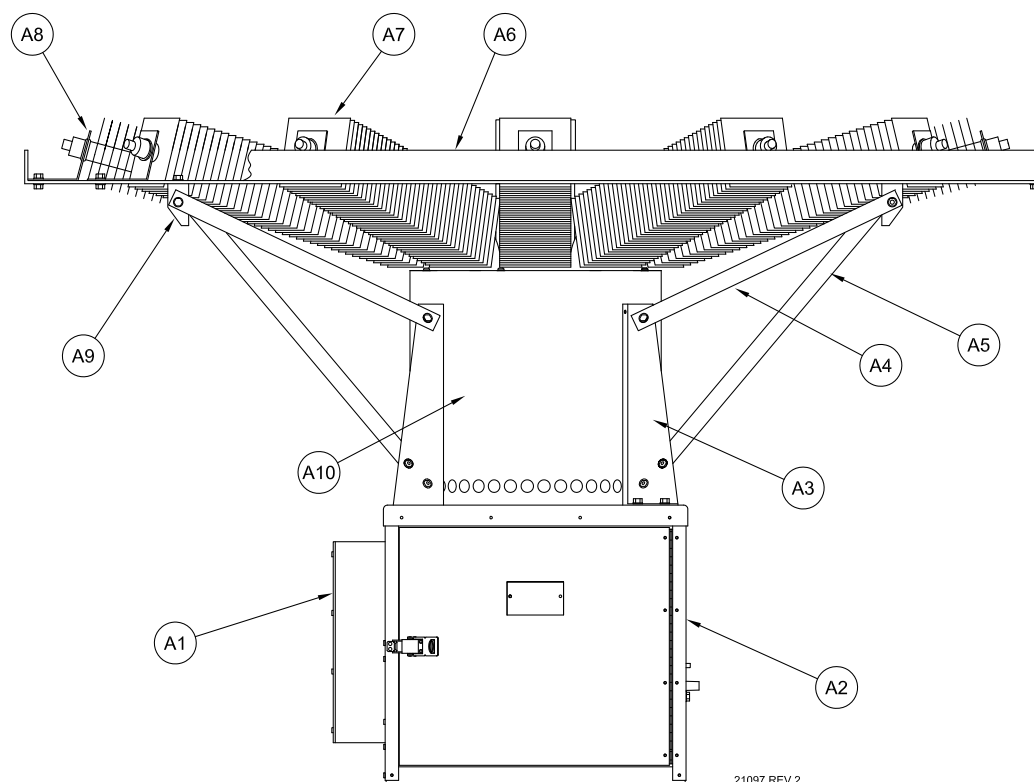


Figure 19 8550 TEG Parts List

Item	Part No.	Description
A1	6300-03162	Limiter, Model 6720
A2	6200-21611	Cabinet Assy
A3	4900-06431	Support, Upright, Heat Pipe
A4	4900-06394	Support Arm, Upper, Heat Pipe
A5	4900-06395	Support Arm, Lower, Heat Pipe
A6	4900-06393	Support Ring, Heat Pipe
A7	4900-22895	Heat Pipe Assy, Water/Methanol (Orange tip)
	4900-22896	*Heat Pipe Assy, Water/Ethanol (Black tip)
	4900-22897	*Heat Pipe Assy, Methanol (White tip)
A8	4900-06396	Heat Pipe Clip
A9	4900-06397	Support Bracket
A10	4900-06398	Converter Shroud

*Note: The Heat Pipe Assy type will vary depending on the TEG type as follows:

Warm Ambient:	uses 12 each of 4900-22895
Cold Ambient:	uses 6 each of 4900-22897 (white tip) alternating with 6 each of 4900-22896 (black tip).
Medium Ambient:	uses 12 each of 4900-22896

Check the colour of the tip of the Heat Pipe to determine which type to use.

3.10.1 8550 TEG Parts List

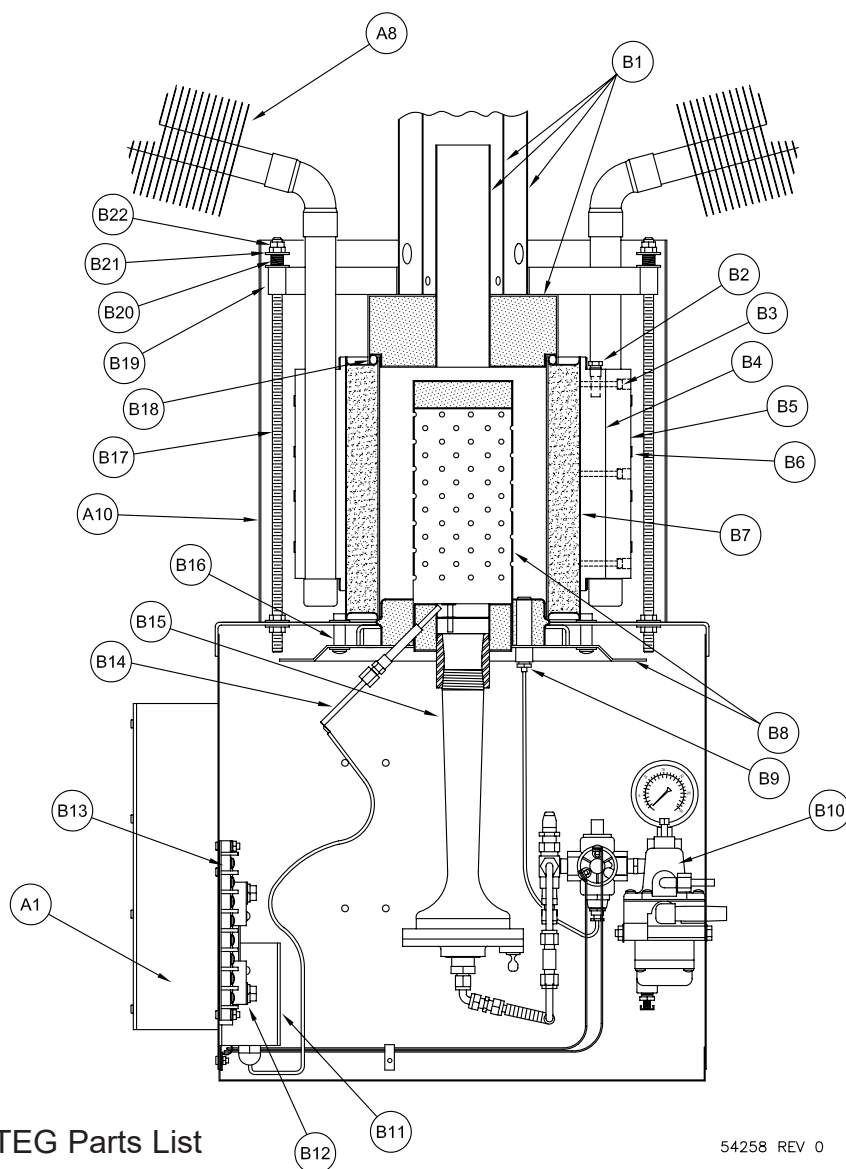


Figure 20 8550 TEG Parts List

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Item	Part No.	Description
B1	4500-05406	Exhaust Stack Assy, 8550
B2	3054-50506	Plug, 1/4 MNPT, Hex, Brass, B-4-P
B3	2510-02104	Screw, Cap, Soc-H-Hex, 10-32 x 1", SS
B4	4900-21646	Shoe, Heat Pipe
B5	4900-06462	Block, Heat Pipe
B6	2900-06991	Clamp, Oetiker, 178-315SQ
B7	7900-08906	Power Unit, 8550
B8	6100-22490	Burner Assy
B9	3400-00177	Thermocouple, 24"
B10	6400-54253	Fuel System, Natural Gas
or	6400-54252	Fuel System, Propane

