Remote Start Electronics with TEG Charge Controller

Operating Manual

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Remote Start Quick Start Procedure

Following the field wiring (section 5.2) and the temperature sensor (section 4.2) installation:

- Turn on the gas supply to the TEG
- Switch the Local/Remote switch to LOCAL position
- Toggle the Start switch
- The spark ignition system (SI) should begin sparking and the fuel will start flowing
- The sound of combustion should be heard within 7 seconds
- If combustion is not successful after three ignition attempts, wait for the DC PWR and SI PWR lights on the TCC board to turn off, then toggle the start switch again
- Refer to the standard TEG operating manual for SETUP jumper position and instructions to configuring the TEG for Vset
- When TEG Vset setup is completed, return the TEG to running configuration: jumper in RUN
- Refer to section 8.1 Electronics Setup for instructions to configure the TEG On value, TEG Off value and Limiter/Converter (L/C) Output Voltage value

  NOTE: The L/C output MUST be configured on-site for the specific application

- Refer to the standard TEG operating manual for the customer load connection and connect the customer load / battery charge wiring
- Return the Local/Remote switch to REMOTE position

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i ATTENTION

This manual covers the special features of the remote start model 5060, 5120 or 5220 TEG. The operation instructions in this section supersede instructions in the standard thermoelectric generator operation manual where differences are present.

Throughout the manual there will be paragraphs proceeded by the text **WARNING**. It is imperative that the advice be adhered to, as failure to do so may result in personal injury and/or damage to the equipment.

1 INTRODUCTION

The purpose of this Remote Start option is to provide automatic start and stop control of the models 5060, 5120 and 5220 TEGS based of battery voltage sensing, as well as safe remote and local starting and stopping of the TEG, in nominal 12V systems or 24V systems. A spark ignition board constantly monitors the presence of the TEG's combustion flame and relays this information to the TEG Charge Controller (TCC) board. Control of the TEG can be either by a signal from the customer's Supervisory Control and Data Acquisition System (SCADA), the battery voltage sensing, or by the manual switches located on the TCC board.

The included temperature sensor measures the temperature of the battery when it is mounted to one of the battery posts and the TCC board uses this reading to temperature compensate the automatic charging voltage by stopping the TEG at the compensated value.

Temperature compensation is required because of the large range of temperatures the batteries are exposed to. Typically, battery charging voltages are given assuming the temperature is 25ºC. Any deviation below this temperature will mean the batteries are not fully charged if the same upper charging limit is maintained resulting in reduced battery capacity. Any deviation above 25ºC can overcharge the battery resulting in permanent battery damage.

To avoid this, the temperature of the battery is measured and the effective battery charge limits are adjusted. The TEG On voltage will not change with temperature. The TEG Off voltage will be temperature compensated from 25 ºC at a rate of 5.5 mV/(ºC) per battery cell. On a 12V system, this equates to 0.033 V/ºC. On a 24V system, this equates to 0.066 V/ºC.

2 MAJOR DIFFERENCES FROM STANDARD TEGs

The remote start TEG has a few differences from the standard TEG, which are listed below:

- Addition of a second enclosure containing the remote start electronics
- On applicable TEG models, the SOV is replaced with a system voltage dependent solenoid controlled by the spark ignition (SI) board within the remote start electronics
- The standard electrode is replaced with a electrode required by the SI
- The burner assembly is different to accommodate the replacement electrode
- A second pressure switch is added to the fuel system to provide a fuel pressure SCADA signal.
- The standard exhaust stack assembly is replaced with a rain cap exhaust stac assembly
- TEG Cabinet and legs are different to accommodate the additional enclosure

3 IDENTIFICATION

3.1 Remote Start Box

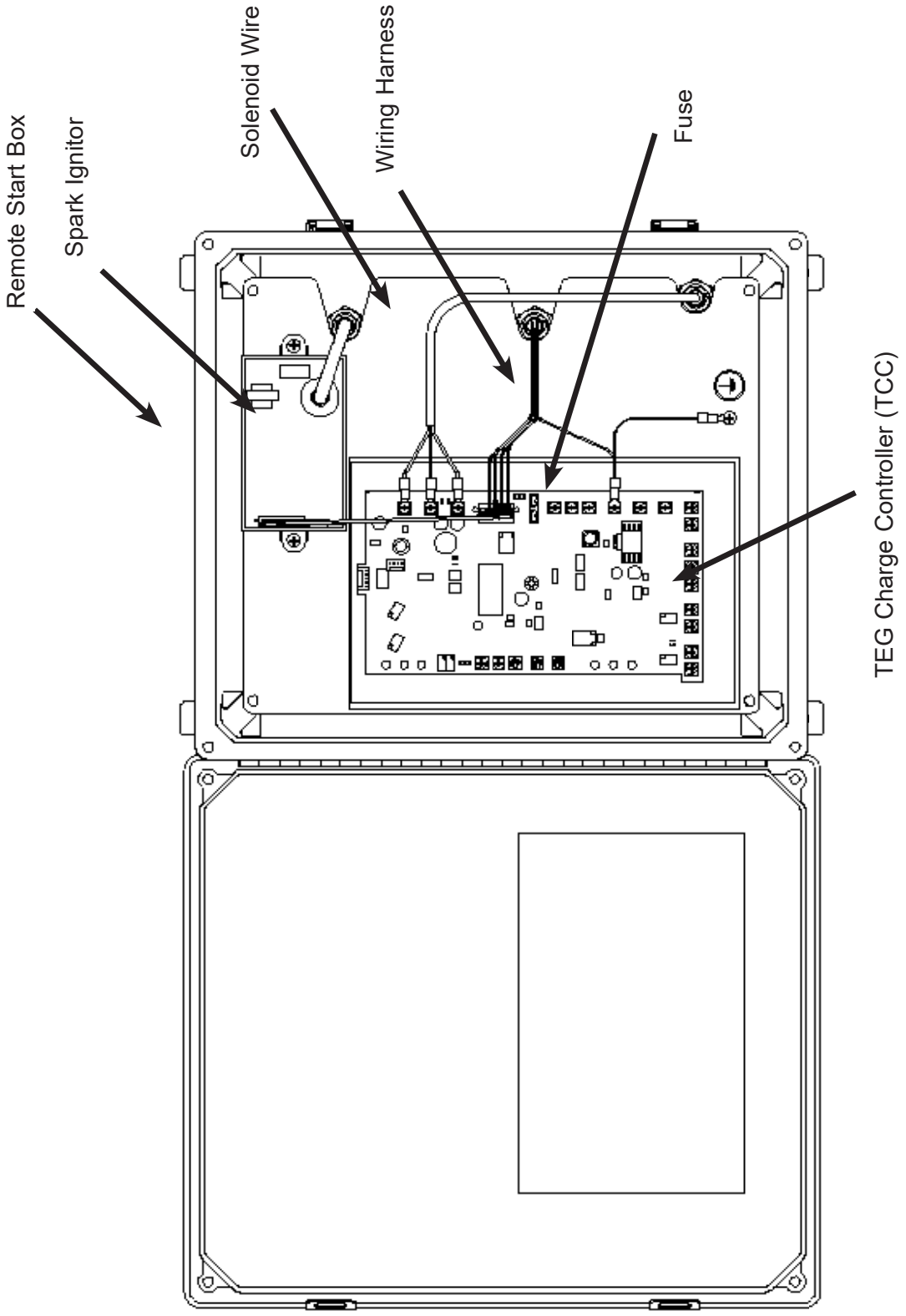

Figure 1 Remote Start Box

3.2 TCC Board

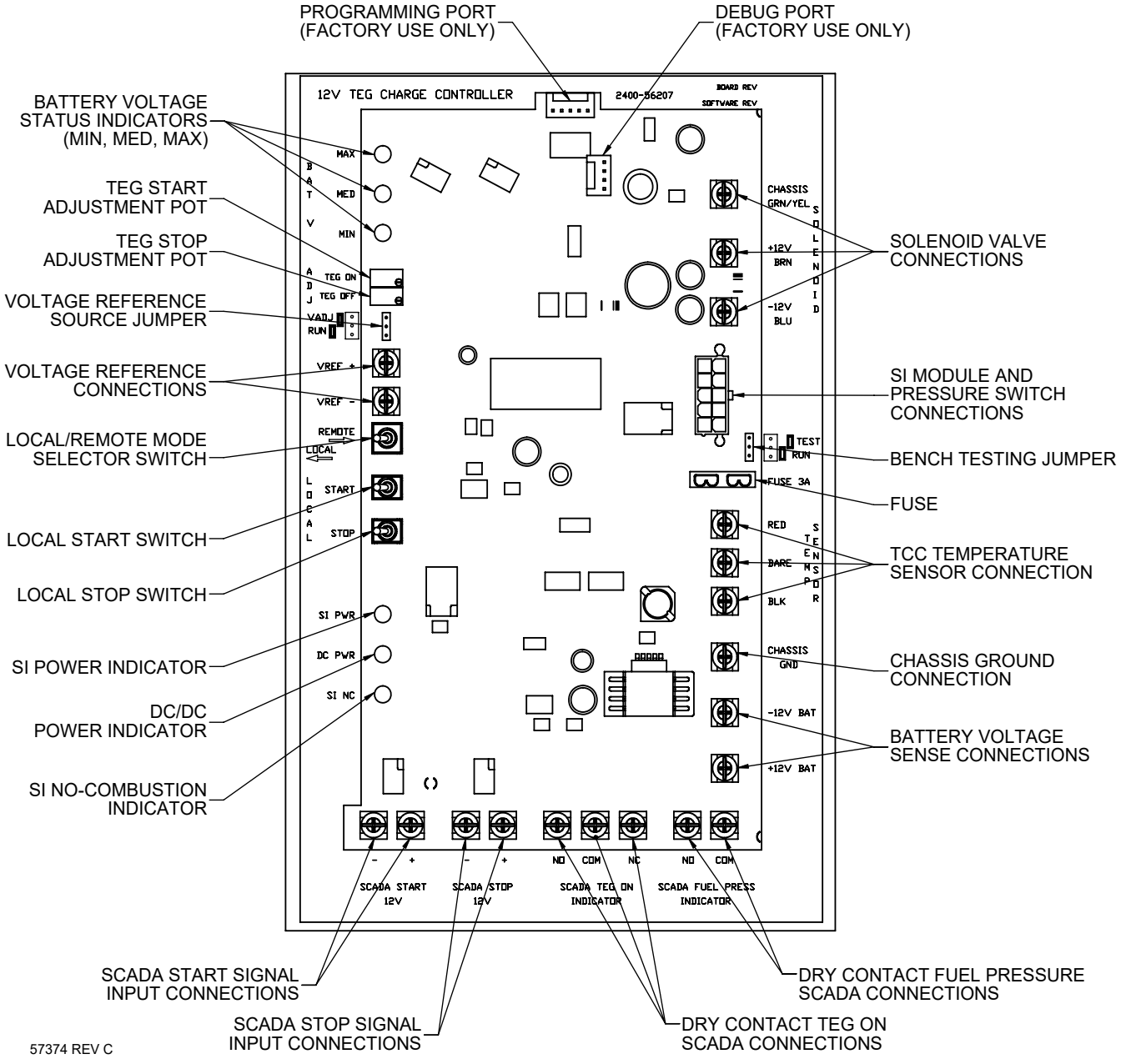

Figure 2 TEG Charge Controller

4 INSTALLATION

4.1 Electronics Installation

The Remote Start box is factory mounted on the left side of the cabinet (on the opposite side of the limiter or L/C electronics).

4.2 Temperature Sensor

The temperature sensor is to be installed on site, in the battery enclosure on one of the battery terminals.

Figure 3 Example of the Temperature Sensor Mounted to a Single Battery

5 WIRING

Some of the wiring is factory installed, and some of the wiring is required to be field installed. All SCADA wiring is to be supplied and installed by the customer, as needed.

Figure 4 on page 5.4 is for 5060/5120-12V systems
Figure 5 on page 5.5 is for 5060/5120-24V systems
Figure 6 on page 5.6 is for 5220-12V systems
Figure 7 on page 5.7 is for 5220-24V systems

5.1 Factory Installed Wiring

Solenoid Wiring
3 conductor wire 18 AWG Silflex wire is factory installed from the TCC board to the solenoid in the TEG cabinet.

The solenoid receives power through the battery voltage sensing wires, when the SI module is powered and requiring the solenoid valve to be operational.

10-position Connector Wiring
Consists of a wiring harness that is factory installed from the TCC board to the SI module and to the pressure switches inside the TEG cabinet

Four wires are connected to the SI module: two are power to the module, one is the valve control signal, and one is a no-combustion signal.

Two sets of two wires are connected to the two pressure switches. One pressure switch is used as a SCADA indicator of fuel pressure. The second pressure switch is a switch connecting the battery power to the TCC board to allow operation when fuel is present

Ground Wire
Single green wire is factory installed from the TCC board to the ground bus on the backpan within the control box

The ground wire is required for the spark return path, from generated spark connected to the electrode in the TEG burner assembly, to the DC/DC converter powering the SI module

SI Cable
The high energy spark ignition cable is factory installed from the SI board in the remote start box to the electrode in the TEG cabinet.

5.2 Field Installed Wiring

Battery Voltage Sense Wiring
Two wires are field installed from the TCC board to the batteries within the battery enclosure.

These wires are used to power the TCC board and to accurately measure the battery voltage at the battery.

The input voltage range is 11 – 16.5 Vdc, with an approximate 0.3A draw for a nominal 12V system. The input voltage range is 22 – 32 Vdc, with an approximate 0.6A draw for a nominal 24V system.

Temperature Sensor Wiring
3 conductor temperature sensor wiring harness is to be cut to length and installed in the field.

Trim back about one inch of the outer sheath of the wiring harness; be careful not to cut into any of the inner wire insulation. Install the fork terminals onto the ends of each wire. The bare drain wire does not have covering insulation.

The temperature sensor harness is terminated with a female quick connect plug that mates to the male quick connect plug installed on the temperature sensor.

Voltage Reference Connection Wiring
No wires are permanently wired to these connections during standard operation.

The voltage reference connection is used to set the TEG On and non-temperature compensated TEG Off values, either on the bench or in the field. This is a temporarily wired connection for adjustment only.

NOTE: Customer Load / Battery Charge Wiring
Refer to the standard TEG operating manual for locating the Customer Load connection. The battery charge wiring is connected to this location using appropriate gauge of wire. Wire gauge is dependent on ampacity, physical installation and distance to load/battery affecting voltage drop across length of wiring.

5.3 Optional SCADA Wiring

SCADA wiring is customer supplied and installed in the field

SCADA Start Wiring

Polarity sensitive wiring from the SCADA Start connections on the TCC board to the SCADA system; Supply a momentary nominal system voltage to the connections to activate the on-board relay, which signals a SCADA start request when the Local/Remote switch is in Remote position. Current draw is less than 20mAdc

SCADA Stop Wiring

Polarity sensitive wiring from the SCADA Stop connections on the TCC board to the to SCADA system; Supply a momentary nominal system voltage to the connections to activate the on-board relay, which signals a SCADA stop request when the Local/Remote switch is in Remote position. Current draw is less than 20mAdc

SCADA TEG On Wiring

Dry contact connection from the SCADA TEG On Indicator Connections on the TCC board to SCADA system: Normally open, normally closed and common connection provided, allowing the SCADA system to read when the TEG has been requested to start. Maximum switching current rating through relay contacts: 2Adc resistive load (maximum power - 60W)

SCADA Fuel Pressure Wiring

Dry contact connection from the SCADA Fuel Pressure Indicator Connections on the TCC board to the SCADA system, through the Hobbs Pressure Switch: Normally open and common connection provided, allowing the SCADA system to read when the pressure switch is closed. Maximum switching current rating through pressure switch: 8Adc – 12Vdc, 4Adc – 24Vdc resistive load.