3.10.2 8550 TEG Parts List

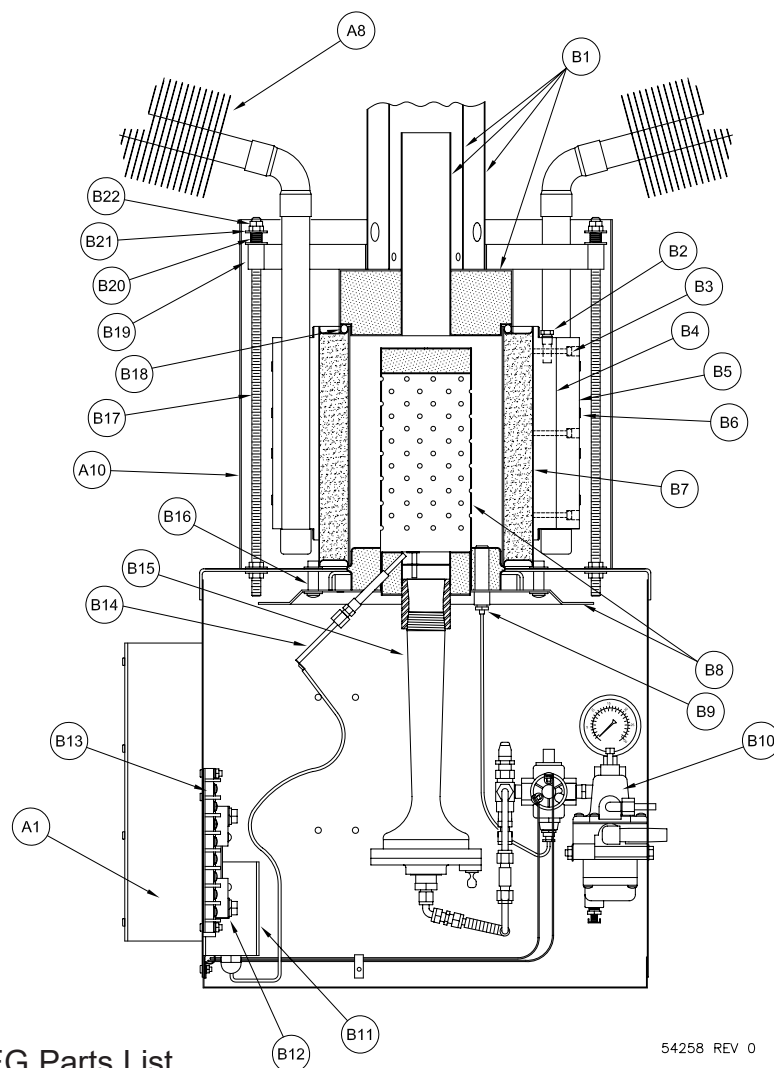
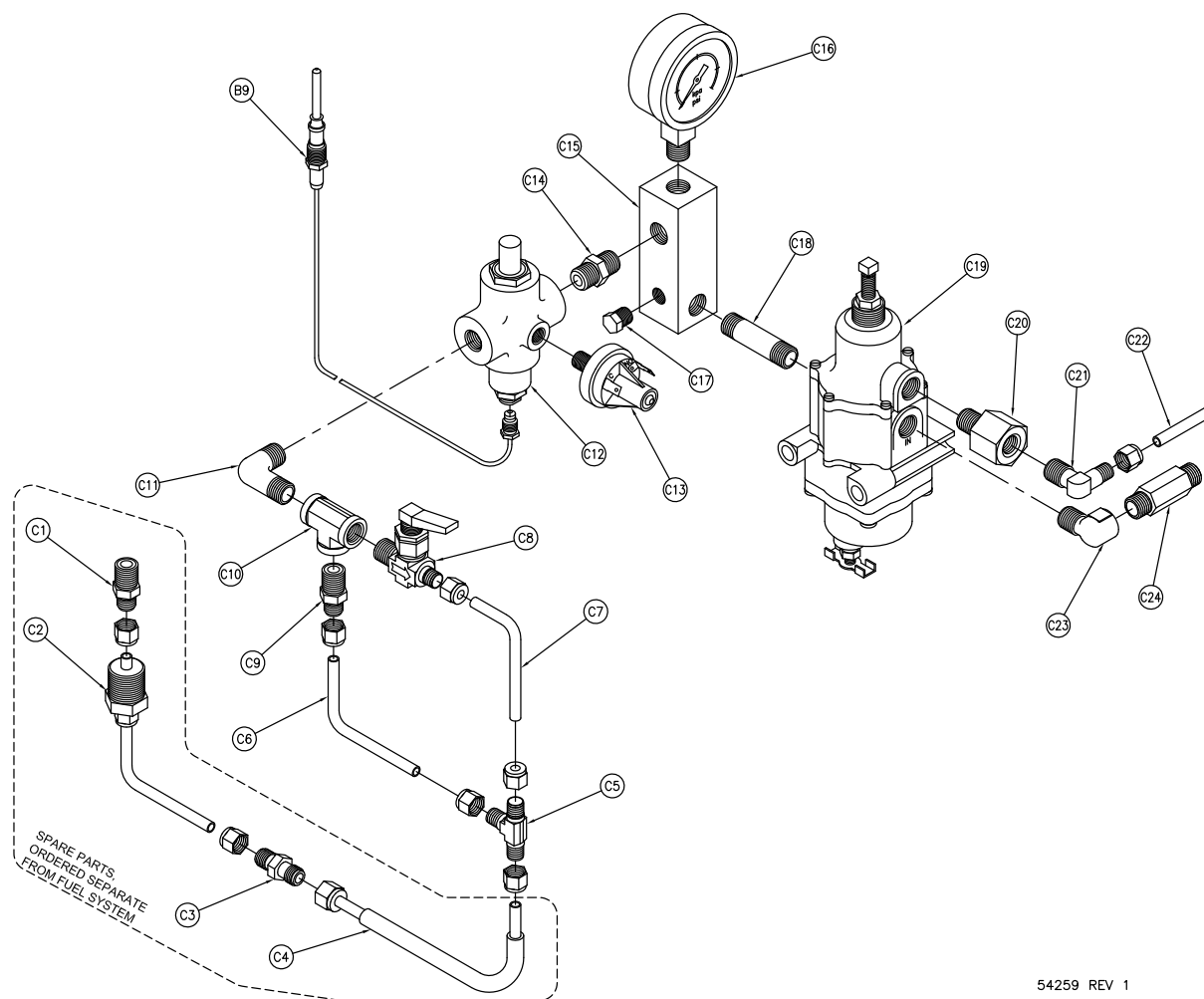


Figure 20 8550 TEG Parts List

54258 REV 0

Item	Part No.	Description
B11	6300-20144	Spark Ignitor Module
	2400-27019	Battery, 2V, 2.5 AH, D size (inside B11)
B12	2400-05238	Shunt, 50 Amp 50 mV, Bach 6709
B13	2200-02110	Terminal Block, 8 Position
B14	4900-06768	Spark Electrode Assy
B15	4000-06418	Venturi
B16	2900-06968	Stand Off, 1/2" Hex, 1/4-20 x 5/8", SS
B17	4900-06400	Mounting Rod, Converter
B18	4900-05545	Exhaust Gasket
B19	4900-06645	Converter Mounting Ring
B20	2900-05576	Spring, Spae-naur 610-403
B21	2856-05578	Washer, Flat, 5/16, SS
B22	2556-05579	Nut, Hex, 5/16-18, SS

3.11 Fuel System Parts Lists



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Figure 21 Fuel System Parts List, 8550 TEG

Item	Part No.	Description
C1	4200-06434	*Orifice, Propane, 0.040
or	4200-06433	*Orifice, Natural Gas, 0.061
C2	4200-05897	*Orifice Tube Assy
C3	3084-05554	*Union, 1/4 TB, B-400-6, Brass
C4	4200-05286	*Fuel Line Kit
C5	3084-05551	Union Tee, 1/4 TB, B-400-3, Brass
C6	4200-24915	Tube, Start Circuit
C7	4200-24916	Tube, Run Circuit
C8	3094-05552	Valve, Toggle, Needle, B-IGM4-S4, Brass
C9	3400-05549	Snubber, Propane, B4SMA-400W
or	3400-05550	Snubber, Natural Gas, B4SMA-400L
C10	3074-05048	Tee, 1/4 FNPT, 101-B, Brass
C11	3034-00476	Elbow, 90 , 1/4 MNPT, Brass

*Parts must be ordered separately for remainder of fuel system

3.11.1 Fuel System Parts Lists

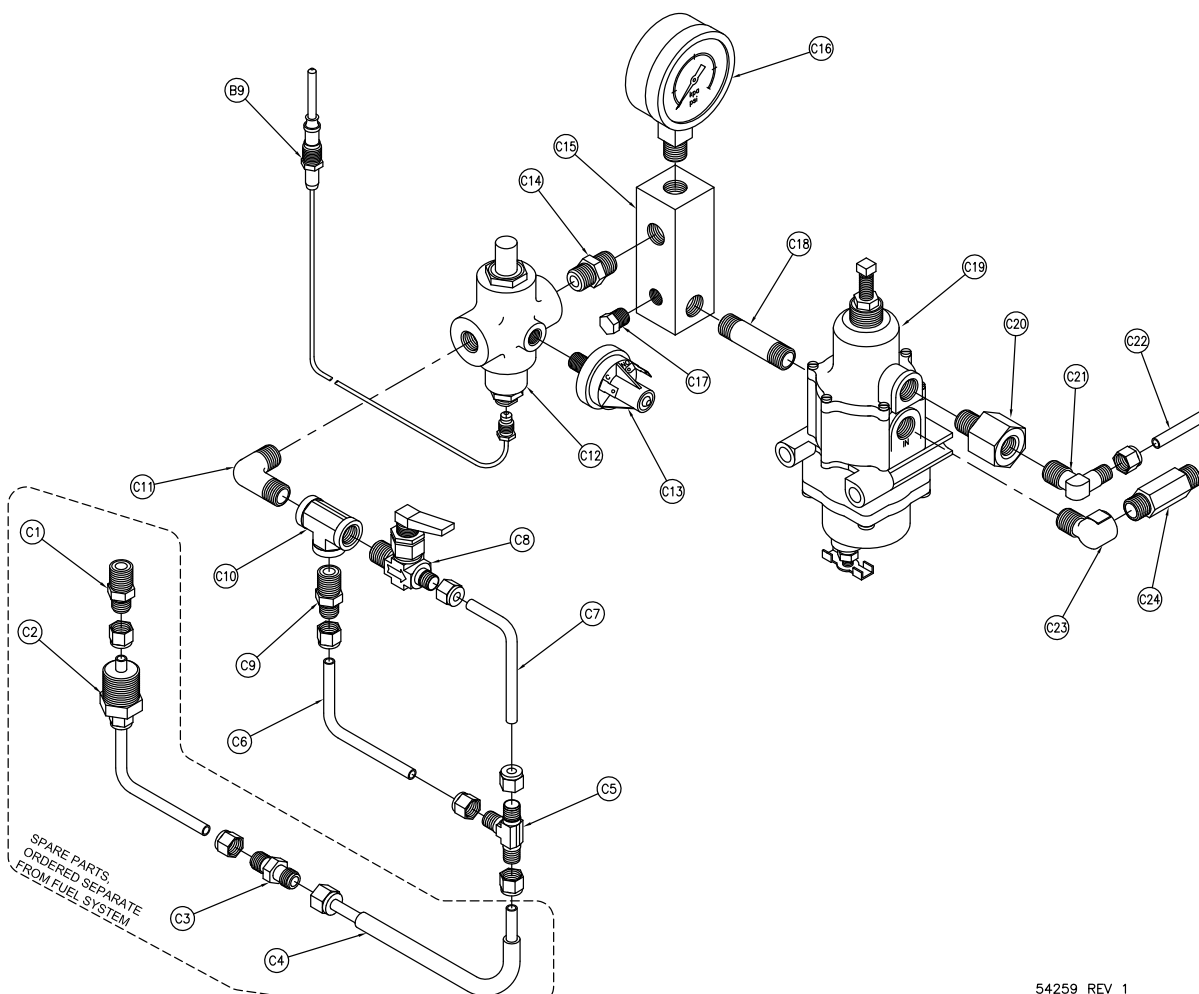


Figure 21 Fuel System Parts List, 8550 TEG

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Item	Part No.	Description
C12	3090-00176	Valve, Shut-Off
C13	3400-06471	Switch, Pressure, 1.5 PSI
C14	3044-00501	Nipple, Hex, 1/4 NPT x 1 1/2", Brass
C15	4200-02100	Manifold Block
C16	3200-00406	Gauge, Pressure, 0-30 PSI
C17	3054-00432	Plug, Hex Hd, 1/8-27 NPT, Brass
C18	3044-00376	Nipple, 1/4 NPT x 2" Lg, Brass
C19	3100-22359	Regulator, 3-20 PSI, Fisher 67CFR
C20	3011-02360	Adaptor, 1 1/4 MNPT X 1/4 FNPT, SS
C21	3031-20071	Elbow, 1/4 TB x 1/4 NPT, SS
C22	4200-20122	Vent Tube Assy
C23	3034-00384	Elbow, Street, 1/4 NPT, Brass
C24	3044-02154	Nipple, Hex, 1/4 NPT x 2" Lg, Brass
C25	3400-22363	Filter Kit, Fisher 67CFR, 1F257706992 & T14057T0022

4 6720 VOLTAGE LIMITER OPTION FOR MODEL 8550

4.1 General Information

4.1.1 Product Application

The 6720 Voltage Limiters are attached across the generator output in parallel with the customer load. They can be used in multi generator systems to:

- Provide an optimum load condition for the TEGs.
- Provide a constant-adjustable voltage to the customer load.