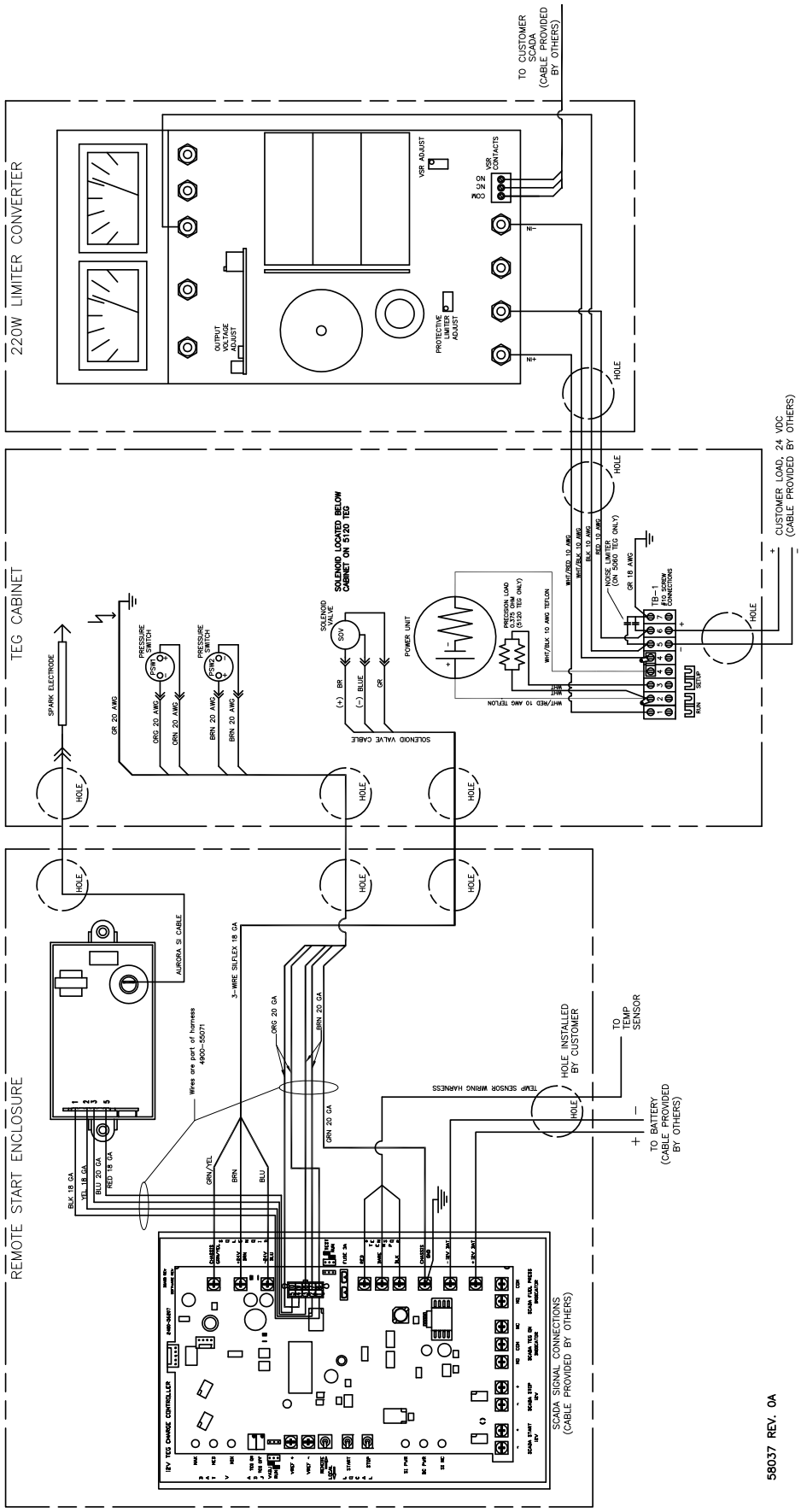

Figure 4 5060 / 5120 - 12V System Wiring

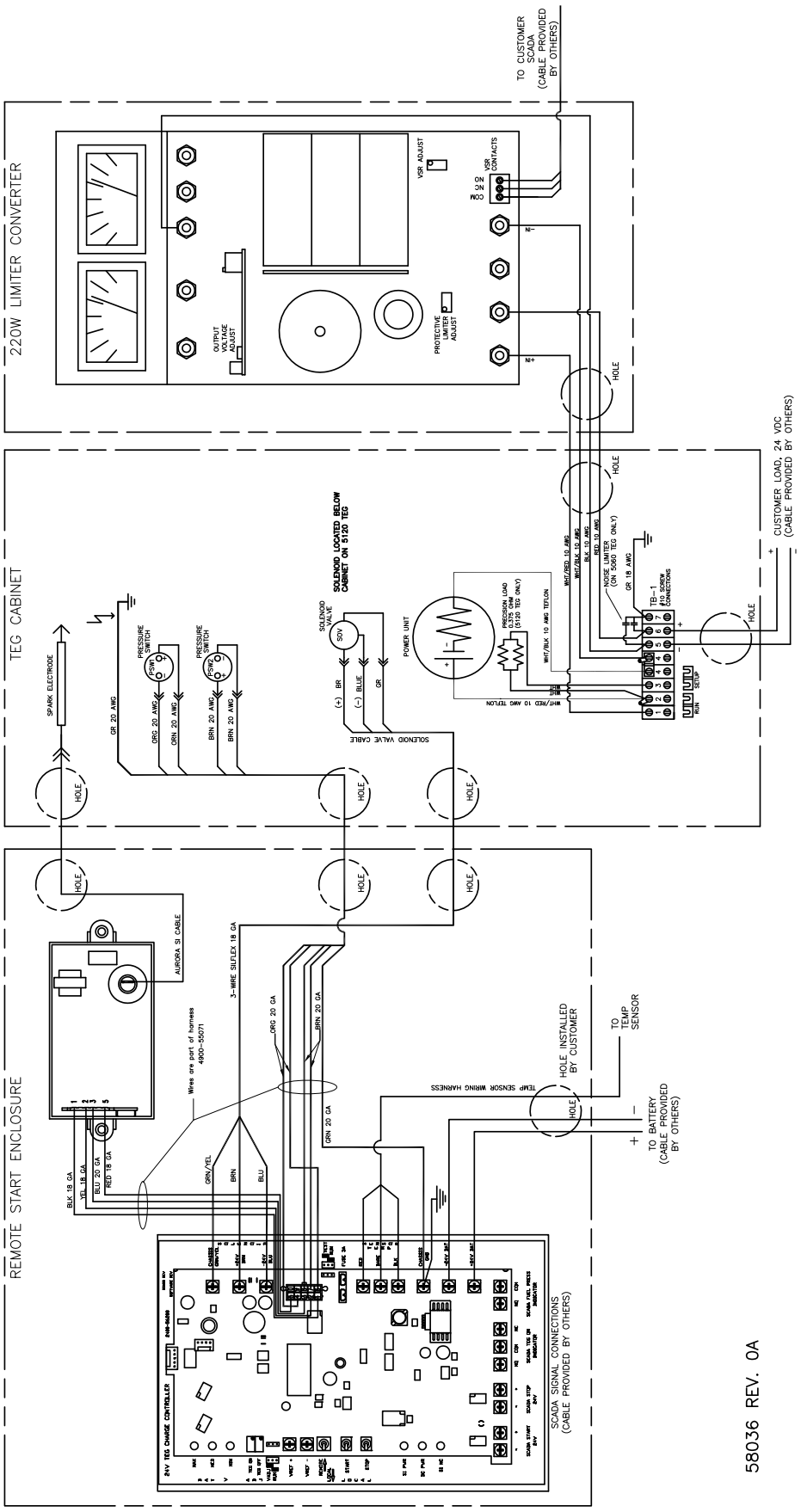

Figure 5 5060 / 5120 - 24V System Wiring

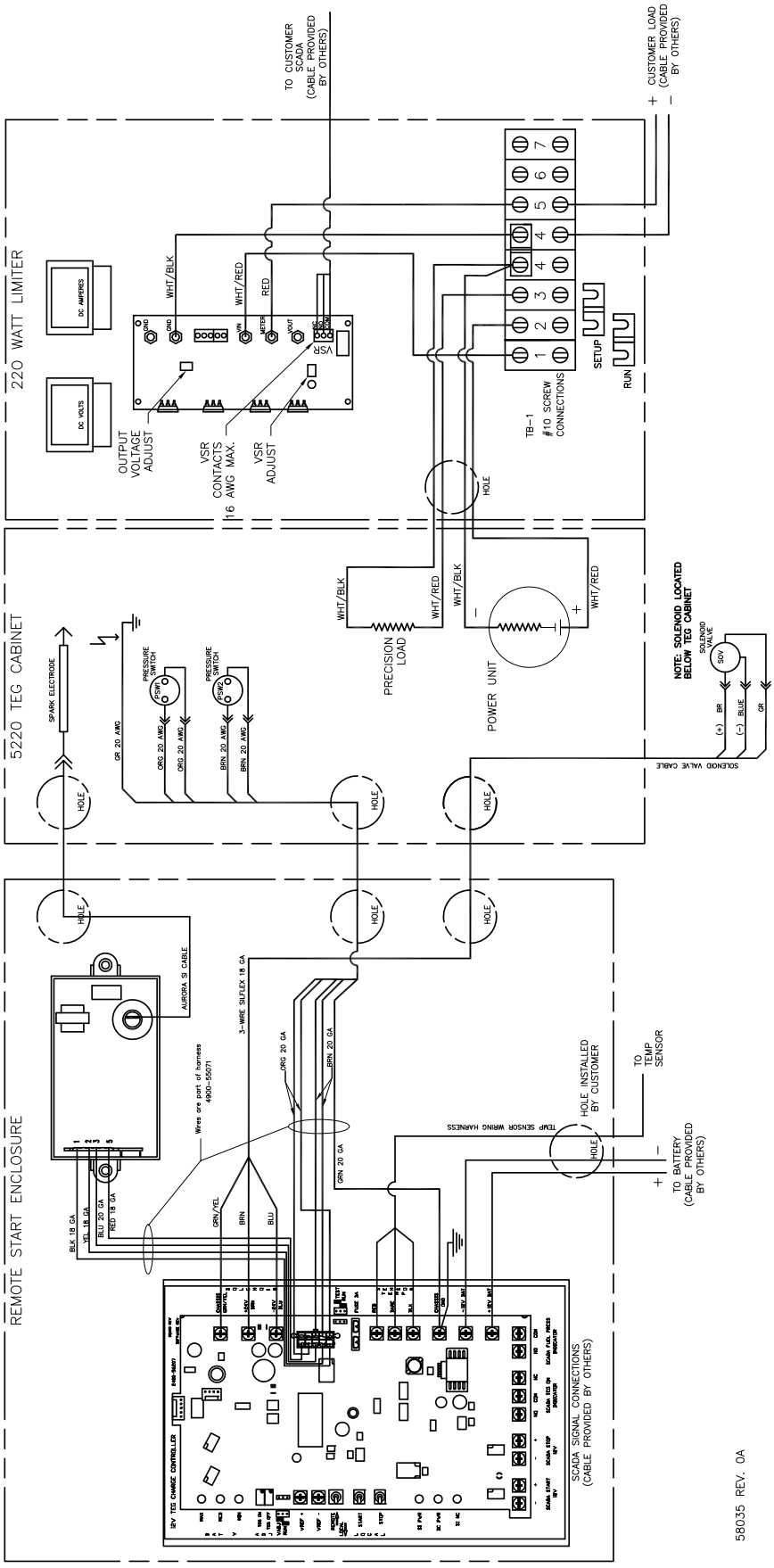

Figure 6 5220 - 12V System Wiring

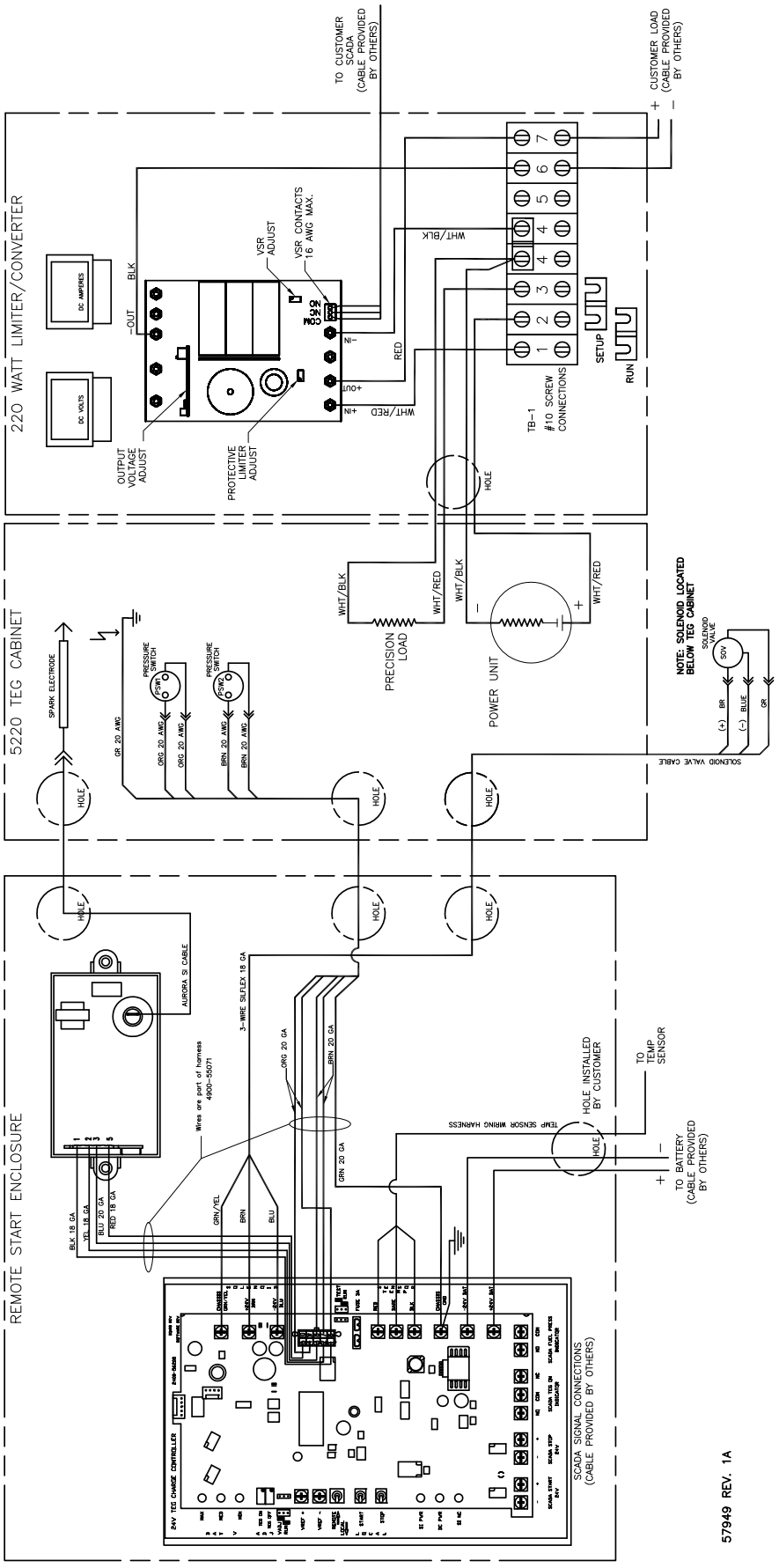

Figure 7 5220 - 24V System Wiring

6 INDICATORS

All of the indicators are located on the TCC board and are described below (See Figure 2).

6.1 Battery Voltage Status Indicators

Three green LED's, located in the top left hand corner of the board, are used to indicate the battery voltage. Only one light is on at a time.

MIN LED: when the battery voltage is at or below the TEG On value set within the TCC, only the MIN light is on. When the system is set to Remote mode, the MIN led is also the voltage sensing start signal, used to start the TEG

MED LED: when the battery voltage is in between the TEG On and the TEG Off values, only the MED light is on. This indicates that the battery voltage is between the charging and discharging voltages

MAX LED: when the battery voltage is at or above the TEG Off value set within the TCC, only the MAX light is on. When the system is set to Remote mode, the MAX led is also the voltage sensing stop signal, used to stop the TEG.

6.2 SI Power Indicator (SI PWR)

One green LED, top light in the set of lights located in the lower left hand corner of the board, is used to indicate when the spark ignitor (SI) module is being powered from the TCC board.

6.3 DC/DC Power Indicator (DC PWR)

One green LED, middle light in the set of lights located in the lower left hand corner of the board, is used to indicate when the internal DC/DC converter is being powered by the TCC board.

6.4 SI No-Combustion Indicator (SI NC)

One red LED, bottom light in the set of lights located in the lower left hand corner of the board, is used to display the no-combustion signal received from the SI module.

NOTE: The no-combustion signal is related to the functionality of the spark-ignitor; see Section 8.6 for more information.

7 SETTINGS / ADJUSTMENTS

In addition to adjustments listed for the limiter/converter or limiter electronics, listed in the standard manual, the remote start adjustments are all located on the TCC board and are described below (See Figure 2).

7.1 Voltage Reference Source Jumper

The jumper is located on the left hand side, near the middle of the TCC board.

There are two positions: RUN and VADJ

- RUN position uses the battery voltage, connected at the lower right hand corner of the board to display the battery voltage status on the light and to start and stop the TEG when running in Remote mode. This is the position the jumper needs to be in for operation

- VADJ position uses the reference voltage connected at the VREF connectors, located below the jumper, to display its voltage on the status lights. The purpose of this jumper position is to use an alternate adjustable power source to make changes to the TEG ON and TEG OFF voltages. The Local/Remote switch should be in the Local position when using the VADJ position, since theconnected voltage affects the voltage sensing on and off signals controlling the starting and stopping of the TEG.

When the jumper is removed, the battery voltage status lights will turn off. When the jumper is re-installed, wait 10 seconds to allow the internal programming to finish initializing, before using the battery voltage status lights as indicators

7.2 Bench Testing Jumper

The jumper is located on the right hand side, near the middle of the board by the fuse and 10-position connector.

There are two positions: RUN and TEST

- RUN position uses the system fuel pressure switch to connect the power from the battery to the remainder of the board. This is the position the jumper needs to be in for operation

- TEST position is for bench testing purposes. When the jumper is in the TEST position, it bypasses the pressure switch and makes the connection on the board allowing the board to be configured on the bench

7.3 Enable / Disable Temperature Compensation

Temperature compensation is enabled when the temperature sensor is connected to the TCC board. The temperature sensor comes with a short length of wires and a plug. The plug attaches to a temperature sensor extension cable which takes the signal from the temperature sensor to the TCC board

To disable temperature compensation on the TCC board, one must either disconnect the plug between the temperature sensor and the extension cable or disconnect the temperature sensor extension cable where it connects to the TCC board. Unbolting the temperature sensor from the battery WILL NOT work as the sensor will pick up the air temperature and compensate for it.

WARNING: The temperature sensor should always be installed and connected to the TCC board. Disconnecting the temperature sensor will cause the system to not operate as intended and can cause harm to the batteries.

7.4 TEG On/Off Value - In-Field Adjustment Using the TEG

WARNING: The following procedure uses live circuits. Take extreme care when making or breaking the jumper connections, as touching other connections may damage multiple components.

Equipment required:
Voltmeter, small flat blade screwdriver, two wires (minimum 20 AWG, 48in (122 cm) length each) to connect the Customer Load output connection to the Vref connections on the TCC board

Figure 8 on page 7.4 is for 5060/5120-12V or 24V systems
Figure 9 on page 7.5 is for 5220-12V systems
Figure 10 on page 7.6 is for 5220-24V systems

1. To make adjustments to the TEG OFF voltages, the temperature compensation must be disabled, by disconnecting the temperature sensor from the TCC board
2. Disconnect the customer load from the terminal strip. The terminal strip is either located inside the TEG cabinet on 5060/5120 models, or inside the electronics on the right hand side of the TEG on 5220 models
2. Switch the Local/Remote switch on the TCC board to Local position
3. If the TEG is running, skip to step 6
4. If the TEG is not running, press and release the Local Start switch. The TEG will begin its ignition sequence
5. If the TEG was just started, allow the TEG to run for a minimum of 15 minutes without the load to allow the TEG to start generating enough power for the converter to output a voltage
6. Carefully connect jumper wires from the Customer Load output connections (located on the terminal strip) to the TCC VREF connections.
7. Move the Voltage Reference Source Jumper from the RUN position to the VADJ position. Wait 10 seconds to allow the internal programming to finish initializing.

8. Record the operating value for the L/C output voltage prior to making any adjustments. This value will be used to reset the output voltage after the adjustments are complete.
9. Use the Output Voltage Adjustment Pot on the L/C board or limiter board to vary the voltage source to the desired value for setting either the TEG On value or TEG Off value. Monitor this voltage using a voltmeter.
10. See required procedure in section 7.6 and/or section 7.7 for detailed instructions on setting the TEG On or Off value
11. When adjustments are complete, reset the L/C output voltage back to the original value recorded in step 8. See TEG Setup section 8.1 for details on how to determine the L/C output voltage value.
12. Follow the steps under “Restore Operating Mode”, Section 7.8

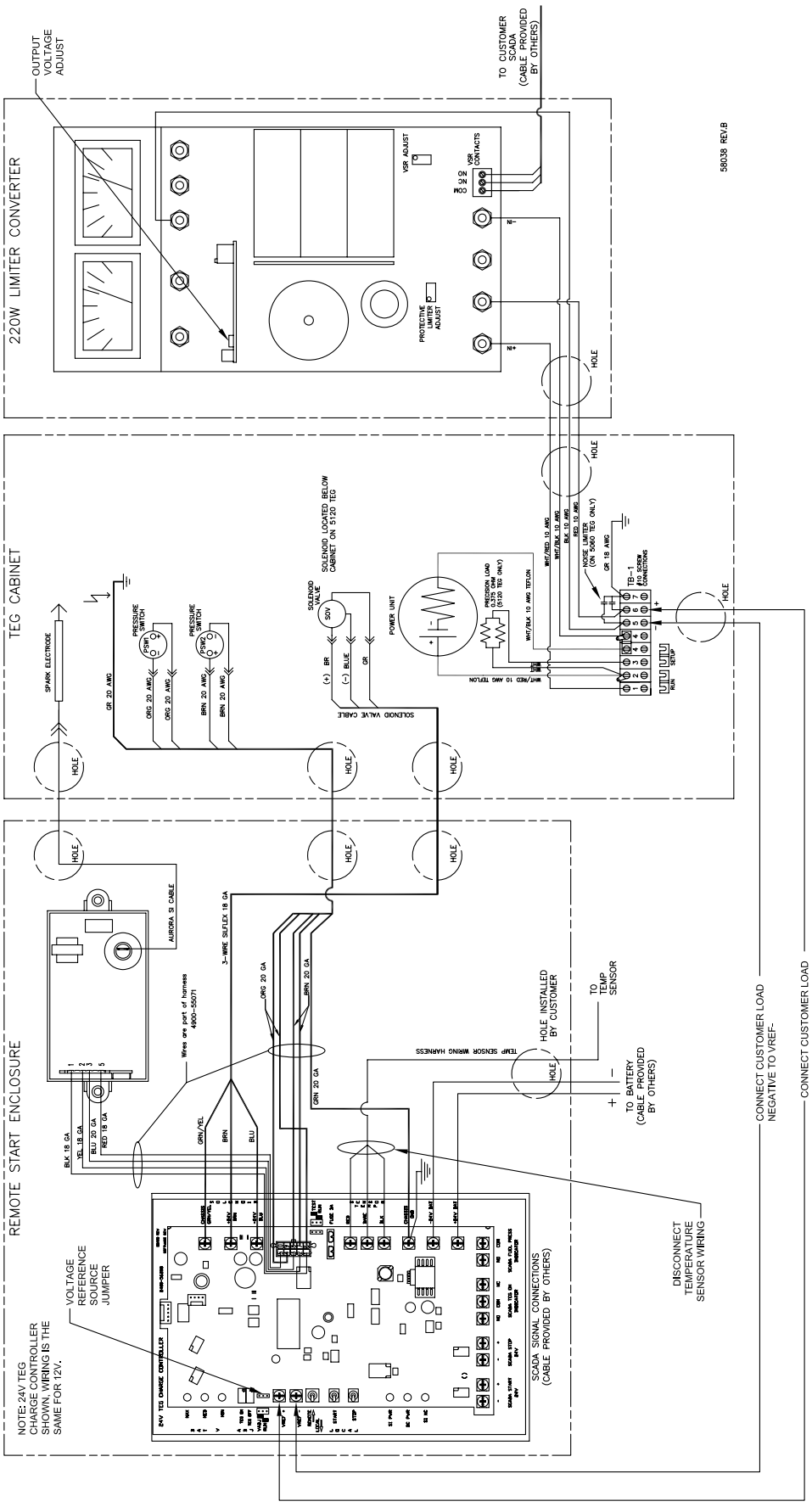

Figure 8 In-Field Adjustment - 5060 / 5120 Systems

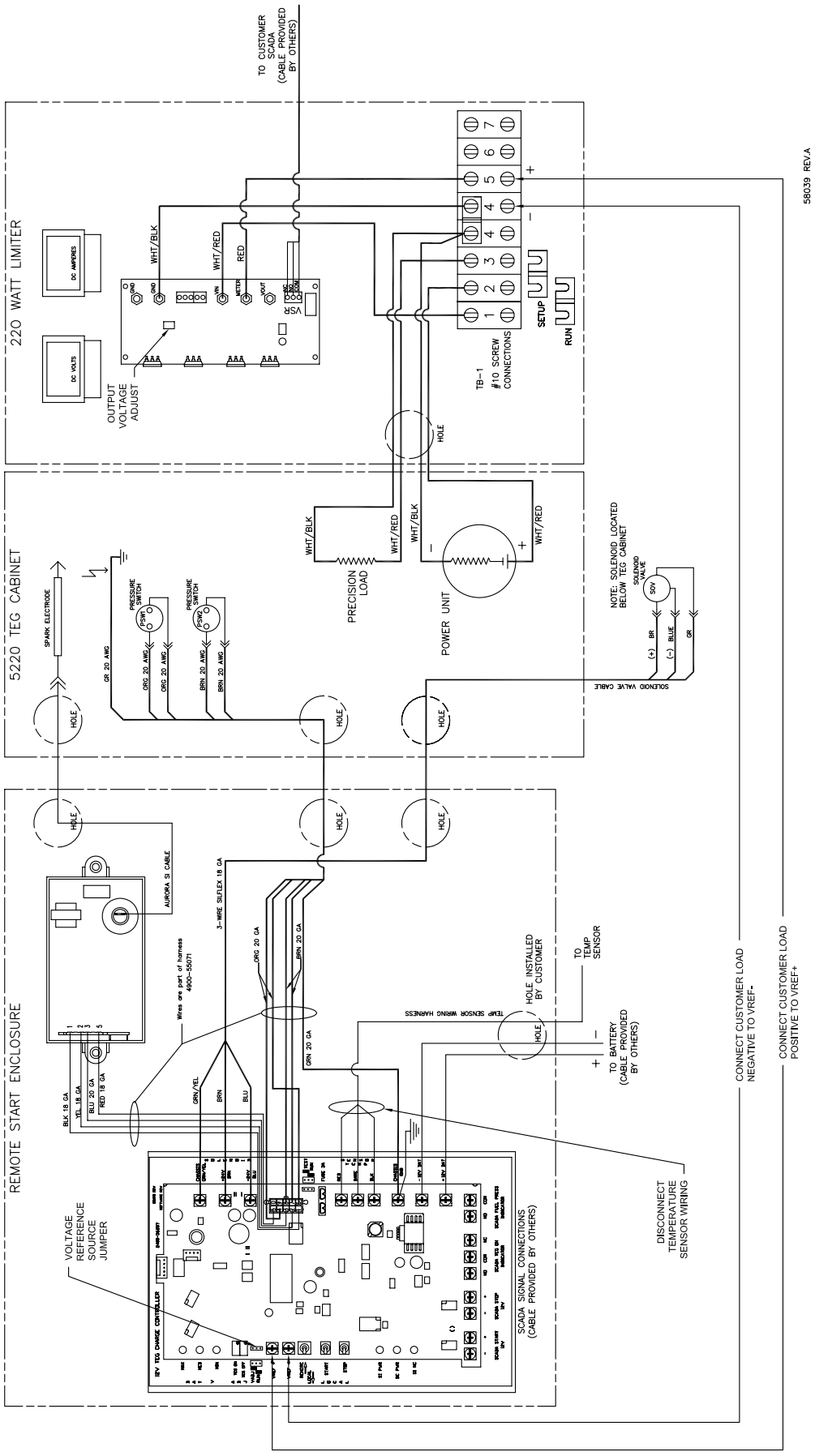

Figure 9 In-Field Adjustment - 5220 - 12V Systems

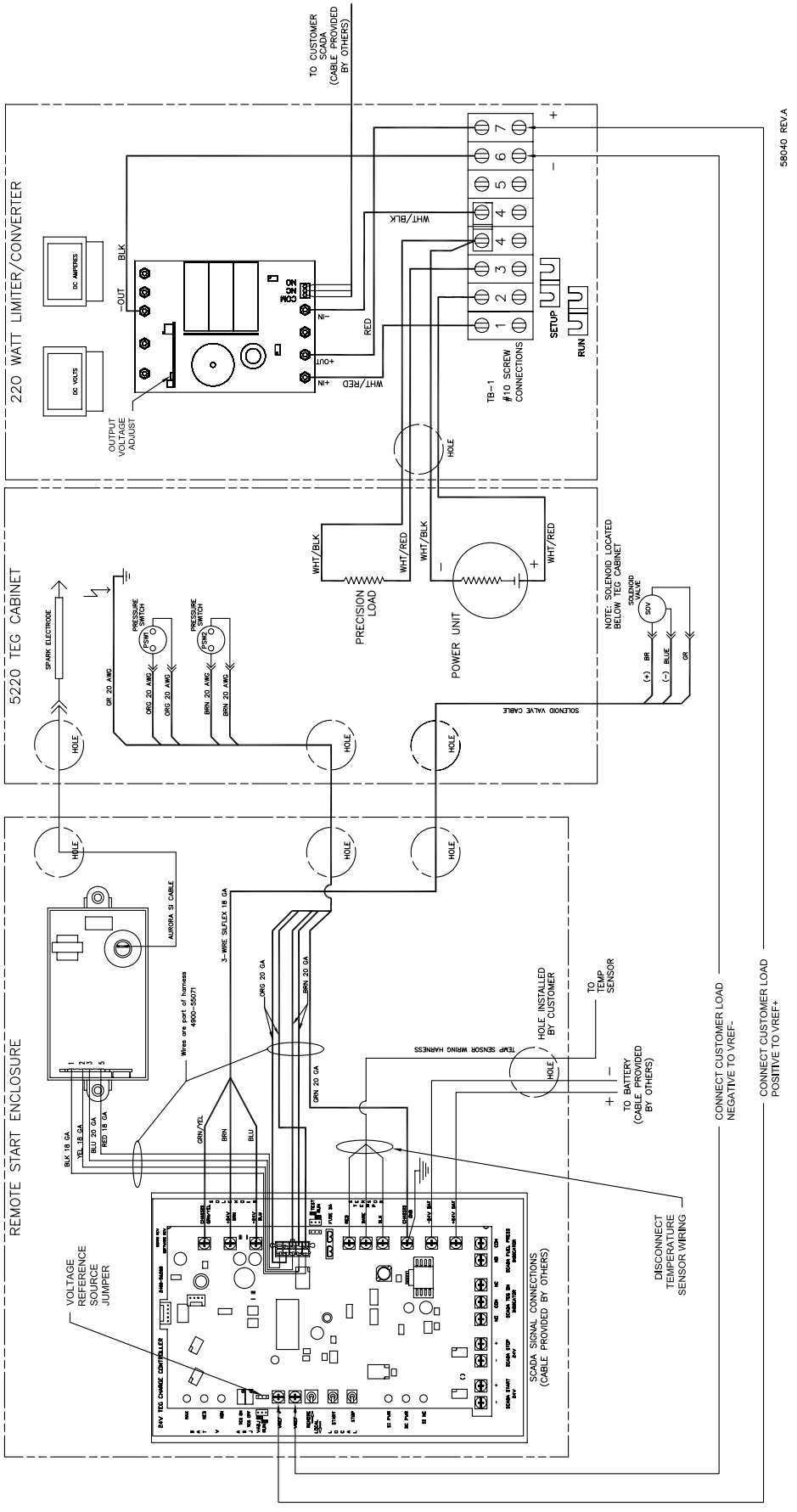

Figure 10 In-Field Adjustment - 5220 - 24V Systems

7.5 TEG On/Off Value - Bench Adjustment

Equipment required: Voltmeter, 30Vdc 1Adc power supply, small flat blade screwdriver

To make adjustments to the TEG OFF voltages, the temperature compensation must be disabled, by disconnecting the temperature sensor from the TCC board

1. Switch the Local/Remote switch to the Local position
2. Move the Voltage Reference Source Jumper from the RUN position to the VADJ position
3. Connect the power supply to the VREF
4. Use the power supply voltage to vary the voltage source to the desired value for setting either the TEG On value or TEG Off value
5. See required procedure for detailed instructions

7.6 TEG ON Adjustment

The TEG ON adjustment is setting the voltage that the TEG will start. It is typically a voltage setting where the customer wants the battery charging to begin.

The TEG ON adjustment pot is located on the left hand side, near the top of the TCC board. It is the upper of the two pots and is labeled “TEG ON” (See Figure 2).

1. Set the voltage source to the desired voltage for turning the TEG ON. The boards come set from the factory at 12.2 V for a 12 V system and 24.4 V for a 24 V system.

   Start the adjustments with the MIN LED in the OFF state. If it is lit, turn the adjustment screw on the TEG ON potentiometer counter clockwise unit it goes off.

2. Turn the adjusting screw on the TEG ON potentiometer clockwise until the MIN LED lights. You can repeat this several times to get comfortable with how fast (slow) to turn the pot to get the LED to light.

   Once set, the adjustment can now be verified by adjusting the voltage source. Start by adjusting the voltage source so the MIN LED is off. Reduce the voltage on the voltage source until the MIN LED lights up and determine if your setting is correct.

7.7 TEG OFF Adjustment

The TEG OFF adjustment is setting the voltage that the TEG will stop. It is typically a voltage setting where the customer wants the battery charging to end. To adjust this value, the temperature compensation must be disabled, by disconnecting the temperature sensor. This voltage is set using the charging voltage based on 25ºC, without temperature compensation.

The TEG OFF adjustment pot is located on the left hand side, near the top of the TCC board. It is the lower of the two pots and is labeled “TEG OFF” (See Figure 2).

1. Set the voltage source to the desired voltage for turning the TEG OFF. The boards come set from the factory at 13.6 V for a 12 V system and 27.2 V for a 24V system.

   Start the adjustments with the MAX LED in the OFF state. If it is lit, turn the adjustment screw on the TEG OFF potentiometer clockwise unit it goes off.

2. Turn the adjusting screw on the TEG ON potentiometer counter clockwise until the MAX LED lights. You can repeat this several times to get comfortable with how fast (slow) to turn the pot to get the LED to light.

Once set, the adjustment can now be verified by adjusting the voltage source. Start by adjusting the voltage source so the MAX LED is off. Increase the voltage on the voltage source until the MAX LED lights up and determine if your setting is correct.

7.8 Restore Operating Mode

Following the adjustments, return the unit to operating mode:

1) Remove the voltage source from the VREF terminals

WARNING: If the adjustments were made in the field, the wires connected to the L/C board are live when the TEG is hot.

2) Replace the Voltage Reference Source jumper from ADJ to RUN position
3) Reconnect the temperature sensor
4) Switch the Local/Remote switch to the Remote position.
   Following an in-field adjustment, this may turn off the TEG if the battery voltage is at or above the compensated TEG Off value.
5) If the adjustments were made in the field using the TEG, reconnect the load by connecting it to the terminal strip

8 OPERATION

For normal operation:

- the voltage reference source jumper needs to be in the RUN position
- the bench testing jumper needs to be in the RUN position
- the limiter/converter electronics or limiter electronics output voltage must be adjusted for the application and the operation mode (Local or Remote). See the TEG Setup section 8.1 below for details

For automatic remote operation:

- the Local/Remote switch needs to be in the Remote position

WARNING: The temperature sensor should always be installed and connected to the TCC board. Disconnecting the temperature sensor will cause to system to not operate as intended and can cause harm to the batteries.

8.1 Electronics Setup

The remote start electronics are set to the following default values at the factory:

Nominal System Voltage	Factory Set TEG On Value (volts)	Factory Set TEG Off Value (volts @ 25ºC)	Factory Set Limiter/Converter Output Value - no load (volts)
12V models: 5060-12 5120-12 5220-12 (Limiter Only)	12.2	13.6	14.1
24V models 5060-24 5120-24 5220-24	24.4	27.2	27.0

8.1.1 TEG On and TEG Off Values

The TEG On value is the voltage that the TEG will start, and is selected to be the minimum voltage the battery should fall to before starting the TEG

The TEG Off value is the voltage that the TEG will stop, and is selected to be the battery charging voltage. The value is set using the non-temperature compensated charging voltage at +25ºC, by referencing the battery specifications. Within the electronics, the temperature sensor measures the temperature of the battery and temperature compensates the TEG Off value.

The factory set TEG On and TEG Off values were selected to maintain a valve regulated lead-acid gelled electrolyte solar battery system between approximately 50% and 80% state of charge in an application where the TEG is a backup power source to a solar system. If the application is different, these values can be changed to the required values based on the components in the system by following the in-field adjustment procedure section 7.4 or the bench adjustment section 7.5.

8.1.2 Limiter/Converter Output Value

The limiter/converter (L/C) electronics or limiter electronics output voltage is set to a default factory value as listed in the table above. It will need to be adjusted depending on the application and operating mode (Local or Remote).

Follow the output voltage adjustment procedure in the standard TEG manual for adjusting the output value for the L/C or limiter. Ensure the adjustment is made with the load or battery disconnected from the customer load connections (no-load setting)

WARNING: Changes to the L/C or limiter output directly affect the output voltage to the load connection, particularly in Local mode.

8.1.2.1 Local Mode – L/C Output

In Local mode, the TEG will run until stopped using the Local Stop switch, and the output voltage will strive to reach the output setting. Set this as required for the load. In a battery charging system, set the L/C output to the charging voltage required by the battery and application; the output voltage will charge the battery up to the output voltage setting.

If the Remote Start electronics is expected to be operated in Local mode, the L/C or limiter electronics output voltage must be set to ensure the output voltage does not cause harm to the load being connected to the output. If the load is a battery, consult the specification of the battery and assess the needs of the application to determine the required output charging setting.

WARNING: The TEG On and TEG Off values do NOT control the operation of the TEG when it is running in Local mode. Temperature compensation is only applied to the TEG Off value and has no effect in Local mode. If the L/C output is set incorrectly, it may cause damage to what is connected on the output.

8.1.2.2 Remote Mode – L/C Output

In Remote mode, the TEG Off value stops the TEG but this requires that the L/C output voltage value be set higher than the TEG Off value to ensure the TEG Off value is reached before the set output voltage, otherwise the TEG will run continuously. The temperature sensor compensates the TEG Off value to reduce over- or under-charging the battery.
To determine the setting for L/C output voltage value, in a battery charging application using the temperature sensor while running in Remote Mode, use the following calculations:

Vout Setting = (Losses) + (TEG Off Value) + (Temp Comp Value)

Temp Comp Value = ∆ Temp * 0.033 V/ºC (for 12V systems)
Temp Comp Value = ∆ Temp * 0.066 V/ºC (for 24V systems)

∆ Temp = 25ºC – Tmin

Where:

Vout Setting = the voltage to set the L/C output with nothing connected to the customer load connections on the terminal strip (located inside the TEG cabinet on 5060/5120 models, or inside the electronics on the right hand side of the TEG on 5220 models)

Losses = losses in the cables connecting the output of the limiter/converter to the battery, plus losses in the on-board reverse protection diode

TEG Off Value = the determined charging voltage (or float voltage) for the batteries being used. Based on the application and as referenced on the battery specification at room temperature with any temperature compensation – typically at 25ºC (volts dc)

Temp Comp Value = value used as part of the calculation to determine the L/C Vout setting. Based on the minimum operating temperature and nominal system voltage (volts dc)

∆Temp = temperature difference between 25ºC (fixed reference temperature) and minimum temperature (degrees Celsius)

Tmin = the minimum temperature where the TEG will be operating (degrees Celsius)

EXAMPLE: The following example is for reference only, to demonstrate the calculations. Recalculate the L/C setting using values for the specific application.

The minimum temperature is determined to be -25ºC
The system is a nominal 24V system
The charging voltage (from the battery specification) is determined to be 27.2V
Losses approximated to be 1.0V (0.7V diode drop, plus very small losses in the cables)
Δ Temp = 25ºC – Tmin
= 25ºC – (-25ºC) = 50ºC

Temp Comp Value = Δ Temp * 0.066 V/ºC (for 24V systems)
= 50º * 0.066
= 3.3 V

Vout Setting = (Losses) + (TEG Off Value) + (Temp Comp Value)
= 1.0 + 27.2 + 3.3
= 31.5 V

Set the no-load L/C output to 31.5Vdc (Remote Mode only)

WARNING: Do not leave the site with the TEG system in Local mode and the TEG running, otherwise the batteries will be over-charged and the TEG will run continuously. The output voltage of the TEG electronics should be set at a higher voltage to allow battery charging up to a higher voltage during colder temperatures. When in remote mode, the TCC board calculates when to stop the TEG based on the temperature compensation and the set TEG Off value, and stops the TEG when that voltage has been reached. This functionality is not part of the Local operating mode

8.1.3 Limitations

Maximum Limiter/Converter output voltage is 36 x 2.5Vdc (24V models). Depending on the requirements of the system, based on the calculations in 8.1.2 for the specific application, the output value calculated may be higher than the maximum possible on some Limiter/Converters. If this occurs, at the cold temperatures the temperature compensated TEG Off value may be higher than the L/C output value. This will cause the TEG to run continuously until the temperature rises enough to cause the temperature compensated TEG Off value to fall below the L/C output.