4.1.2 Product Description

The 6720 Voltage Limiter is a solid state linear amplifier shunt regulator. The limiter circuit senses the TEG output voltage through a series of resistors and transistors that act to hold the voltage at an adjustable level. Figure 22 shows the dimensions of the 6720 Voltage Limiter. Specifications:

Voltage Range: 24-30 Volt

Power Range: 0-729 Watt

Regulation: 0.25% at 25°C, no load to full regulation

Temperature Coefficient: 0.009%/°C (average from -40°C to +45°C)

Ripple: 0 (pure DC source)

Overload Protection: The limiter is in parallel with the TEG, therefore the internal resistance of the TEG limits the circuit current.

Reverse Current Protection: Protected by a diode in series with the output.

Open Circuit: The open circuit voltage cannot rise above the limiter set voltage.

Voltage Sensing Relay (VSR): The limiter is equipped with a standard Voltage Sensing Relay. The VSR provides a set of contacts that indicate an alarm condition when the voltage drops below a preset minimum.

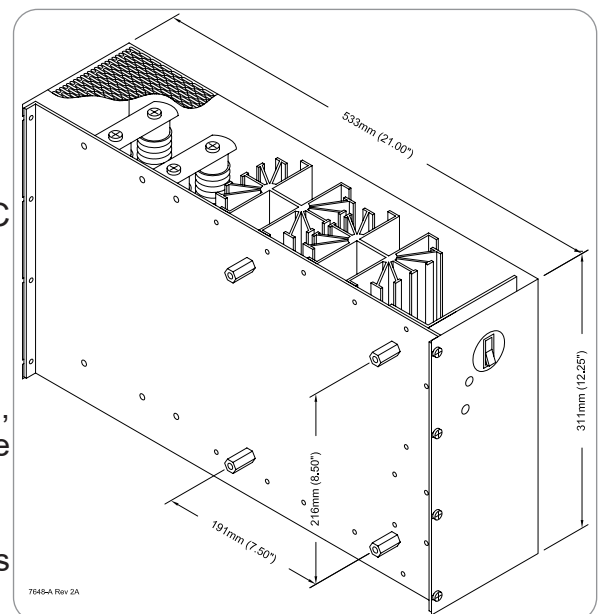


Figure 22 6720 Voltage Limiter Physical Description

4.2 Operation

4.2.1 Output Voltage Adjustment

Adjustment of the voltage limiter output voltage should not be attempted until the generator system is set up and operating according to the Generator Instruction Manual.

- 1) Check all electrical connections.
- 2) Disconnect any customer load attached to Terminals 2 and 4 of TB-1.
- 3) Connect plus (+) of a DC voltmeter to Terminal 6 and minus (-) to Terminal 4 using a voltmeter of appropriate range and 1% accuracy.
- 4) Locate the voltage adjustment screw (see Figure 23 and Figure 24) and turn the screw until the desired voltage is obtained.
- 5) Connect the customer load to Terminals 2(+) and 4(-).
- 6) Check all wire connections for tightness, close and latch the door

4.2.2 Removal of Reverse Current Diode

Each Voltage Limiter has a high current diode in series with the output to provide reverse current protection in installations where batteries are being charged. Discharge of the batteries can occur if any of the following conditions exist:

- a) The Voltage Limiter is set lower than the battery voltage with normal TEG output.
- b) The Voltage Limiter voltage is set equal to or lower than the battery voltage and the TEG has zero or lower than the battery voltage output.

The diode has a power loss of 12 Watts with a load current of 17 Amps and voltage drop of 0.7 Volts.

In installations where maximum power is required, it may be desirable to permanently bypass the diode.

Important: Before the diode is bypassed the customer must determine that battery discharge will not occur or that it is not detrimental to the installation.

If the desire is to bypass the diode, refer to the Schematic diagram (Figure 25) and parts illustration (Figure 26).

Remember the TEG delivers power at 20-30 Amps, therefore select wire size and connection method accordingly.

4.2.3 Voltage Sensing Relay Adjustment

If using the VSR in your system is necessary, proceed with the following adjustment procedure.

1. Refer to Figure 23 and Figure 24.
2. Connect a DC voltmeter to the voltage limiter output.
3. Remove the voltage limiter cover.

4. Set the voltage limiter output voltage to the desired alarm point voltage according to section 2.1.
5. Place an ohmmeter between terminals 1 and 2 of VSR terminal strip.
6. Turn the VSR adjustment screw (Figure 23) until the contacts just open (they are closed during normal operation).
7. Reset the voltage limiter output voltage to desired operating level.
8. Connect the customer alarm wiring to the VSR terminal strip (Figure 24).

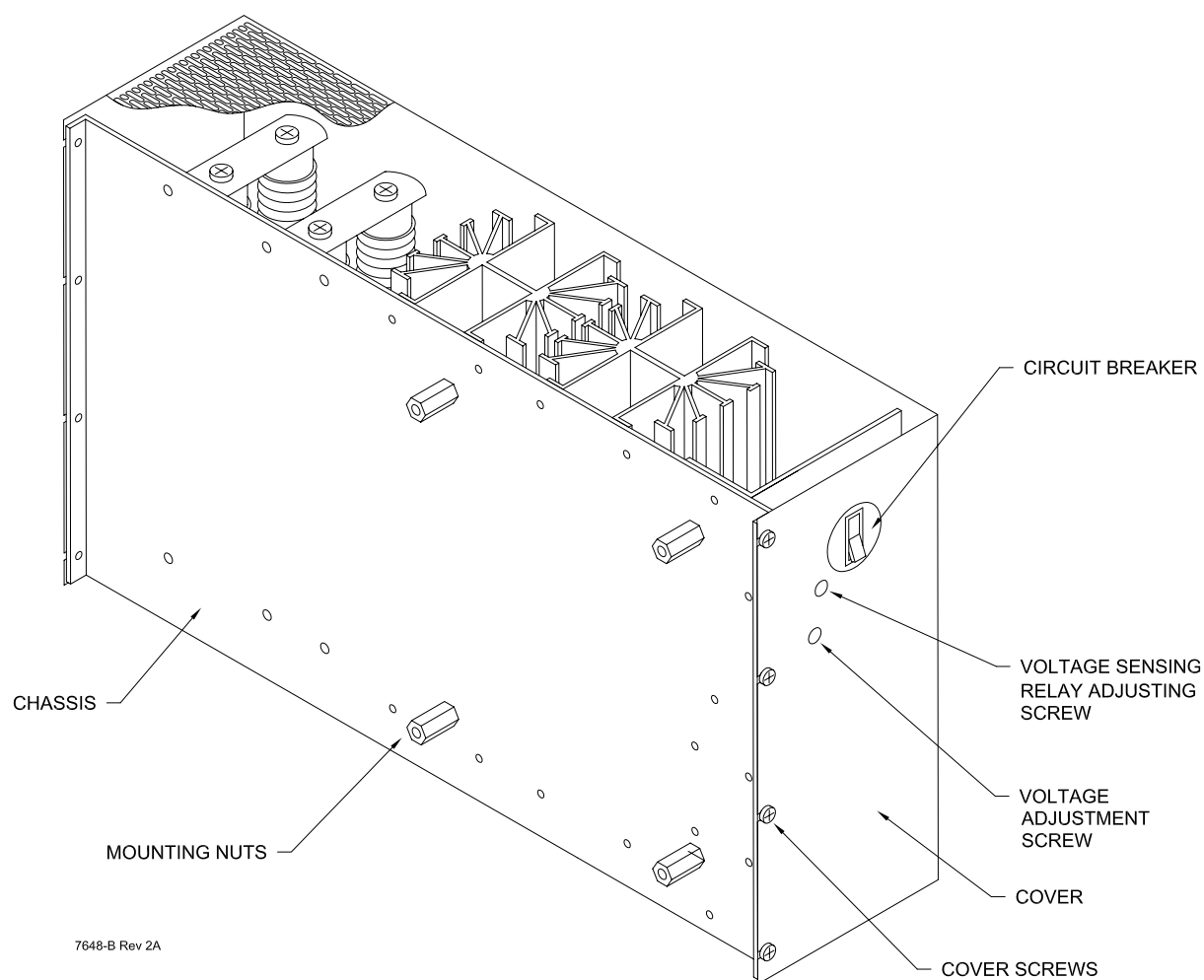
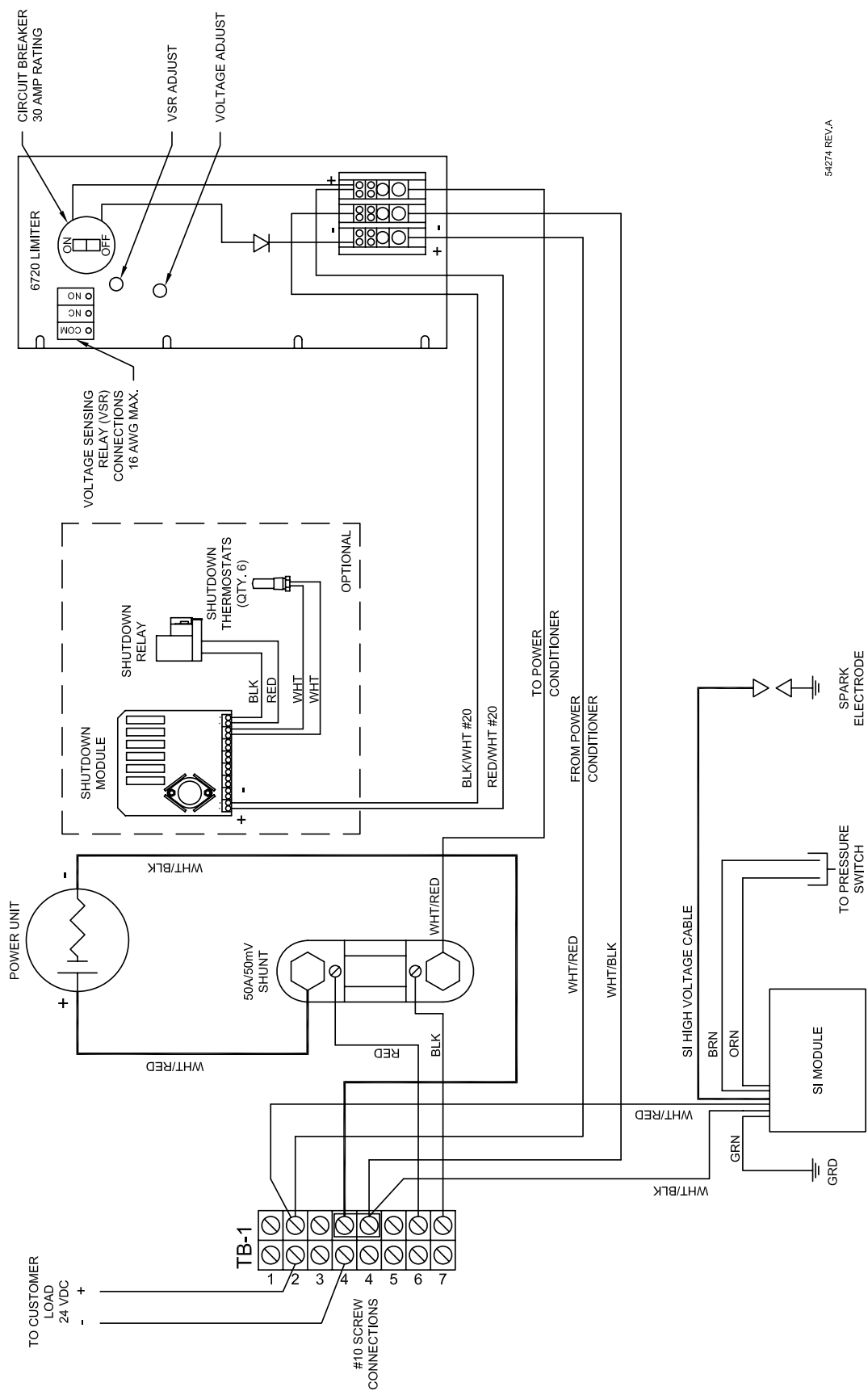


Figure 23 6720 Voltage Limiter



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Figure 24 Wiring diagram, 8550 TEG with voltage limiter

4.3 Service

4.3.1 Theory of Operation

4.3.1.1 Each thermoelectric couple of the TEG is much like a single lead acid battery cell in that it is fundamentally a low voltage, high current power source. For example each thermoelectric couple in a Model 8550 TEG produces typically 87mV at 21 Amps. The generator consists of 325 couples in series producing a load voltage of 28 Volts. This voltage is the matched load point in the Model 8550 TEG where maximum power is transferred to the load. In multi generator systems several TEGs are placed in series to obtain the required load voltage.

4.3.1.2 The 6720 Voltage Limiter can be used in multi generator systems to:

- a) Provide the optimum load condition for the TEGs
- b) Provide a constant adjustable voltage to the customer load.

The Voltage Limiter is a solid state shunt regulator. Transistors Q1 and Q3 act as a regulator driver network for transistors Q25 and Q26, which provide the drive to power transistors Q21 to Q24. A voltage divider network (resistors R4, R13 and R16) sensed the TEG output voltage to the base of Q3. Resistor R13 is adjustable and is used to set the voltage limit point. The emitter voltage of Q3 is held constant by Zener Diode D1. Resistor R5 keeps D1 slightly conducting and in a linear mode of operation so that good regulation is maintained.

An increase in the customer load resistance will cause the TEG output voltage to increase and Q3 to turn on. Current flow through resistors R1, R7 and R15 turns on Q1, Q25 and Q26 that drive Q21 to Q24. Power transistors Q21 to Q24 and power resistors R29, R30 and R31 together dissipate the excess power, thus holding the TEG output voltage constant.

If the customer load resistance decreases, the opposite takes place. Transistor Q3 and subsequent stages turn off, resulting in less power being dissipated in Q21 to Q24 and R29 to R31, thus a constant TEG output voltage is maintained.

3.1.3 The VSR (Voltage Sensing Relay) circuit is used to sense an under voltage alarm condition on the output of the TEG. The operation of the circuit is very similar to the limiter control circuit described above. Resistor R14 is adjustable and is used to set the alarm point. If the TEG output voltage rises above the level set by R14, Q4 will turn on, energizing relay K1 through Q2. Feedback through resistor R11 causes the circuit to de-energize K1 at a voltage lower than the level at which it was energized (e.g., relay energized at 15V, de-energized at 12V). This gives the VSR circuit more stability.

4.3.2 Maintenance

The all solid-state high reliability design of the voltage limiter renders it nearly maintenance free. Periodically check for the following:

1. Obstruction of air flow through the heat sink area.
2. Output voltage level is correct. Reset if necessary, see Section 4.2.1.
3. Tighten the wire connections at input and output of the power conditioner. Look for oxidized high resistance contacts. If any exist, clean and re-tighten.

4.3.3 Trouble Shooting

When the generator system to which the voltage limiter is attached is not producing rated power or voltage, it is necessary to decide which product is faulty.

Note: Do not attempt to troubleshoot the voltage limiter until it has been confirmed that the TEGs are operating correctly according to its Instruction Manual.

If the TEGs are operating correctly do the following steps:

1. Check all wires for bad contacts, making sure that they are tight and the voltage limiter is electrically connected to the TEG correctly.
2. Disconnect the customer load from Terminals 2 and 4 of TB-1 (see Wiring Diagram, Figure 24)
3. Check the output voltage at Terminals 2 and 4 of TB-1. If the TEGs are operating correctly, but the voltage is abnormal then the Voltage Limiter may be faulty. See Section 4.3.4 for repair.

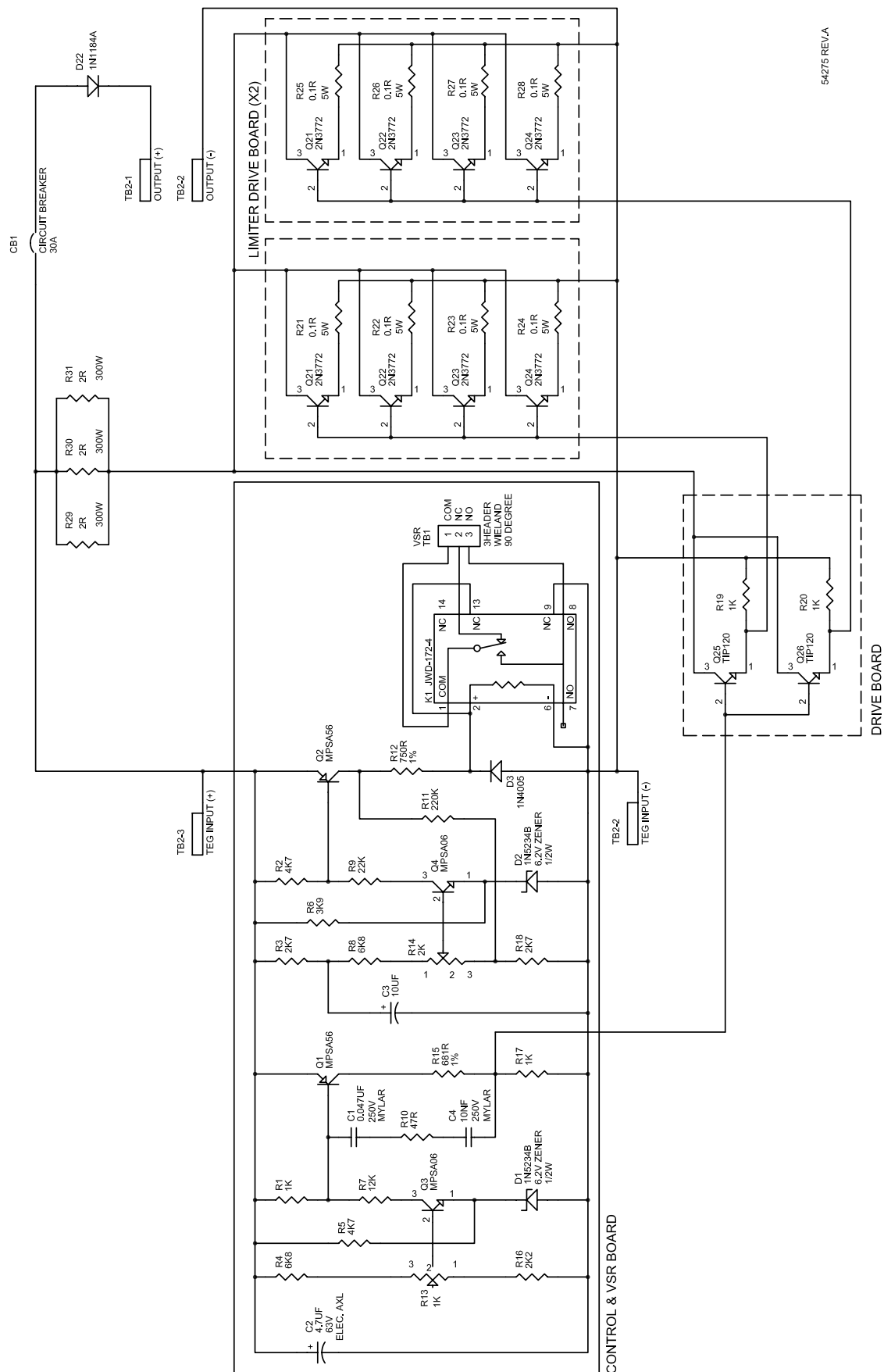
4.3.4 Repair

4.3.4.1 Field Repair: If the Voltage Limiter is determined to be faulty after trouble shooting the TEG, do the following steps:

1. Refer to Wiring Diagram, Figure 24.
2. Remove the cover from the Voltage Limiter (8 each #10-32 screws).
3. Referring to Schematic Diagram, Figure 25, check the various circuit voltages with a voltmeter.
4. Determine if one of the components is faulty and replace it.