Maximum 5220-12V Limiter output value is marginally higher than 18 Vdc. The purpose of the limiter is to ensure the TEG does not reach voltages higher than the set value, since higher voltages mean lower currents and hotter temperatures across the TEG which is not desired.

8.2 On-site TEG Operation

8.2.1 TEG Start Up

To start the TEG follow the following steps:

1) Ensure the gas supply is connected to the TEG
2) Switch the Local/Remote switch to the Local position
3) Toggle the Start switch
4) The spark ignition system (SI) should begin sparking and the fuel will start flowing
5) The sound of combustion should be heard within 7 seconds
6) If combustion is not successful after three ignition attempts, wait for the DC PWR and SI PWR lights on the TCC board to turn off, then toggle the start switch again

WARNING: Do not leave the site with the TEG system in Local mode and the TEG running, otherwise the batteries will be over-charged and the TEG will run continuously. The output voltage of the TEG electronics is set at a higher voltage to allow battery charging up to a higher voltage during colder temperatures. When in remote mode, the TCC board calculates when to stop the TEG based on the temperature compensation and the set TEG Off value, and stops the TEG when that voltage has been reached. This functionality is not part of the Local operating mode

7) Switch the Local/Remote switch back to the Remote position. The TEG will keep running until the temperature compensated TEG off value is reached

8.2.2 TEG Shut down

To turn off the TEG, follow one of the following methods:

1) Turn the TEG off using the TCC board:
   a) Switch the Local/Remote switch to the Local position
   b) Toggle the Stop switch
   c) Power will be removed from the spark ignitor, causing the solenoid to close
   d) The TEG will continue to produce power while it is still hot,

2) Turn off the manual gas valve
   a) The combustion will continue until the fuel pressure drops, causing the pressure switches to close.
   b) When the pressure switch closes, the power on the TCC board will be interrupted; this removes power from the spark ignitor and causes the solenoid to close. One pressure switch is used as a switch in-line between the TCC battery voltage connection and the remainder of the board.
   c) When the solenoid closes, a small amount of gas is trapped between the manual gas valve and the solenoid, which is enough to close the pressure switch and TCC board receives power.
   d) The TEG will remain off unless the following situation occurs:

If the Local/Remote switch is in the Remote position, and the MIN battery voltage light is on, the TCC board will attempt to start the TEG. When an ignition sequence is started, the solenoid valve will be opened and the trapped gas will be released. The pressure switch will open and the TCC will lose power

8.3 Automatic Remote operation

When the Local/Remote switch is set to Remote, operation of the remote start electronics is automatic and based on voltages.

The temperature sensor is used to measure the temperature of the battery, and this temperature reading is used to calculate a temperature compensated TEG Off value.

The measured battery voltage is compared to the TEG On and temperature compensated TEG Off values to determine when to start or stop the TEG. When the battery voltage falls to or below the TEG On value, the TEG is started.

When the battery voltage rises to or above the compensated TEG Off value the TEG is stopped. The compensated TEG Off value is based on the battery temperature and the set TEG Off value.

WARNING: If ignition fails after the three attempts by the spark ignitor, it will enter lockout and the system has to be manually reset at site.

8.4 SCADA Remote operation

When the Local/Remote switch is set to Remote, SCADA Start and Stop signals can also be used for TEG control.

When the battery voltage has fallen to or below the automatic voltage start TEG On level, as indicated by the MIN battery voltage indicator, the TEG will be started by the automatic Voltage Start signal, a SCADA Start signal is not required and a SCADA Stop signal is overridden by the Voltage Start signal. After the TEG is started and is delivering power to the battery and load, the automatic Voltage Start signal and the MIN battery voltage indicator will remain on until the battery voltage level raises 0.5V in a nominal 12V system (1.0V in a nominal 24V system) above the TEG On set value. During this range the SCADA Start and Stop signals are overridden by the Voltage Start signal.

When the TEG is running and the battery voltage is above the TEG On set value plus the voltage delta (0.5V in 12V system, and 1.0V in 24V system), a momentary SCADA Start signal will start the TEG and a momentary SCADA Stop will stop the TEG.

When the battery voltage has charged up to the temperature compensated TEG Off value, the automatic Voltage Stop signal will stop the TEG. The SCADA Stop signal is not required, since the Voltage Stop signal overrides the SCADA signals

When the battery voltage falls below the compensated TEG Off value plus the voltage delta (0.5V in 12V system, and 1.0V in 24V system), a momentary SCADA Start signal will start the TEG and a momentary SCADA Stop will stop the TEG.

Battery Voltage		System Status	SCADA start/stop signals
12V System	**24V System**		
VBatt > TEG On Value		Discharging	Not Operational
VBatt > TEG On +0.5V	VBatt > TEG On +1.0V	Charging	Functional
VBatt < TEG Off Value		Charging	Functional
VBatt > TEG Off +0.5V	VBatt > TEG Off +1.0V	Discharging	Not Operational

8.4.1 Optional SCADA Signals

SCADA Start

The SCADA Start signal is sent remotely by the customer's SCADA. A momentary system voltage dependent signal is required to toggle the SCADA Start relay on the TCC board (nominal 12V signal in 12V systems, nominal 24V signal in 24V systems). This start signal is used as a remote start command when the TCC board is in the Remote mode and the battery voltage is between the MIN and MAX battery voltages as indicated by the TCC indicators

When the MIN battery voltage indicator is lit, the voltage sensing start command is active, and a Remote Start signal is not required.

When the MAX battery voltage indicator is lit, the voltage sensing stop command is active and overrides a remote start signal when the remote start signal is removed.

WARNING: Do not keep the remote start signal on longer than for a moment. The TCC board will start the TEG and keep it running for as long as the remote start signal is applied, regardless of the voltage sensing stop command, which will over-charge the batteries and run the TEG
continuously.

SCADA Stop

The SCADA Stop signal is sent remotely by the customer's SCADA. A momentary system voltage dependent signal is required to toggle the SCADA Stop relay on the TCC board (nominal 12V signal in 12V systems, nominal 24V signal in 24V systems). This stop signal is used as a remote stop command when the TCC board is in the Remote mode and the battery voltage is between the MIN and MAX voltages as indicated by the TCC indicators

When the MIN battery voltage indicator is lit, the voltage sensing start command is active and overrides a Remote Stop signal.

When the MAX battery voltage indicator is lit, the voltage sensing stop command is active, and a Remote Stop signal is not required.

SCADA TEG On Indicator

The SCADA TEG On indicator provides a set of contacts to indicate when the TCC board is attempting to start the TEG and when the TEG is running.

When a start command is received by the TCC board, the TCC board will attempt to start the TEG. When the TCC board powers the SI board, the TEG On relay is also energized. When the relay is energized, the connection between the NO (normally open) and COM (common) is closed, and the connection between the NC (normally closed) and COM is open. The TEG On relay stays energized while the TEG is running and it also stays on if an SI lockout failed ignition situation occurs following a voltage sensing TEG On start.

The TEG On relay is de-energized when the TCC receives a stop command. The TEG On relay will remain energized if an SI Lockout failed ignition condition occurred following a voltage sensing TEG On start since a remote stop will not reset this condition.

SCADA Fuel Pressure Indicator

The SCADA Fuel Pressure indicator provides contacts to indicate when the pressure switch is closed. The connections are labelled as NO (normally open) and COM (common).

8.5 Spark Ignitor (SI) Operation

The spark ignitor receives power from the TCC board when it signals a start of the TEG.

1) The SI starts with a 3 second delay as the module performs start-up tasks.
2) The SI Valve Signal turns on a relay on the TCC board to power the solenoid valve and begins its first 7 second trial for ignition.
3) If flame is sensed, the SI enters its run mode. It suppresses the spark and keeps the valve signal on, and the solenoid valve remains open.
4) If no flame is sensed, the SI performs a 10 second inter-purge, when there is no sparking, the valve signal is off and the no-combustion signal is on. This is followed by another trial for ignition
5) If a flame is not sensed during the second trial for ignition, it performs another inter-purge and third trial for ignition
6) If a flame is not sensed during the third and final trial for ignition, the SI will enter a lockout and the no-combustion signal will be on. A lockout does not allow any additional trials for ignition while the module remains powered
7) If flame is lost during the run mode, the unit will energize the spark and perform a trial for ignition and follow the previous sequence to achieve ignition within the three attempts
8) If a flame is sensed when the gas valve is not energized, the unit will enter the lock-out mode and the no-combustion signal will be on. This can occur when attempting to re-start a hot TEG. The TEG will need to cool a bit before attempting a re-start
9) A hard lockout condition in the spark ignitor module requires the module to be pow-

ered down for more than 5 seconds before restoring power to the module to re-attempt another ignition sequence. This requires the user to wait mor than 5 seconds between a stop signal and a start signal, in both Local and Remote mode.

10) The TCC board provides power to the spark ignitor when required by either the voltage sensing control signals, remote signals or user switch signals. See the TCC Operating Chart for more details about the TCC and spark ignitor control

WARNING: The system has to be manually reset at site, if it was started by a voltage start signal and fails to achieve ignition after three attempts and enters lockout. To reset the system, switch to Local mode, toggle the Stop switch to turn off the power lights in the lower left corner of the TCC board, wait 5 seconds and toggle the Start switch to attempt a re-start. When ignition has been achieved, return the switch to Remote mode.

8.6 Operation Chart

TEG Operation	Controller Operating Mode	Action	Initial Indicators	System Operation Outcome	Outcome Indicators
TEG is not running	Switch in Local Mode	Local Start Switch Pressed	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: Off SI PWR light: Off	Controller will start the TEG: SI module receives power and starts the ignition sequence	DC PWR and SI PWR lights will turn on
		Local Stop Switch Pressed	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: Off SI PWR light: Off	Controller will stop the TEG: SI module power is removed	DC PWR and SI PWR lights will be turned off
		Remote Start Signal Received	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG remains off. Switch in Local Mode	No change to indicators
		Remote Stop Signal Received	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG remains off. Switch in Local Mode	No change to indicators
		Battery Voltage Status MIN Light turns on	Battery Voltage Light MIN: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG remains off. Switch in Local Mode	No change to indicators
		Battery Voltage Status MAX Light turns on	Battery Voltage Light MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG remains off. Switch in Local Mode	No change to indicators
		Switch moved to Remote Position, Battery Voltage Status MIN light on	Battery Voltage Light MIN: On DC PWR light: Off SI PWR light: Off	Controller will start the TEG: SI module receives power and starts the ignition sequence	DC PWR and SI PWR lights will turn on
		Switch moved to Remote Position, Battery Voltage Status MED or MAX light on	Battery Voltage Light MED or MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG remains off. Battery voltage is above the TEG On value	No change to indicators
		(During Ignition Sequence)	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: On SI PWR light: On	The SI module attempts three ignition cycles: a sparking period, followed by a purge period.	SI NC light will light during the SI purge period
		(Failed Ignition Sequence)	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: On SI PWR light: On	If successful ignition has not been achieved during one of the three sparking periods, the controller will remove power to the SI module following a brief time (15 - 60 seconds). A local start can be re-attempted	DC PWR and SI PWR lights will be turned off
TEG is not running	Switch in Remote Mode	Local Start Switch Pressed	Battery Voltage Lights MED or MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG remains off. Switch in Remote mode	No change to indicators
		Local Stop Switch Pressed	Battery Voltage Lights MED or MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG remains off. Switch in Remote mode	No change to indicators
		Remote Start Signal Received	Battery Voltage Lights MED: On DC PWR light: Off SI PWR light: Off	Controller will start the TEG: SI module receives power and starts the ignition sequence	DC PWR and SI PWR lights will turn on
		Remote Start Signal Received	Battery Voltage Lights MAX: On DC PWR light: Off SI PWR light: Off	Controller will start the TEG while the start signal is applied. Once the start signal is removed the MAX battery voltage turns off the TEG	DC PWR and SI PWR lights will turn on while the start signal is applied
		Remote Stop Signal Received	Battery Voltage Lights MED or MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG is not running	No change to indicators
		Battery Voltage Status MIN Light turns on	Battery Voltage Light MIN: On DC PWR light: Off SI PWR light: Off	Controller will start the TEG: SI module receives power and starts the ignition sequence	DC PWR and SI PWR lights will turn on
		Battery Voltage Status MAX Light turns on	Battery Voltage Light MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG is not running	No change to indicators
		Switch moved to Local Position	Battery Voltage Lights MED or MAX: On DC PWR light: Off SI PWR light: Off	No action is taken. TEG remains off. Mode has been changed; waiting for local switch to be pressed	No change to indicators
		(During Ignition Sequence)	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: On SI PWR light: On	The SI module attempts three ignition cycles: a sparking period, followed by a purge period.	SI NC light will light during the SI purge periods

8.6 Operation Chart (cont.)

TEG Operation	Controller Operating Mode	Action	Initial Indicators	System Operation Outcome	Outcome Indicators
		(Failed Ignition Sequence)	Battery Voltage Lights MIN: On DC PWR light: On SI PWR light: On	If successful ignition has not been achieved during one of the three sparking periods, the controller will locked in a failed ignition mode. A site visit is required to remove power from the controller to reset the locked condition	Battery Voltage Lights MIN: On DC PWR light: On SI PWR light: On SI NC light: On
		(Failed Ignition Sequence)	Battery Voltage Lights MED or MAX: On DC PWR light: On SI PWR light: On	If successful ignition has not been achieved during one of the three sparking periods, the controller will remove power to the SI module following a brief time (15 - 60 seconds). A remote start can be re-attempted	DC PWR and SI PWR lights will be turned off
TEG is running	Switch in Local Mode	Local Start Switch Pressed	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running	No change to indicators
		Local Stop Switch Pressed	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: On SI PWR light: On	Controller will stop the TEG: SI module power is removed	DC PWR and SI PWR lights will be turned off
		Remote Start Signal Received	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running. Switch in Local Mode	No change to indicators
		Remote Stop Signal Received	Battery Voltage Lights MIN, MED or MAX: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running. Switch in Local Mode	No change to indicators
		Battery Voltage Status MIN Light turns on	Battery Voltage Lights MIN: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running. Switch in Local Mode	No change to indicators
		Battery Voltage Status MAX Light turns on	Battery Voltage Lights MAX: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running. Switch in Local Mode	No change to indicators
		Switch moved to Remote Position, Battery Voltage Status MIN or MED light on	Battery Voltage Lights MIN or MED: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running. Battery voltage is below the TEG Off value	No change to indicators
		Switch moved to Remote Position, Battery Voltage Status MAX light on	Battery Voltage Lights MAX: On DC PWR light: On SI PWR light: On	Controller will stop the TEG: SI module power is removed	DC PWR and SI PWR lights will be turned off
TEG is running	Switch in Remote Mode	Local Start Switch Pressed	Battery Voltage Lights MIN or MED: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running. Switch in Remote mode	No change to indicators
		Local Stop Switch Pressed	Battery Voltage Lights MIN or MED: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running. Switch in Remote mode	No change to indicators
		Remote Start Signal Received	Battery Voltage Lights MIN or MED: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running	No change to indicators
		Remote Stop Signal Received	Battery Voltage Lights MIN: On DC PWR light: On SI PWR light: On	No action is taken while the battery voltage MIN light is active. TEG remain running	No change to indicators
		Remote Stop Signal Received	Battery Voltage Lights MED: On DC PWR light: On SI PWR light: On	Controller will stop the TEG: SI module power is removed	DC PWR and SI PWR lights will be turned off
		Battery Voltage Status MAX Light turns on	Battery Voltage Lights MIN or MED: On DC PWR light: On SI PWR light: On	Controller will stop the TEG: SI module power is removed	DC PWR and SI PWR lights will be turned off
		Switch move to Local Position	Battery Voltage Lights MIN or MED: On DC PWR light: On SI PWR light: On	No action is taken. TEG remains running. Mode has been changed; waiting for local switch to be pressed	No change to indicators

8.7 Block Diagram

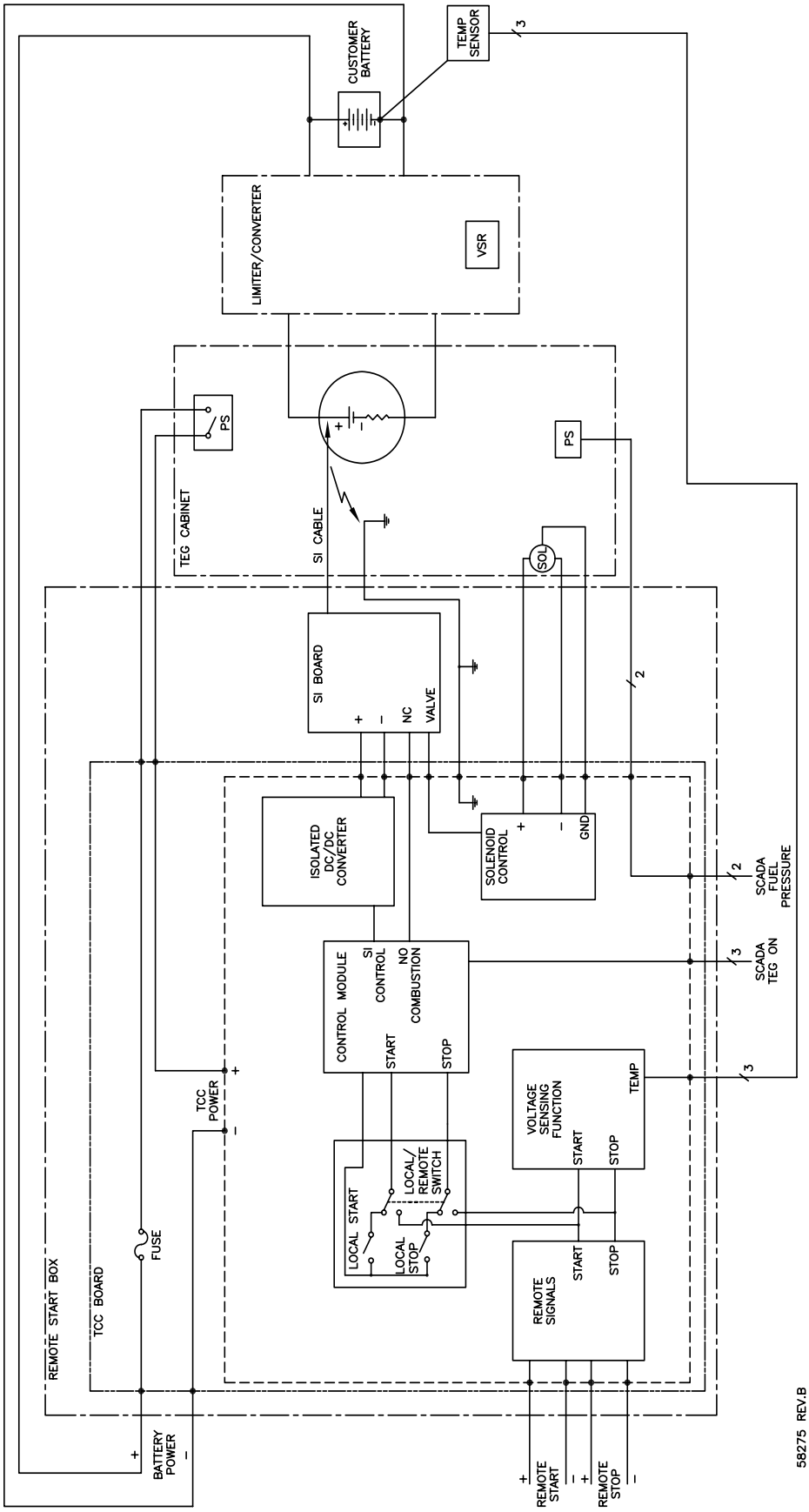

Figure 11 Block Diagram

9 MAINTENANCE

Remove the fuse from the TCC board if performing maintenance on the TEG.

WARNING: The two battery connections will still be live, because they are wired directly to the battery

9.1 TCC Board Examination

The TCC board does not require routine maintenance. When operating correctly and all board jumpers are in the correct positions, one of the battery voltage indicator lights will be on when fuel is available and the board is connected to the battery bank.

9.2 Verify basic operation of the TCC control board

Follow these steps to check the operation of the TCC when fuel is available and the TEG is not running:

1) Switch the Local/Remote switch to the Local position
2) Toggle the Local Start switch
3) The SI PWR, DC PWR and SI NC lights should turn on
4) After three seconds, the SI NC light should turn off and the spark ignitor should start sparking, as well as the solenoid should open, to start an ignition sequence.
5) If the spark ignitor does not sense flame, the SI NC light will be turned on while the spark ignitor is performing an inter-purge.
6) If there is no ignition or no lights as described in step 3, verify that there is input voltage on the battery connections. Verify the fuse is not damaged and needs replacing. See “Checking the pressure switches” section 9.3.1.5 to verify the pressure switches are closed when fuel is present.
7) If there is power to the board, one of the three battery voltage LED’s will be on. If the DC PWR or SI PWR lights do not turn on after toggling the Start switch, the TCC board may need to be replaced

9.3 Spark Ignition System

The spark ignition system has been changed in TEGS with the remote start electronics, and consists of the following parts:

- Spark electrode
- Spark ignitor module
- Solenoid valve
- Pressure switches

When the TCC requires the TEG to start because of voltage sensing or a start signal, it powers the spark ignitor module. When the spark ignitor module is powered, it begins ignition sequences which generate sparks from the electrode to the combustion chamber, as well as open the solenoid valve allowing gas to flow into the burner chamber, causing ignition to occur. Once combustion is detected, the SI will stop sparking and the SI will continue to monitor the presence of flame at the electrode. If the SI did not detect combustion for a period of 7 seconds, it will stop sparking and turn off the valve signal causing the solenoid to close, and wait for a 10 second purge period and then make another attempt at ignition. The SI will attempt 3 ignition trials and if flame detection cannot be maintained, the spark ignitor will lockout. The TCC board provides power to the spark ignitor. See the TCC Operating Chart for more details about the TCC and spark ignitor control.

The solenoid is system voltage dependent and draws power from the battery voltage connection on the TCC board.

When the manual ball valve is opened, fuel pressure causes the pressure switches (located in fuel system) to close. This allows the battery voltage connection on the TCC board to power the remainder of the board through one pressure switch, allowing the TCC board to operate. The second pressure switch is a straight through connection on the TCC board allowing a SCADA connection.

9.3.1 Spark Ignition System Maintenance

The SI system may require occasional maintenance. If the Igniting Control system fails to ignite it must be checked and serviced as necessary. Use the procedures below to maintain the SI system.

WARNING: Remove the fuse in the TCC board, to remove power from the TCC and indirectly from the spark ignition system to prevent any signals or switches from accidentally starting the system and cause a possible high voltage shock.

9.3.1.1 Check the Spark Electrode

Follow these steps to check the spark electrode:

1) Remove the Spark Electrode by loosening the wing-nut and sliding the electrode out.
2) Inspect the electrode for any cracks in the ceramic rod. If any cracks are found the electrode must be replaced.

3) Slide the electrode back into position through the burner back until it stops, then pull it back 3 to 6 mm (1/8 to 1/4 in.). The ceramic rod should extend about 25mm (1.5 in.) from the holding screw.
4) Tighten the wing-nut only until it is snug. DO NOT over tighten or the ceramic rod will crack.
5) Switch the TCC Local/Remote switch to the Local position.
6) Re-install the fuse into the TCC board
7) Toggle the Local start switch. Arcing should occur in the combustion chamber (making a clicking noise). Fuel combustion should occur, if the fuel is connected and available.
8) If arcing occurs the SI system is functioning well.

9.3.1.2 Check Power Supply to the Spark Ignitor

Follow these steps to check the power supply voltage to the spark ignitor:

1) Locate the wiring connector plugged into the spark ignitor module and disconnect the connector. See Figure 1 – Remote Start Box
2) Use a voltmeter to probe and measure the voltage between the red and black wires of the spark ignitor connector
3) Switch the TCC Local/Remote switch to the Local position.
4) Toggle the Local start switch
5) The voltage should be between 13 and 15V and the TCC SI PWR light should be on.

9.3.1.3 Check Operation of the Spark Ignitor

Follow these steps to verify correct operation of the ignition controller.

1) Verify electrode gap (1/8” - 1/4”), Section 9.3.1.1 Check the Spark Electrode above.
2) Start the TEG
3) If arcing occurs, the ignition control module is functioning.
4) If no arcing occurs, see section above “check power supply voltage to spark ignitor”. If it is as specified, replace ignition module.

9.3.1.4 Check Solenoid Valve

The solenoid is system voltage dependent and draws power from the battery voltage connection on the TCC board.

12V solenoid is used in a 12V system
24V solenoid is used in a 24V system

Follow these steps to check the Solenoid Valve Operation:

1) If at the beginning of sparking, the solenoid is not heard to click open, unplug solenoid valve connector from the solenoid, make a note of which stake is connected to ground. Measure resistance between the two stakes connecting the blue wire and brown wire:
   12V solenoid should be approximately 65 Ω
   24V solenoid should be approximately 260 Ω
   If the resistance is greater than +/- 20%, replace the solenoid valve.

NOTICE: If measuring across the ground stake and one of the coil stakes, the resistance should measure an open connection.

2) Start the TEG. While SI is sparking, measure voltage of the solenoid connection on the TCC board. If voltage is not approximately the same as the system battery voltage, check power supply to spark ignitor as per section 9.3.1.2.

3) Check for broken wires in the solenoid cable. If it is ok, replace the spark ignitor.

9.3.1.5 Checking the Pressure Switches

Follow these steps to check the pressure switches:

1) Remove the two wires from the pressure switch and connect a multi-meter across the pressure switch terminals, set to measure resistance (ohms). See wiring Figures 4-7
2) Remove fuel pressure from the pressure switch by closing the manual gas valve, placing the TCC Local/Remote switch in the Local position and toggling the Local start switch to purge most of the gas trapped between the manual gas valve and the solenoid. The local start switch may need to be toggled a second time to remove all the trapped fuel. The TCC board will not be powered when all fuel has been removed from between the manual gas valve and the solenoid (all three TCC battery voltage lights will be off)
3) With no fuel pressure in the fuel manifold, check the resistance measured across the switch is near infinity, which indicates the switch is open. Replace the pressure switch if necessary.

Note: Switch should open at pressures below 6.9 kPa (1 psig).

4) Provide fuel pressure to the switch by opening the manual shutoff valve.
5) Check the resistance measured across the switch is near zero, which indicates the switch being closed. Replace the pressure switch if necessary.

Note: Switch should close at pressures above 13.8 kPa (2 psig).

9.4 Troubleshooting

Problem	Probable Cause	Possible Solution	Lookup Section
None of the TCC battery voltage indicator lights are on	TCC Voltage Reference Source jumper may be in the VADJ position	Switch the TCC Voltage Reference Source jumper to the RUN position. One of the battery voltage indicators should light.	Adjustments
	Fuse is blown	Check the TCC on-board fuse for damage and replace if needed	
	Pressure switch not closing with fuel available	Check the pressure switch for contact closure	Maintenance
	TCC battery connection wiring not receiving voltage with fuel available	Verify TCC battery connection wiring is connected to the battery bank	Wiring
	Out of fuel	Power to the TCC board is routed through one of the pressure switches. When there is no fuel, the TCC board is not connected to battery power	
TEG does not attempt to ignite	TCC battery voltage indicator either MED or MAX lite	Battery voltage measured is not requiring the TEG to start. This is normal operation.	
	TCC battery voltage indicator MIN is lite. Board may be in Local mode	Switch the TCC Local/Remote switch to Remote position	Adjustments
	TCC battery voltage indicator MIN is lite and SI may be locked out. TCC lower lights are on (SI PWR, DC PWR, SI NC) A site visit is required to manually start the TEG to reset the SI lockout condition	Switch the TCC Local/Remote swtich to Local position and toggle the TCC Start switch to start the TEG on site. System will not respond to a Remote start while the MIN battery voltage indicator is on. When TEG is running, return switch to Remote position	Operation
	TCC two lower lights are on (SI PWR, DC PWR) and SI is not sparking	Check electrode spark gap	Maintenance
		Check SI system	Maintenance
	Remote Start signal sent while TCC battery voltage indicator MAX is lite.	TEG will not start when the MAX battery voltage level is indicated	