4.3.4.2 Bench Repair: A DC power source with a minimum range of 0 to 39V and a current capacity of greater than 1.0 Amp but less than 20 Amp is required to test the Voltage Limiter.

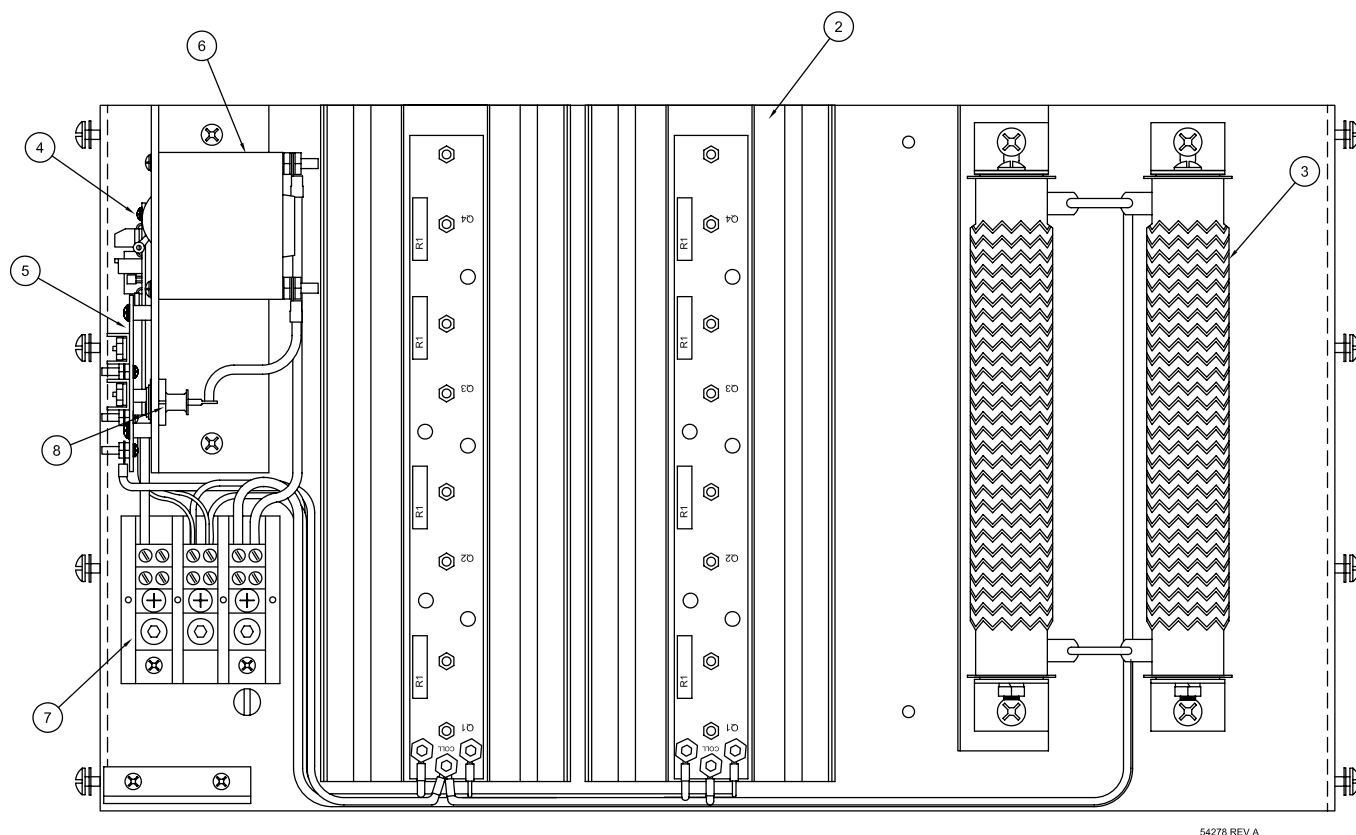
1. Remove the Voltage Limiter from the TEG.
2. Refer to Schematic Diagram, Figure 25.
3. Turn on and set the power supply voltage control to zero. If the power supply has current limiting, set the current limit control to somewhere between 1.0 and 20 Amps.
4. Slowly increase the power supply output voltage until the current begins to flow.
5. Using the Schematic Diagram check for faulty components and replace.



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Figure 25 Schematic Diagram 6720 Voltage Limiter

4.3.5 6720 Limiter Parts List



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Figure 26 6720 Limiter Main Parts

Item	Part No.	Description
1	4900-20184	Cover Assy, Limiter, 8550 (not shown, order separately)
2	2400-03154	Heat Sink Assy
3	2410-00116	Resistor, 2 Ohm, 300 Watt, 10%
4	4900-59056	Control & VSR Board, 24 Volt
5	2400-61042	Driver Board
6	2400-00284	Circuit Breaker, 30 Amp
7	2200-06714	Terminal Block, 3 Pole, Heavy Duty
8	2400-02580	Output Diode

4.3.6 6720 Limiter Electronic Parts (see Figure 6 & 7)

Item	Description
C1	Capacitor, 0.047 μ F, 250 Volt, Mylar
C2	Capacitor, 4.7 μ F, 50 Volt, Elec. Radial
C3	Capacitor, 10 μ F, 35 Volt, Elec. Radial 0.1
C4	Capacitor, 10 nF, 50 Volt, Mono Rad 0.2"
H1	Connector, 3 Pos, Wieland, 90 degree,
K1	Relay, Dip
R1	Resistor, 1K, 1/4 Watt, 5%
R2	Resistor, 4K7, 1/4 Watt, 5%
R3	Resistor, 2K7, 1/4 Watt, 5%
R4	Resistor, 6K8, 1/4 Watt, 5%
R5	Resistor, 4K7, 1/4 Watt, 5%
R6	Resistor, 3K9, 1/4 Watt, 5%
R7	Resistor, 12K, 1/4 Watt, 5%
R8	Resistor, 6K8, 1/4 Watt, 5%
R9	Resistor, 22K, 1/4 Watt, 5%
R10	Resistor, 47R, 1/4 Watt, 5%
R11	Resistor, 220K, 1/4 Watt, 5%
R12	Resistor, 750R, 1/4 Watt, 1%
R13	Potentiometer, 1K, 10 Turn, TT
R14	Potentiometer, 2K, 10 Turn, TT
R15	Resistor, 681R, 1/4 Watt, 1%
R16	Resistor, 2K2, 1/4 Watt, 5%
R17	Resistor, 1K, 1/4 Watt, 5%
R18	Resistor, 2K7, 1/4 Watt, 5%
R21-R24	Resistor, 5 Watt, 10%
R25-R26	Resistor, 1K, 1/4 Watt, 5%
R29-R31	Resistor, 2R0, 300 Watt, 10%
D1	Diode, Zener, 1N5234B, 6.2 V, 1/2 Watt
D2	Diode, Zener, 1N5234B, 6.2 V, 1/2 Watt
D3	Diode, 1N4005/7 1A
D22	Diode, 1N1184A
Q1	Transistor, TO-92, MPSA56
Q2	Transistor, TO-92, MPSA56
Q3	Transistor, TO-92, MPSA06
Q4	Transistor, TO-92, MPSA06
Q21-Q24	Transistor, TO-3, 2N3772
Q25-Q26	Transistor, TIP120

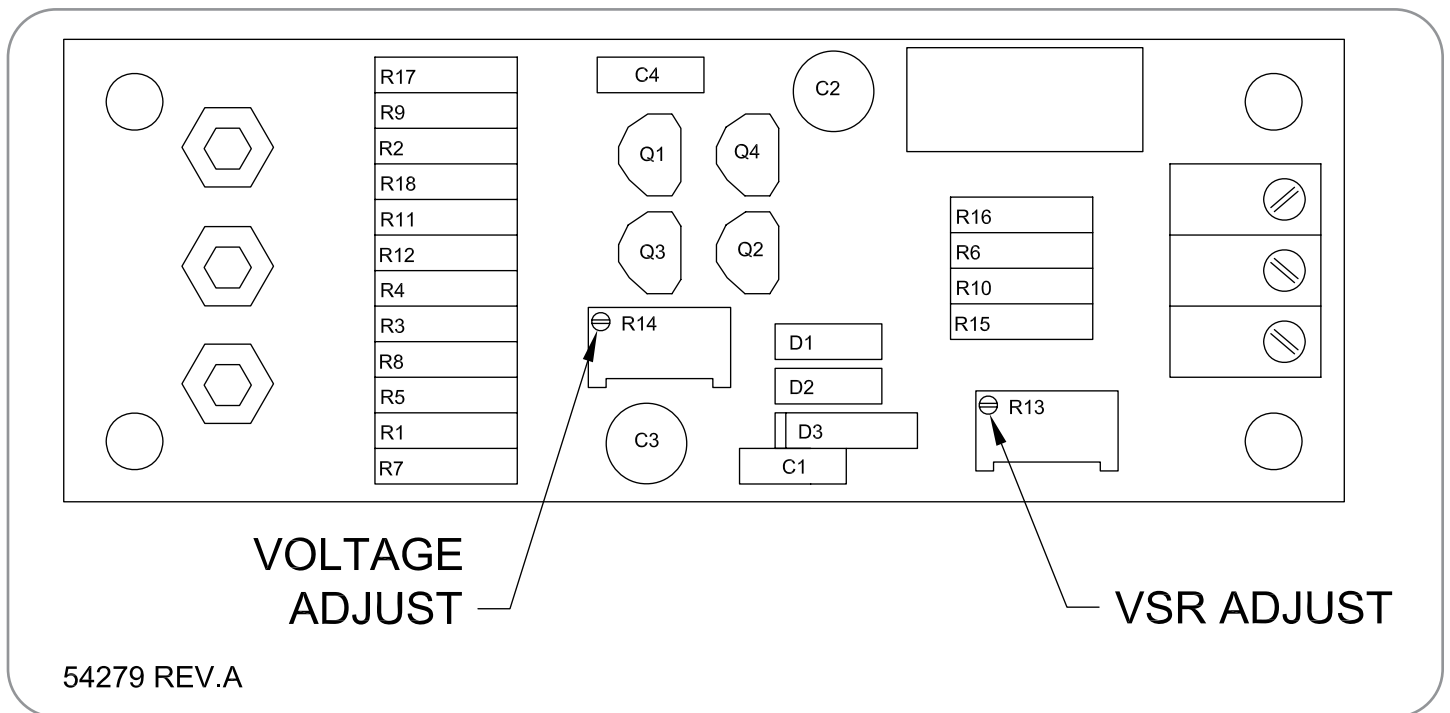


Figure 27 Control & VSR Board

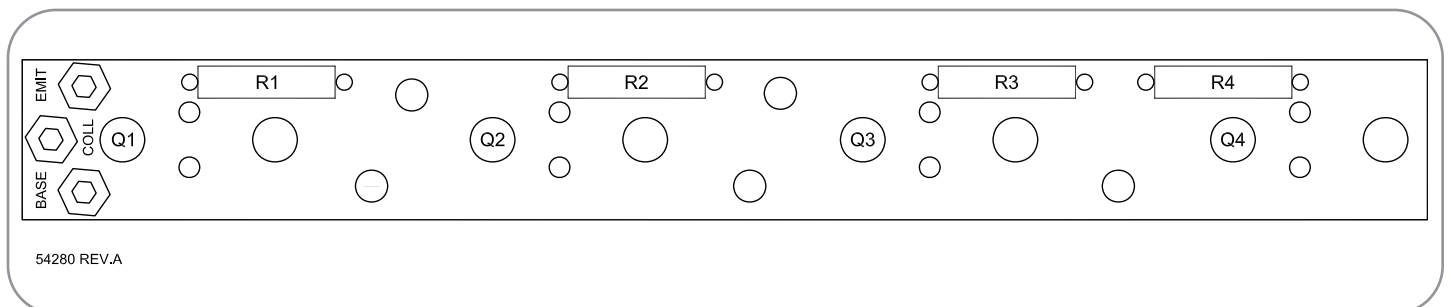


Figure 28 Limiter Drive Board

5 CATHODIC PROTECTION INTERFACE SYSTEM OPTION

5.1 GENERAL INFORMATION

5.1.1 Introduction

The Cathodic Protection Interface System provides for adjustment and monitoring of power to the CP load. The anode and cathode cables enter the cabinet at the bottom and connect directly to the heavy duty terminal block. Refer to Figure 29 for locations and descriptions of the major components of the CP interface cabinet.

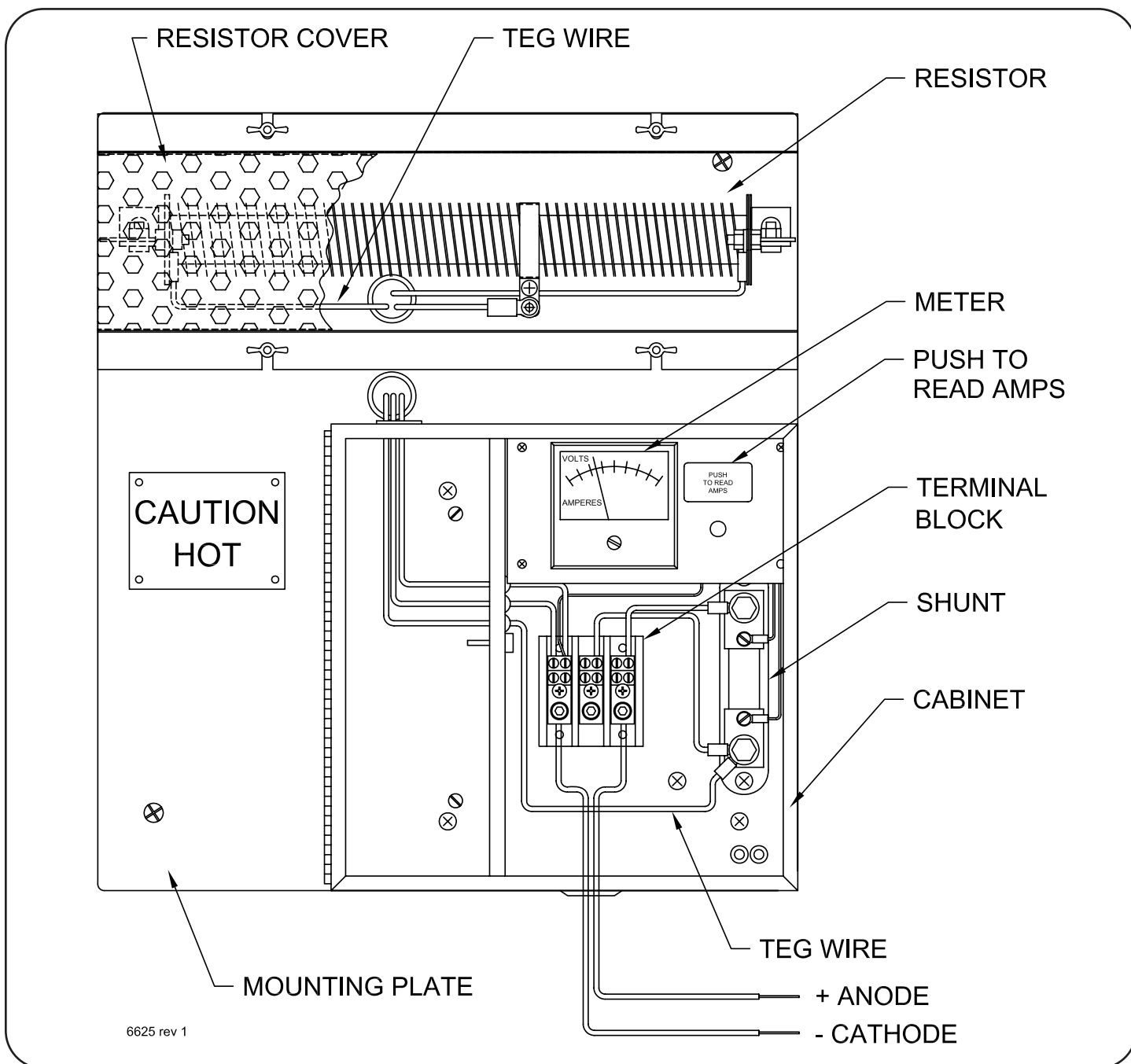


Figure 29 Cathodic Protection Interface Panel

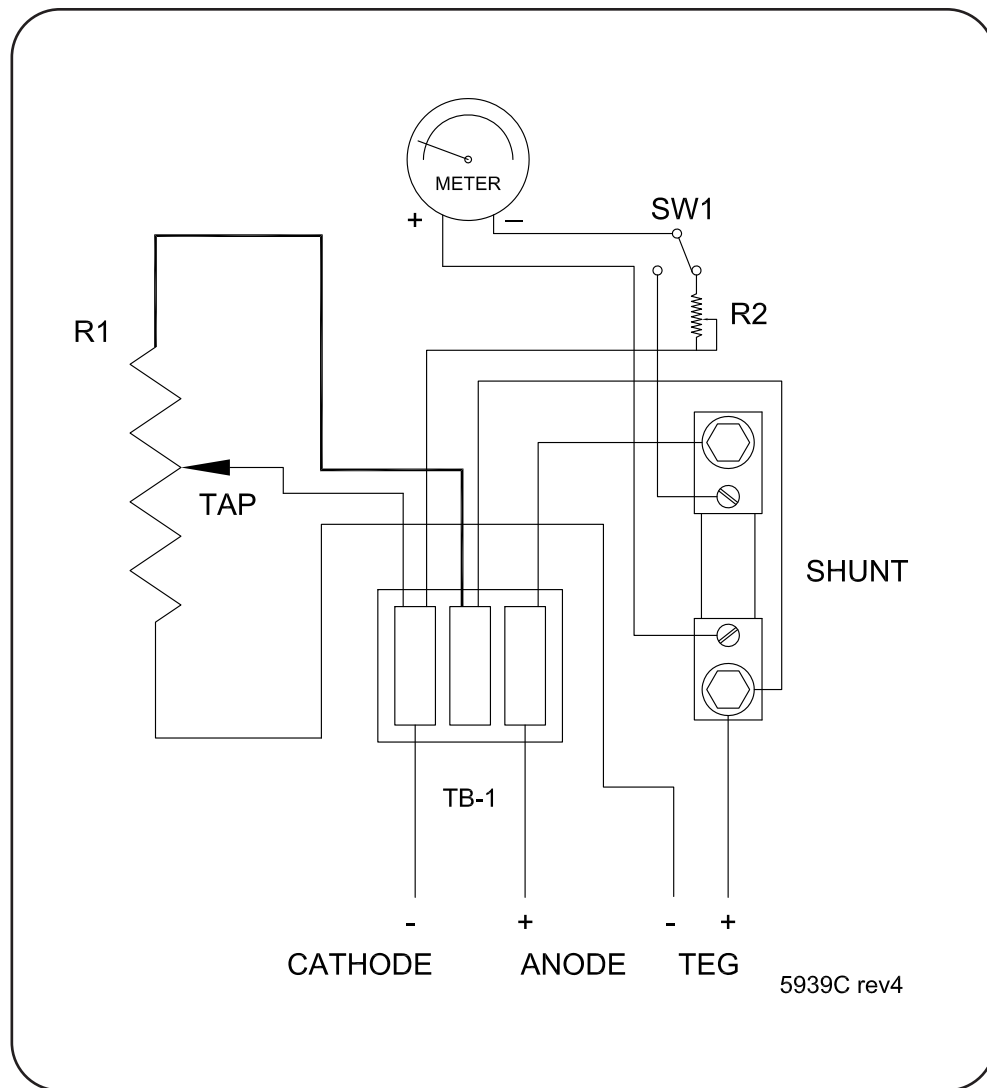


Figure 31 Schematic Diagram, Parallel Connection

5.1.6 Parallel

By connecting the 1000 Watt resistor in parallel with the TEG smaller levels of power may be delivered to the CP load. This is sometimes required to reduce hot spots on the anode. With the tap located at the right side of the resistor the output power will be zero. As the tap is moved to the left the power to the CP load is increased.