9.5 Parts Lists

9.5.1 Remote Start Electronics Parts List

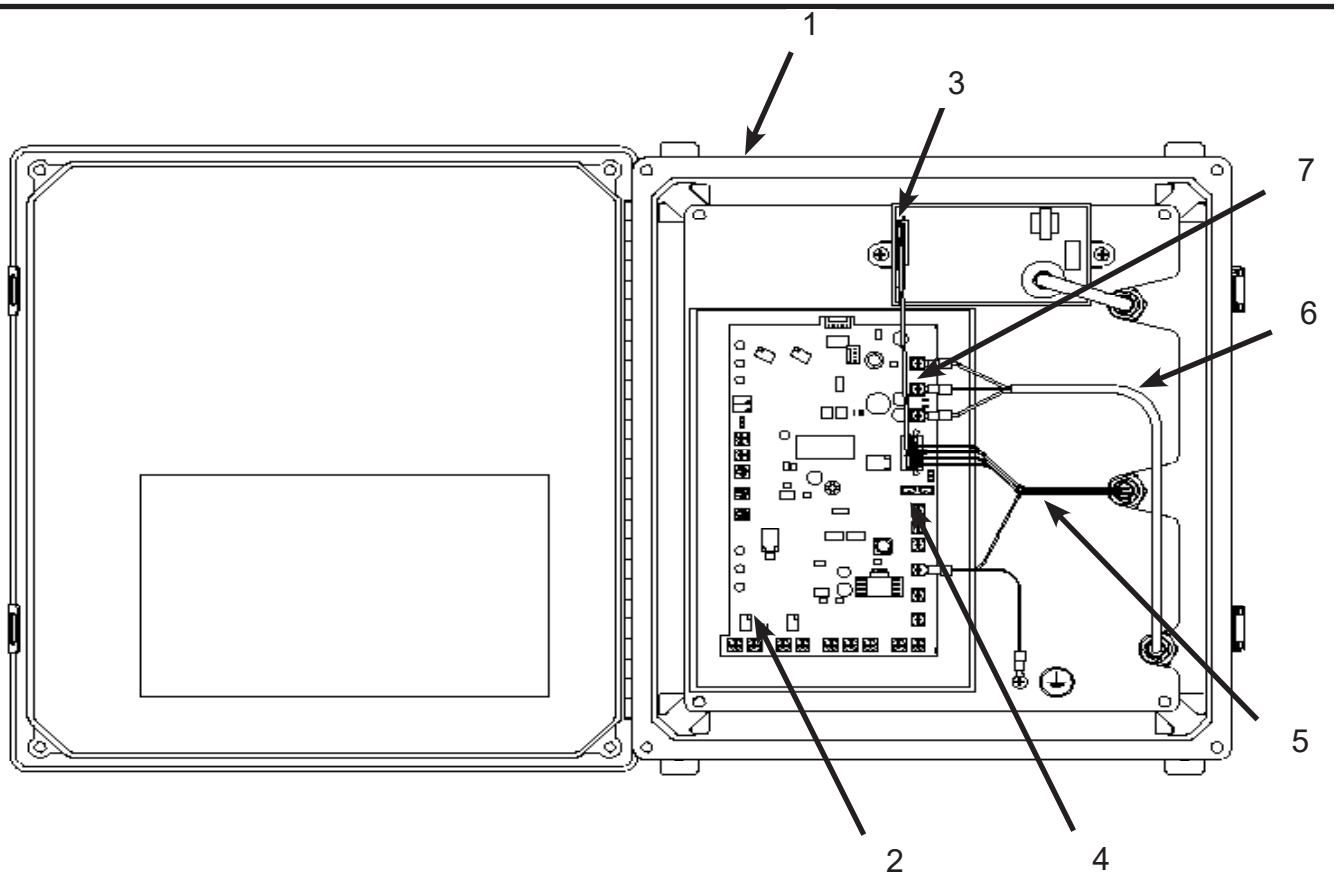

Figure 12 Remote Start Electronics

Item	Part No.	Description
1	56340	Electronics Assy, 12V RS w/ TCC Board, 5060 / 5120 / 5220
OR	56341	Electronics Assy, 24V RS w/ TCC Board, 5060 / 5120 / 5220
2	56207	PCB Assy, TEG Charge Controller 12V RS
OR	56208	PCB Assy, TEG Charge Controller 24V RS
3	63096	SI Board Assy Channel Products 2021-90 50N-12-3-3-7-10-0-P23062
4	56399	Fuse, Blade, 3A, 32V, A to Fast-Act, DK F996-ND
5	64737	Wire Harness, TCC Board,W/MOLEX CONNECTOR, RS
6	22810	Cable, 3 wire, 18 AWG, Black 125C, Silflex-EWKF N2GM H2G-VDE
7	04523	Term Spade, Red #6 Stud, 18-22 Wire, PN18-6FF
N/A	27837	Electrode Assembly, SI, RS, 5050/5120 (NOT SHOWN)
N/A	58496	Electrode Assembly, SI, RS, 5220 (NOT SHOWN)

9.5.2 Fuel System Parts List - Model 5060 RS

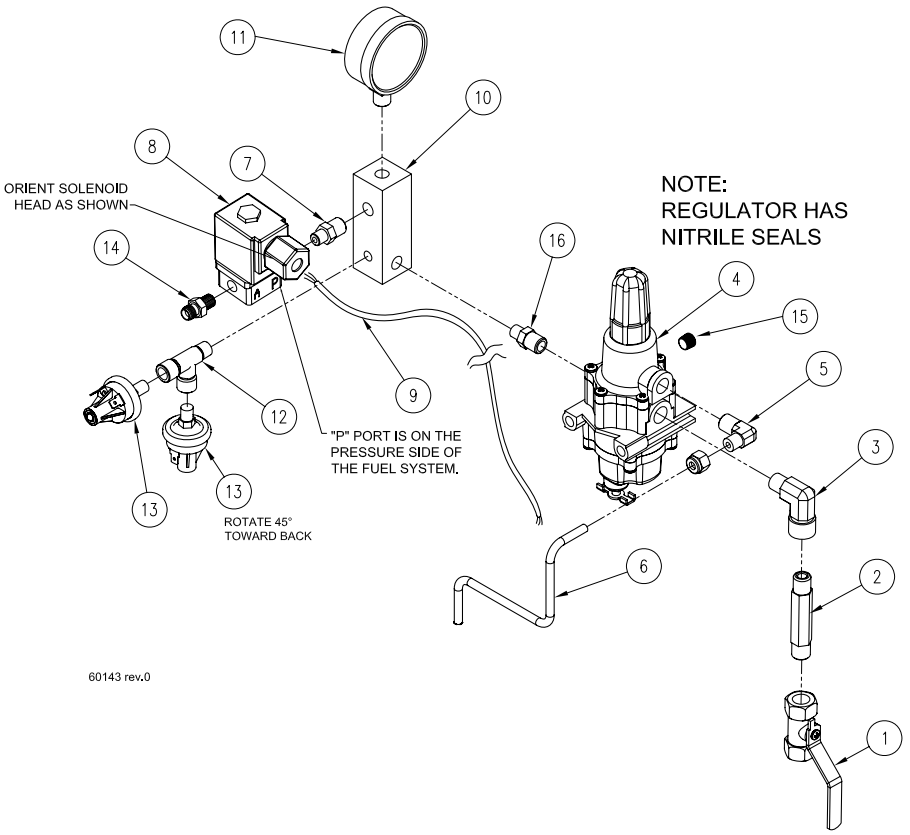

Figure 13 Fuel System - Model 5060 RS

Item	Part No.	Description
1	2498	VALVE, 1/4 NPT, BRASS, 1/4 TURN
2	2154	NIPPLE, HEX, 1/4” X 3”, BRASS
3	21569	ELBOW, Street 1/4 NPT, B-4-SE
4	29356	REGULATOR, FISHER 67CFR, 0-20 PSI
5	20071	ELBOW, 1/4 TB X 1/4 MNPT, SS, SS-400-2-4
6	7981	VENT TUBE ASSY, REGULATOR, SS, 5060/5120/5220
7	6202	REDUCER, 1/4 MNPT X 1/8 MNPT, HEX, B-4-HRN-2
8	27927	VALVE, SOLENOID, 12VDC, NC, 2-WAY, BURKETT 6013 SERIES, 2mm ORIFICE, 1/8 NPT W/BUNA NBR SEAL, #CD04933
OR	29354	VALVE, SOLENOID, 24VDC, NC, 2-WAY, BURKETT 6013 SERIES, 2.5mm ORIFICE, W/BUNA NBR SEAL, #CD04931
9	N/A	Shown as reference, See Remote Start Electronics parts list
10	2100	MANIFOLD BLOCK, FUEL SYSTEM
11	691	GAUGE, PRESSURE, 0-15 PSI
12	23643	TEE, STREET, 1/8” NPT, BRASS, B-2-ST OR 107A
13	6471	SWITCH, PRESSURE 1.6 PSI, 76056-DB 1.6-0.5
14	20977	CONNECTOR, 1/4 TB X 1/8 MNPT, 316 SS, SS-400-1-2
15	58949	PLUG, 1/4” NPT X 7/8”, STEEL, UMBRAKO 1105766
16	501	NIPPLE, HEX, 1/4 NPT X 1 1/8 “ LG., BRASS
N/A	22363	FILTER KIT, FISHER 67CFR (NOT SHOWN)

9.5.3 Fuel System Parts List - Model 5120 RS

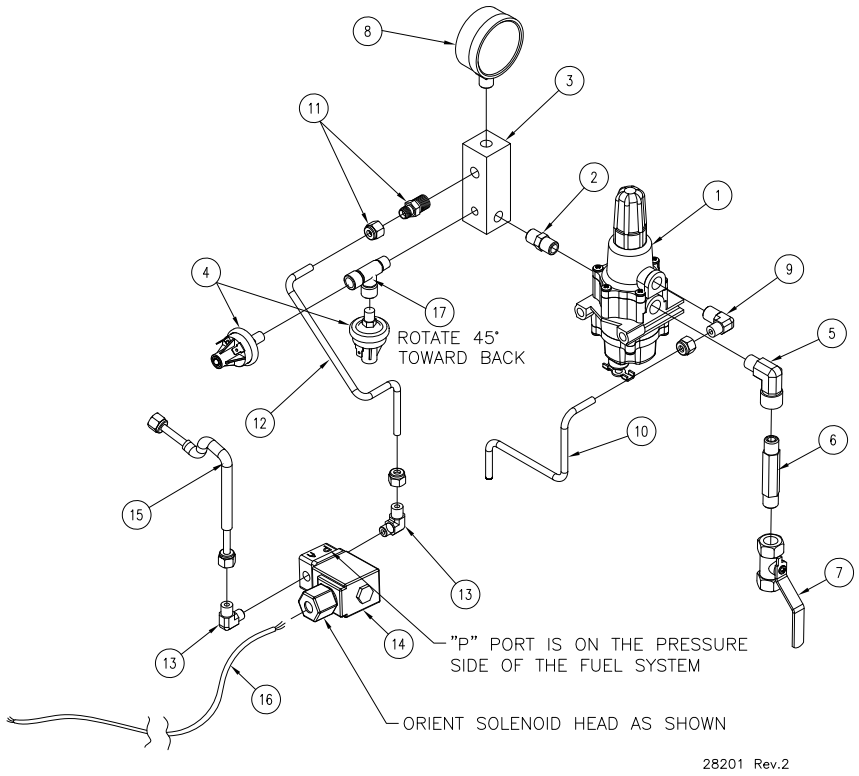

Figure 14 Fuel System - Model 5120 RS

Item	Part No.	Description
1	22359	REGULATOR, FISHER 67CFR, 0-20 PSI
2	00501	NIPPLE, HEX, 1/4 NPT X 1 1/8, BRASS (FAIRVIEW)
3	2100	MANIFOLD BLOCK, FUEL SYSTEM
4	6471	SWITCH, PRESSURE 1.6 PSI, 76056-DB 1.6-0.5
5	21569	ELBOW, Street 1/4 NPT, B-4-SE
6	2154	NIPPLE, HEX, 1/4" X 3", BRASS
7	2498	VALVE, 1/4 NPT, BRASS, 1/4 TURN
8	691	GAUGE, Pressure, 0-15 PSI
9	20071	ELBOW, 1/4 TB X 1/4 MNPT, SS, SS-400-2-4
10	7981	VENT TUBE ASSY, Regulator, SS, 5060/5120/5220
11	380	CONNECTOR, 1/4 TB X 1/4 MNPT, 316 SS, SS-400-1-4
12	28809	FUEL LINE, Manifold, 5120 RS, TELEFONICA
13	26518	ELBOW, 1/4 TB X 1/8 MNPT, SS
14	27927	VALVE, SOLENOID, 12VDC, BURKETT 6013 SERIES, NC-2 WAY, 2mm ORIFICE, #CD04933
14	25082	VALVE, SOLENOID, 24VDC, BURKETT 6013 SERIES, NC-2 WAY, 3mm ORIFICE, #CD02393
15	5289	KIT, Fuel Line, 10 IN.
16	N/A	Shown as reference, See Remote Start Electronics parts list
17	23643	TEE, STREET, 1/8" NPT, BRASS, SWAGELOK B-2-ST
N/A	22363	FILTER KIT, FISHER 67CFR (NOT SHOWN)