The change from series to parallel configuration is made by moving the wire coming from the right side of the 1000 Watt resistor, from the left position to the center position of the heavy duty terminal block.

A complete parts listing is given for the Cathodic Protection Interface Systems on the following pages.

5.1.7 PARTS LIST, CP INTERFACE PANEL, 8550

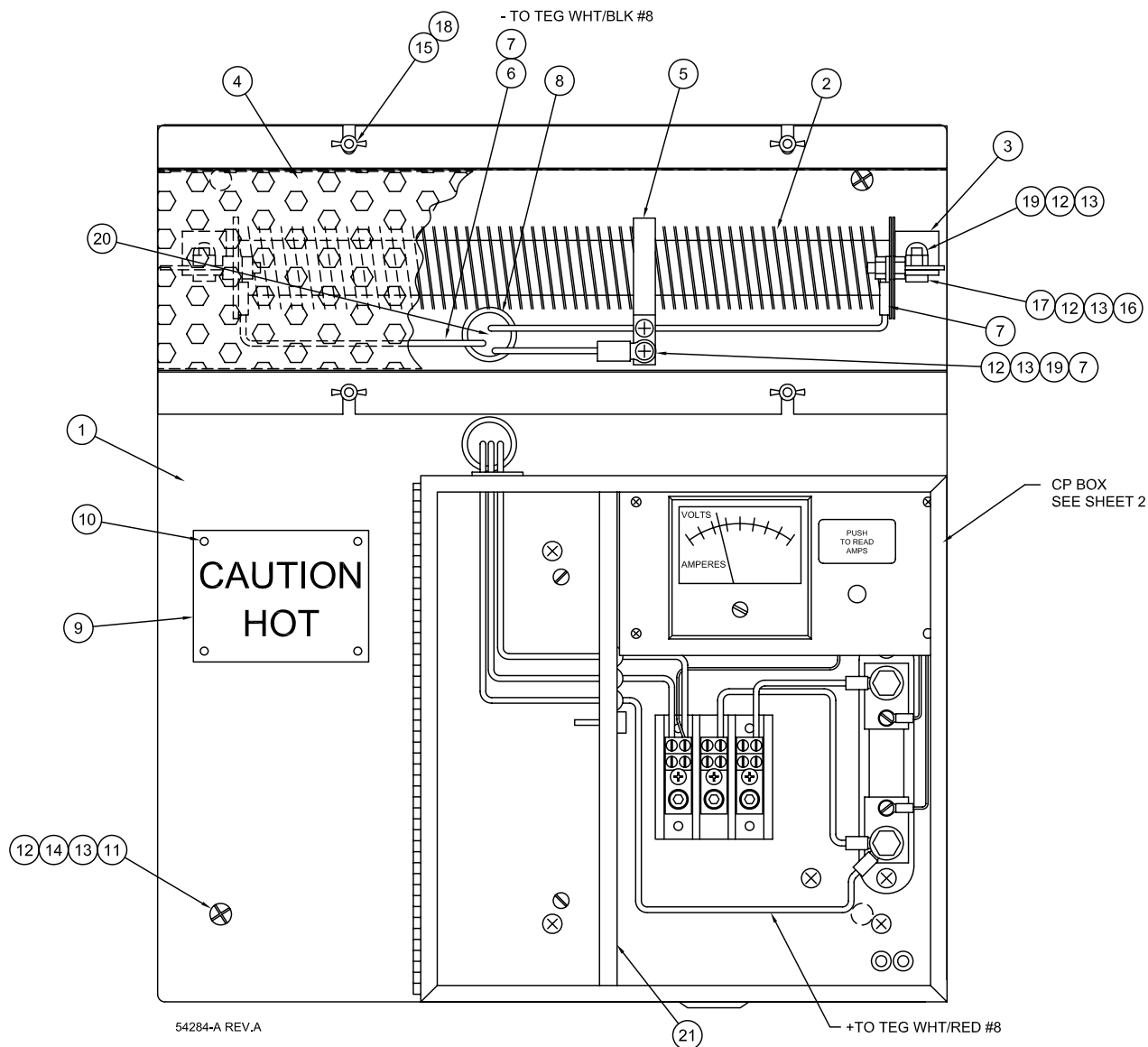


Figure 32 CP Panel Assembly Parts

Item	Part No.	Description	QTY
1	4900-06621	Mounting Plate, 8550 CP	1
2	2410-06566	Resistor, 1 ohm, PFE5K1R00	1
3	4900-06567	Mounting Bracket, Resistor	2
4	4900-06594	Cover Assy, Resistor	1
5	4900-06608	Slide, Resistor	1
6	2108-02107	Wire, #8 wht/blk, TIN-PLT-COP	35
7	2010-02584	Term, Ring, Red, #8 wire, 1/4 stud	1
8	2900-05722	Bushing, Universal, 1"	2
9	3600-06609	Label, Caution Hot	1
10	2900-05225	Rivet, POP, 1/8 SS, 0.126 - 0.187 Grip	4

5.1.7 PARTS LIST, CP INTERFACE PANEL, 8550

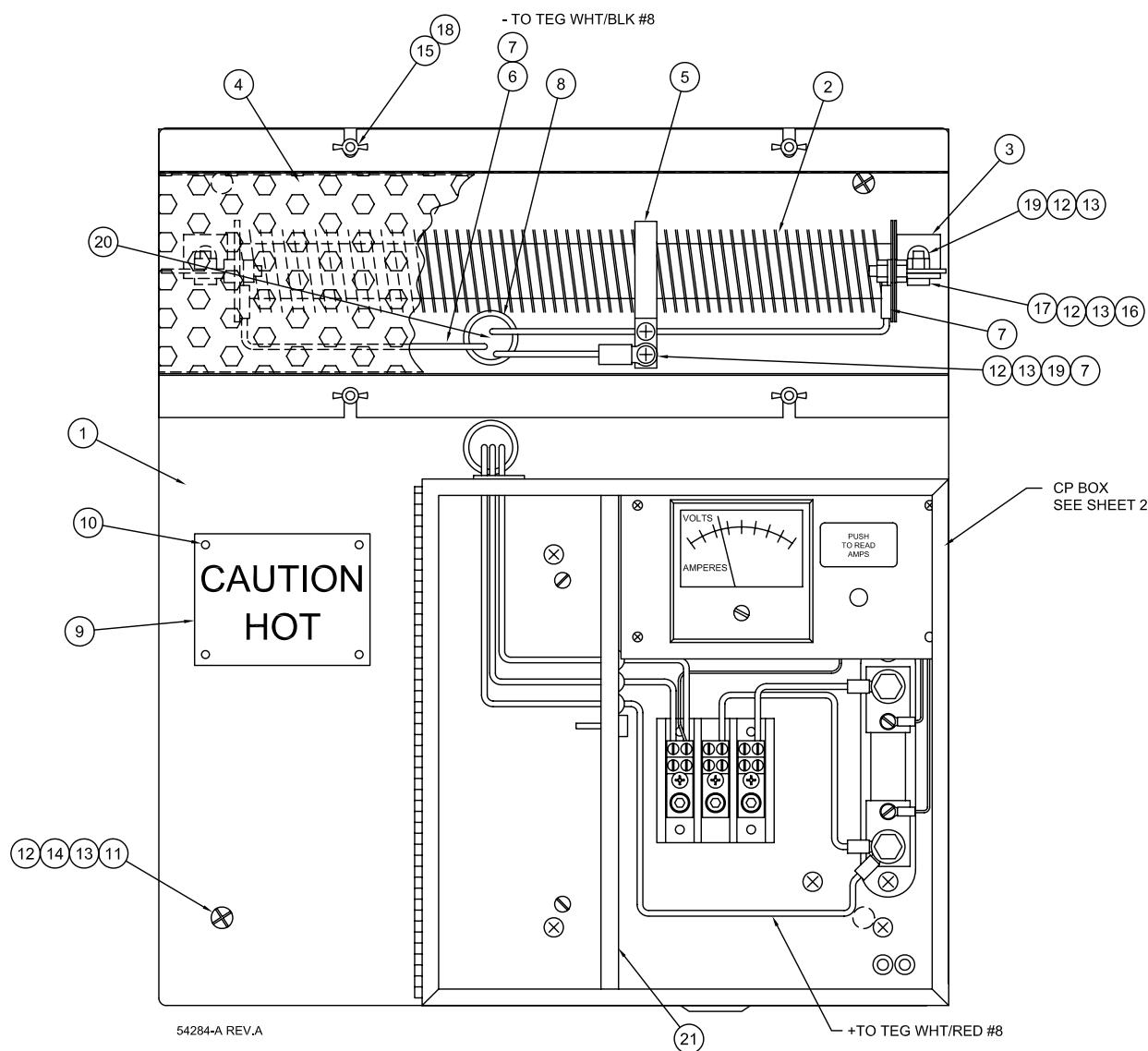


Figure 32 CP Panel Assembly Parts

Item	Part No.	Description	QTY
11	2514-07323	Screw, Mach, P-H-P, 1/4-20 x 1.5	4
12	2714-00611	Nut, Hex, 1/4-20, SS	13
13	2814-00473	Washer, Lock, ext, 1/4, SS	13
14	2814-00557	Washer, Flat, 1/4, SS	4
15	2510-00255	Screw, Mach, P-H-P, 10-32 x 3/8, SS	4
16	2810-00569	Washer, Flat, #10, SS	2
17	2514-00258	Screw, Mach, P-H-P, 1/4-20 x 5/8, SS	2
18	2710-00601	Nut, Wing, 10-32, SS	4
19	2514-00258	Screw, Mach, P-H-P, 1/4-20 x 5/8, SS	3
20	N/A	Cable Tie, 7 3/8 in.	2
21	N/A	Label, Serial Number	1