9.5.4 Fuel System Parts List - Model 5220 RS

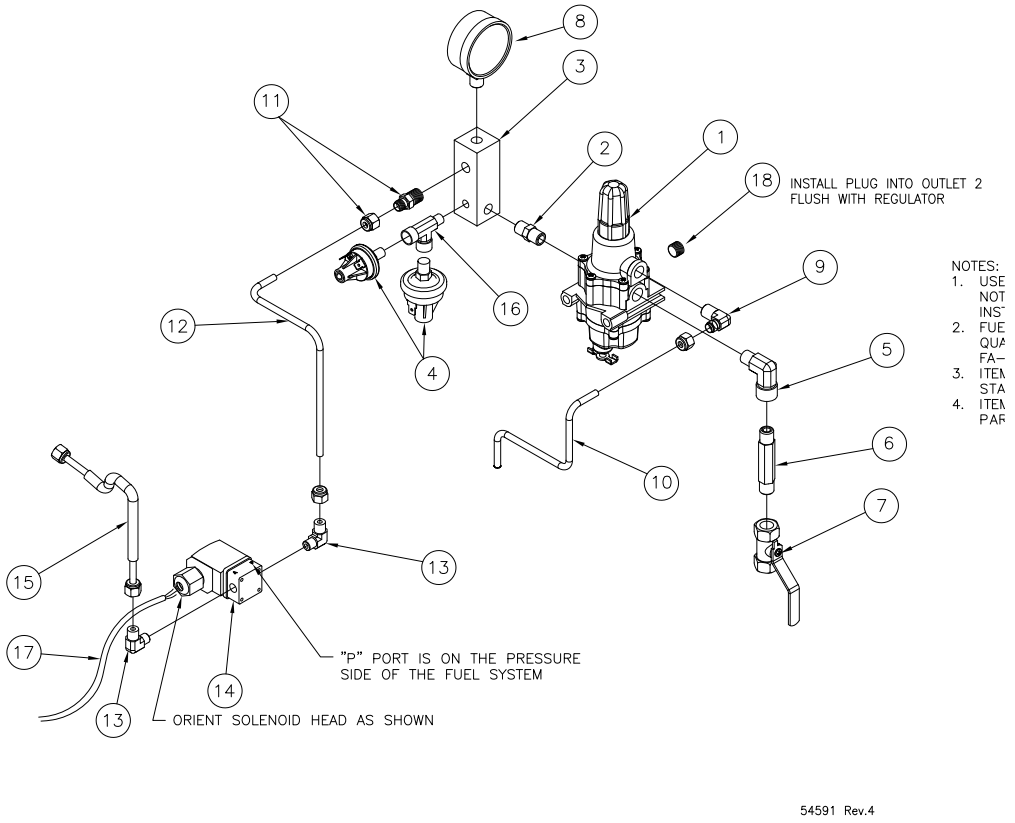

Figure 15 Fuel System - Model 5220 RS

Item	Part No.	Description
1	22361	REGULATOR, FISHER 67CFR, 0-35 PSI, UL144, UL252, 5220
2	501	NIPPLE, HEX, 1/4 NPT X 1 1/8, BRASS (FAIRVIEW)
3	2100	MANIFOLD BLOCK, FUEL SYSTEM
4	6471	SWITCH, PRESSURE 1.6 PSI, 76056-DB 1.6-0.5
5	21569	ELBOW, Street 1/4 NPT, B-4-SE
6	2154	NIPPLE, HEX, 1/4” X 3”, BRASS
7	24653	VALVE, 1/4 NPT, BRASS, 1/4 TURN, Q11F-600TB2.N
8	406	GAUGE, PRESSURE, 0-30 PSI
9	20071	ELBOW, 1/4 TB X 1/4 MNPT, SS, SS-400-2-4
10	7981	VENT TUBE ASSY, Regulator, SS, 5060/5120/5220
11	380	CONNECTOR, 1/4 TB X 1/4 MNPT, 316 SS, SS-400-1-4
12	28809	FUEL LINE, MANIFOLD, RS
13	26518	ELBOW, 1/4 TB X 1/8 MNPT, SS
14	27927	VALVE, SOLENOID, 12VDC, BURKERT 6013, 463305C, 0BBMSNM81, 2-WAY
or	29354	VALVE, SOLENOID, 24VDC, BURKERT 6013, 2.5mm ORIFICE, #92704931
15	5286	KIT, Fuel Line, 10 IN.
16	23643	TEE, STREET, 1/8” BRASS, B-2-ST
N/A	22363	FILTER KIT, FISHER 67CFR (NOT SHOWN)

9.5.5 Burner Parts List - Model 5060 RS

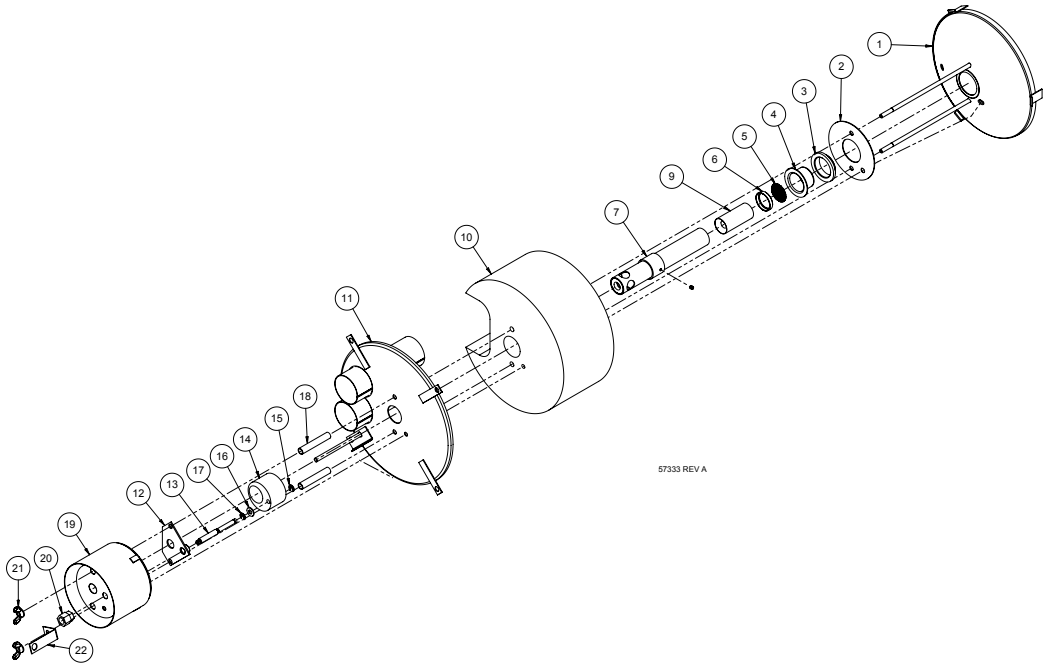

Figure 16 Burner Assembly - Model 5060 RS

Item	Part No.	Description
1	24584	BURNER BACK ASSY, 5060, 5120
2	24586	INSULATION SUPPORT, 5060
3	701	SPACER, INSULATION
4	693	SCREEN HOLDER, 5015/5030/5060/5120/1120
5	1008	BURNER SCREEN ASSY, 5060/TCELL
6	694	INSERT RING, BURNER, 5120/5060/5030/1120
7	999	VENTURI TUBE HOLDER, 5120/5060
8	479	SCREW, SET, SOC-HD. 6-32 X 1/8, SS, CONE POINT
9	698	VENTURI, 5060, TCELL
10	27856	INSULATION BLOCK, 5120
11	27855	BURNER COVER ASSY, 5120
12	747	VENTURI PLATE ASSY, 5120/5060
13	700	VENTURI ADJUST SCREW 5120/5060/5030
14	990	AIR SHUTTER, 5120/5060/5030
15	549	RING, RETAINING,OPEN,SST,VEN PART# 39-5133-18-H
16	569	WASHER, FLAT, #10, SST
17	7267	E-RING, BOWED, SS, SPAENAUR 251-802
18	1005	SPACER, BURNER, 5120/5060
19	27867	AIR STABILIZER ASSY, 5120
20	758	NUT, LOCK, VENTURI ADJ. SCREW
21	601	NUT, WING, 10-32, SST
22	27835	BRACKET, IGNITOR MOUNT, 5120

9.5.6 Burner Parts List - Model 5120 RS

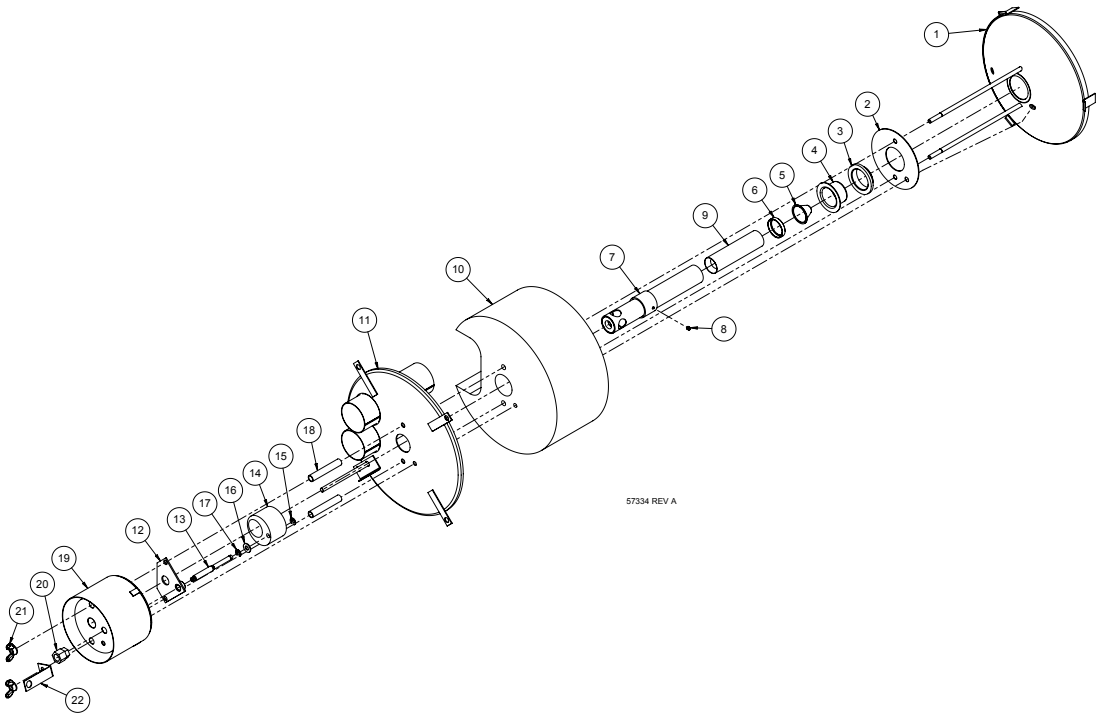

Figure 17 Burner Assembly - Model 5120 RS

Item	Part No.	Description
1	24584	BURNER BACK ASSY, 5060, 5120
2	24586	INSULATION SUPPORT, 5060
3	701	SPACER, INSULATION
4	693	SCREEN HOLDER, 5015/5030/5060/5120/1120
5	873	SCREEN, BURNER, 5120/1120
6	694	INSERT RING, BURNER, 5120/5060/5030/1120
7	999	VENTURI TUBE HOLDER, 5120/5060
8	479	SCREW, SET, SOC-HD. 6-32 X 1/8, SS, CONE POINT
9	971	VENTURI, 5120, 1120, TCELL
10	27856	INSULATION BLOCK, 5120
11	27855	BURNER COVER ASSY, 5120
12	747	VENTURI PLATE ASSY, 5120/5060
13	700	VENTURI ADJUST SCREW 5120/5060/5030
14	990	AIR SHUTTER, 5120/5060/5030
15	549	RING, RETAINING, OPEN, SST, VEN PART# 39-5133-18-H
16	569	WASHER, FLAT, #10, SST
17	7267	E-RING, BOWED, SS, SPAENAUR 251-802
18	1005	SPACER, BURNER, 5120/5060
19	27867	AIR STABILIZER ASSY, 5120
20	758	NUT, LOCK, VENTURI ADJ. SCREW
21	601	NUT, WING, 10-32, SST
22	27835	BRACKET, IGNITOR MOUNT, 5120

9.5.7 Burner Parts List - Model 5220 RS

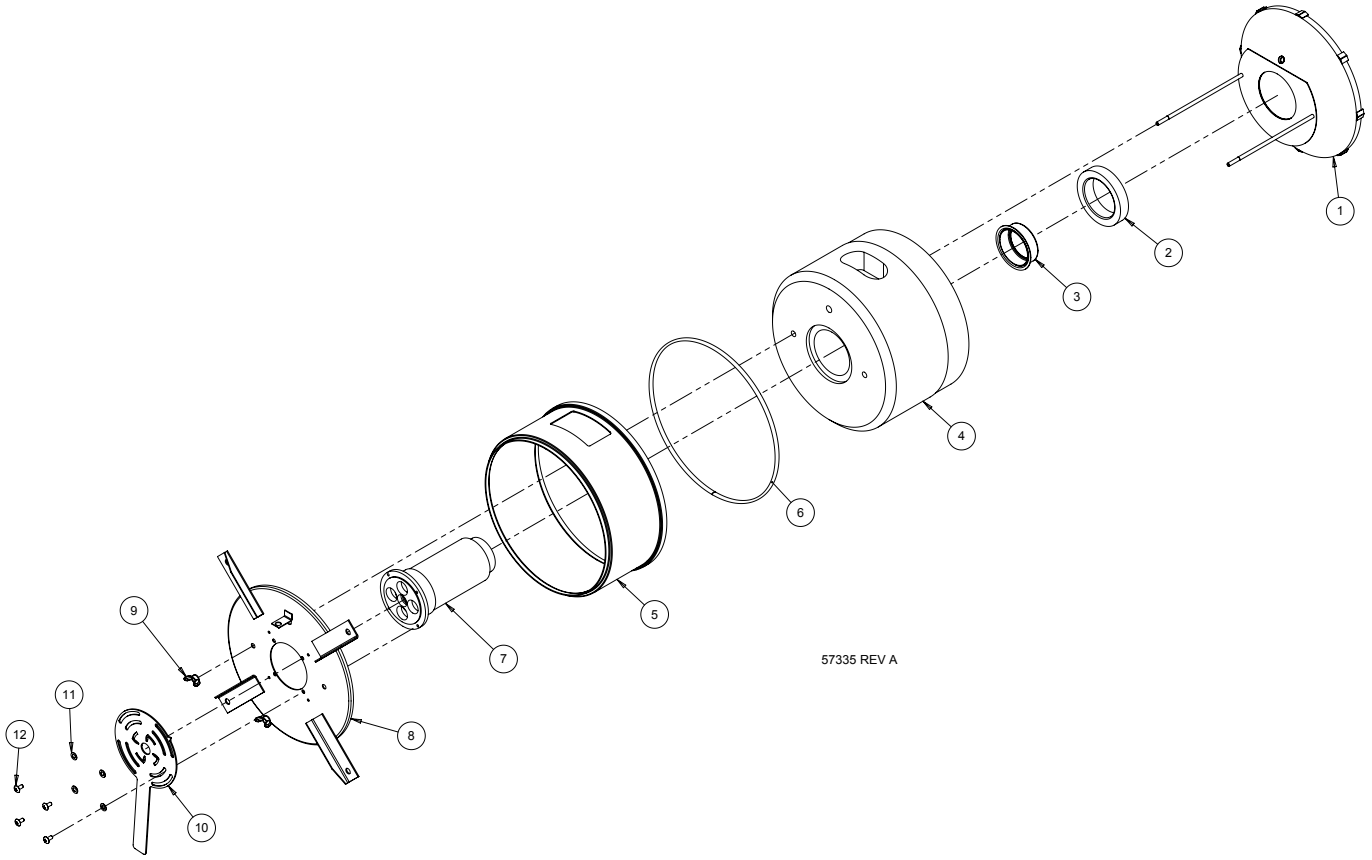

Figure 18 Burner Assembly - Model 5220 RS

Item	Part No.	Description
1	5606	BURNER BACK ASSY 5220
2	5605	HOLDER, SCREEN INSULATOR, 5220
3	5390	BURNER SCREEN ASSY, 5220
4	6086	INSULATION BLOCK, 5220
5	6186	BURNER CAN, SHORT, MACHINED, 5220
6	6631	ROPE, 1/4”, KAO-TEX 2000
7	5375	VENTURI ASSY, 5220
8	5378	BURNER TOP ASSY, 5220
9	0601	NUT, WING, 10-32, SST
10	27900	AIR SHUTTER, PROFILED, 5220
11	27901	WASHER, BOWED, 5 MM, A2 SS, SPAENAUR 681-821
12	05047	SCREW, TRUSS-H-P, 8-32 X 3/8, SS