5.1.8 Parts List, CP Box Assembly

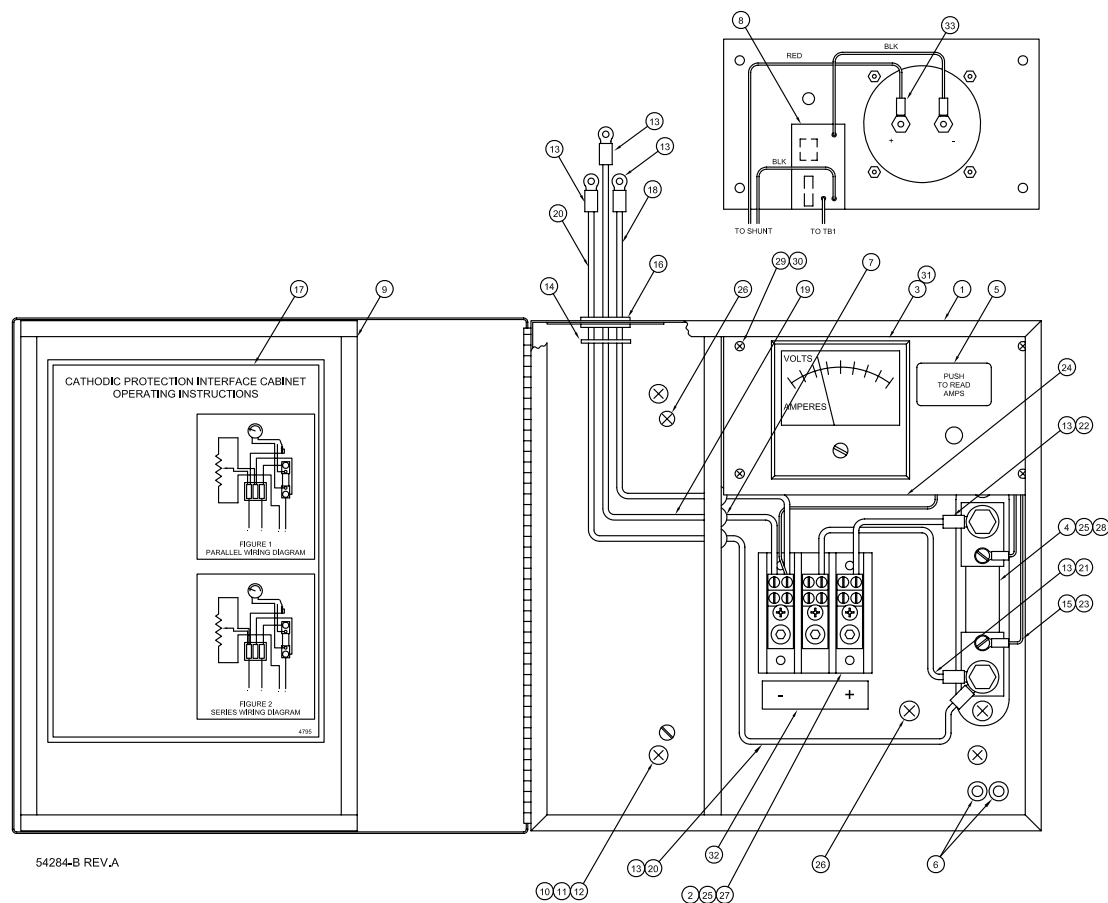


Figure 33 CP Box Assembly Parts

Item	Part No.	Description	QTY
1	4900-06634	Box, 8550 CP	1
2	2200-01815	Terminal Block, Heavy Duty, 3 Pole	1
3	2420-05211	Meter, 0-30V, 0-30A	1
4	2400-06217	Shunt, Type 766, 30 Amp, 50mV	1
5	3600-01931	Label, Push to Read Amps	1
6	2900-03192	Plug, Bumper	3
7	2900-00023	Grommet, Rubber, 7/16"	3
8	2400-02284	CP Meter Assy	1
9	1600-01852	Weather Stripping, 3/8" x 1/8" thk	39
10	2514-03094	Screw, Cap, Hex-hd, 1/4-20 x 3/4 SS	4
11	2814-00473	Washer, Lock, ext, 1/4, SS	8
12	2714-00611	Nut, Hex, 1/4-20, SS	2
13	2010-02584	Term, Ring, Red #8 Wire, 1/4 Stud, PV8-14R	3
14	N/A	Cable Tie, 7 3/8"	1
15	2010-03600	Term, Ring, Red, #8 Wire, 3/8 Stud, PV8-38RX	3
16	2900-05014	Bushing, Universal, 1"	1

5.1.8 Parts List, CP Box Assembly

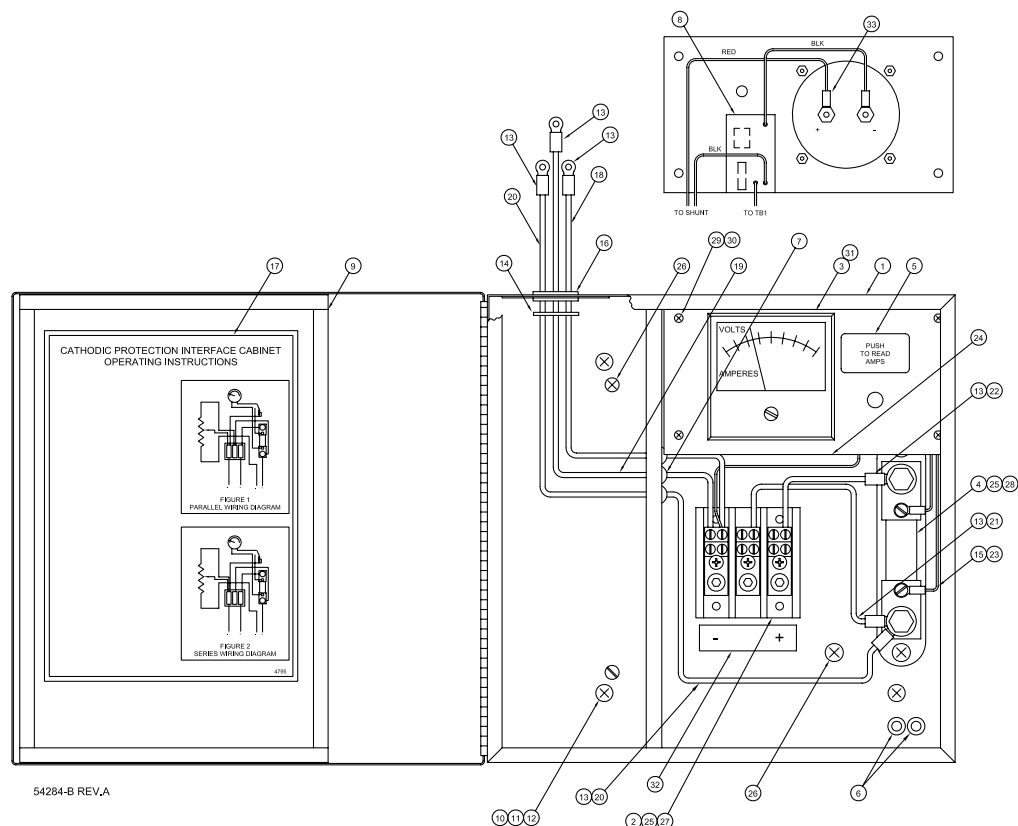


Figure 33 CP Box Assembly Parts

Item	Part No.	Description	QTY
17	3600-04795	Label, CP Interface Instructions	1
18	2108-02107	Wire, #8, wht/blk, TIN-PLT-COP	28
19	2108-02107	Wire, #8, wht/blk, TIN-PLT-COP	27
20	2108-02106	Wire, #8, wht/red, TIN-PLT-COP	44
21	2108-02106	Wire, #8, wht/red, TIN-PLT-COP	8
22	2108-02106	Wire, #8, wht/red, TIN-PLT-COP	6
23	2120-00133	Wire #20, red, TIN-PLT-COP	11
24	4900-02134	Meter Panel, CP, Brushed	1
25	2510-00256	Screw, Mach, P-H-P, 10-32 X 1/2, SS	6
26	2510-00255	Screw, Mach, P-H-P, 10-32 X 3/8, SS	8
27	2810-00469	Washer, Lock, INT, #10, SS	4
28	2810-00539	Washer, Lock, Spring, #10 CAD	2
29	2508-00254	Screw, Mach, P-H-P, 8-32 X 3/8, SS	4
30	2808-00468	Washer, Lock, Int, #8, SS	4
31	2420-06226	Meter Face, 0-15V, 0-30amp	1
32	N/A	Label, Terminal Block	1
33	2010-00204	Term, Ring, Red, #20 wire, 1/4 Stud	1

6 APPENDIX

6.1 Gas Specifications

Gaseous fuels provided to Global Power Technologies' Thermoelectric Generators:⁽¹⁾

1. Shall not contain any particulates larger than 30 μm diameter, including but not limited to sand, dust, gums, crude oil, and impurities.
2. Shall not have a hydrocarbon dew point in excess of 0°C (32°F) at 170 kPa_g (25 psi_g).
3. Shall not contain more than 115 mg/Sm³ ⁽²⁾ (approx. 170 ppm) of H₂S.
4. Shall not contain more than 60 mg/Sm³ (approx. 88 ppm) of Mercaptan Sulphur.
5. Shall not contain more than 200 mg/Sm³ (approx. 294 ppm) of total Sulphur.
6. Shall not contain more than 10% [CO₂] and/or [N₂] by volume, nor vary more than +/- 1% [CO₂] and/or [N₂] during operation.
7. Shall not contain more than 120 mg/Sm³ of water vapour.
8. Shall not contain more than 1% by volume of free oxygen.
9. Shall have a nominal gross heating value of:

Natural Gas:	37 MJ/Sm ³ (1000 BTU/cu.ft.) ⁽¹⁾
Propane/LPG:	93 MJ/Sm ³ (2500 BTU/cu.ft.) ⁽¹⁾
Butane:	108 MJ/Sm ³ (2900 BTU/cu.ft.) ⁽¹⁾
10. Shall not exceed 60°C (140°F) in temperature.

Notes:

(1) - For gaseous fuels outside of these specifications, please contact Global Power Technologies.

(2) - Sm³ = Standard cubic meter of gas at 101.325 kPa at 20°C (NIST).

6.2 8550 Performance Log

[illegible]

6.2 8550 Performance Log

[illegible]