Remote Start Electronics
P-5050 / P-5100 / S-8500
TEG Controller

Operating Manual

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1 BOARD OVERVIEW

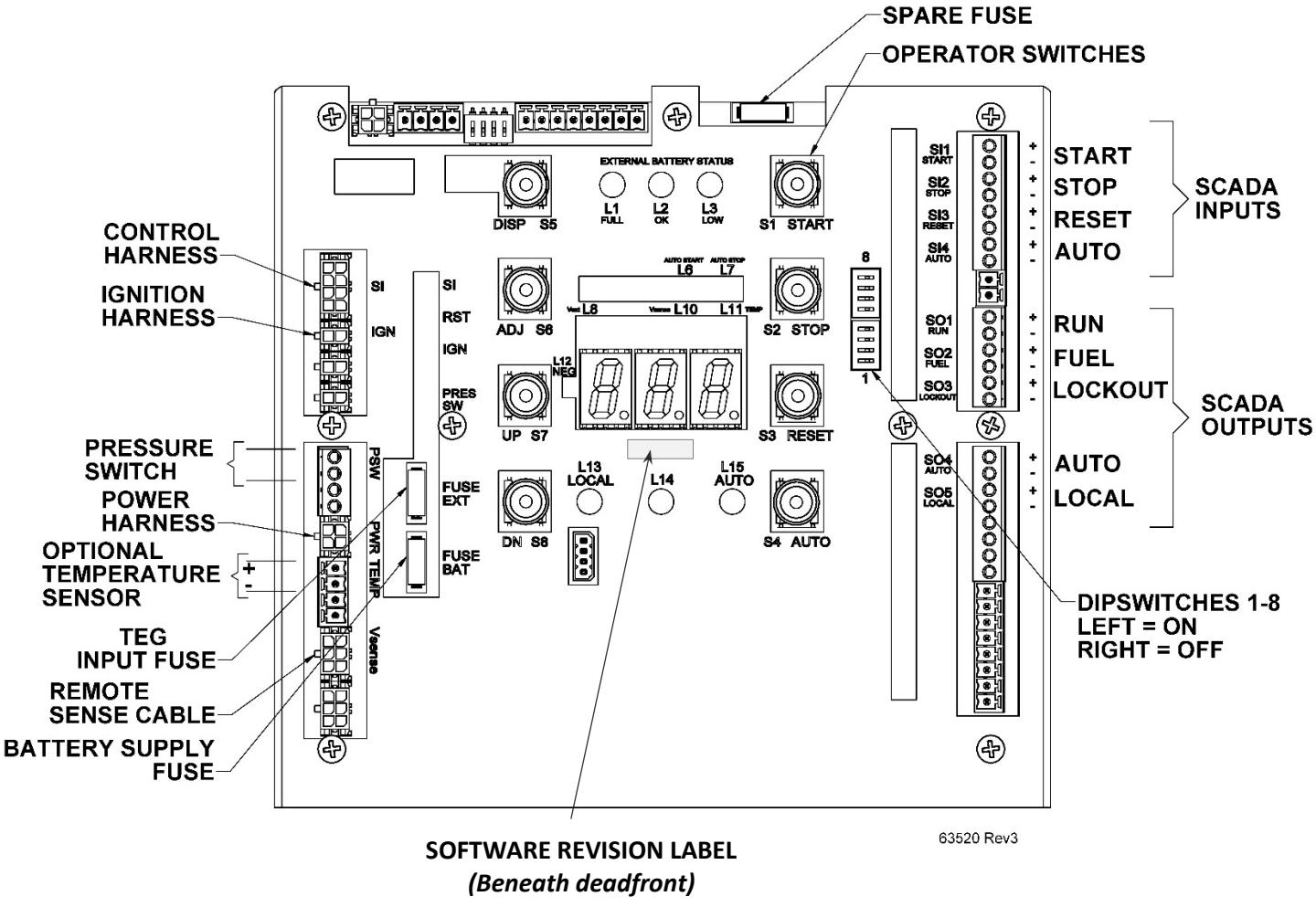
1.1 Introduction

The Remote Start Board (also known as the TEG Controller) provides a method of starting and stopping the TEG either locally or remotely, using on-board buttons, SCADA signal interfacing, or battery voltage measurements.

This manual should be used in conjunction with the TEG Operating Manual for your Model P-5050, P-5100, or S-8500 Generator.

The contents of this manual are for Software Revision 6. The board's software revision is shown on the display during powerup in the format [r.##]. It is also viewable on a software revision label below the numeric display, underneath the deadfront. If you have a Remote Start board with an older revision of software then it is recommended to use the manual that shipped with it, as older software revisions will not fully match the content of this manual.

1.2 Board Diagram



2 FEATURE DESCRIPTIONS

2.1 Fuel Pressure

The pressure switch is connected to the Remote Start Board when it is part of a TEG system. Only if there is fuel available, observed by closed pressure switch contacts, will any ignition requests be attempted. If an ignition request is received with no fuel pressure, the 7-segment display will show [nPS] to indicate the pressure switch has not closed.

2.2 Ignition & Lockout

The Remote Start Board sends an ignition signal to the spark ignition control system (SI Controller) when it receives a start request, and removes the ignition signal when it receives a stop request. During an ignition sequence, the Remote Start Board monitors the Valve On signal from the SI system. If the Valve On signal is not maintained after three ignition trials, the Remote Start Board will enter the Lockout state. During Lockout, the SCADA Lockout Output (SO3) will be asserted, and ignition attempts while in the Lockout state will be ignored and cause [LOC] to flash on the 7-segment display. A reset must be performed either locally with the Reset button or remotely through the SCADA Reset input before any start requests can be reattempted.

2.3 Local and Remote Modes

Any button press causes the Remote Start's operating mode to be switched to Local mode, indicated by the L13 indicator being lit. Any Auto/SCADA starts are ignored until this mode times-out and switches back to Remote operating mode, in which indicator L13 is off. Local mode is held for 1 hour since the last button press, and Indicator L13 will begin blinking 5 minutes before this 1-hour ends. Stop requests are always accepted and acted upon in either operating mode. The operator can manually force the board back into Remote operating mode by displaying the Cycle Count.

2.4 Auto Mode

Turning on Auto functionality enables system-measurement controlled operation while in Remote mode. This mode is recommended for station battery charging systems to improve fuel efficiency and can be toggled on and off by pressing the Auto switch S4 or by applying a SCADA Auto input signal. As long as the Remote Start Board is in Auto Mode and not in Local mode, it will automatically attempt to start the TEG when the system voltage has fallen below the Auto Start threshold, and it will stop the TEG once the system voltage has recovered to above the Auto Stop threshold.

The Remote Start Board enforces a minimum 4-hour runtime for Automatic starts to preserve the operational lifetime of the TEG power unit. Auto Start and Auto Stop voltage setpoints are user adjustable. If an external DC-DC Converter is used between the TEG output and the station battery, like the 24-48V Converter used on 48V TEG models, then the Remote Voltage Sensing dipswitch-3 must be set, and the Remote Sense Cable (GPT# 300203) must be installed for Auto mode to function correctly.

2.5 Voltage Indicators

The Remote Start Board has a heartbeat; one of three L1, L2, or L3 indicators blinks depending on the system voltage level. If the voltage level is below the Auto Start threshold, L3 will blink red. If the voltage level is between the Auto Start and Auto Stop thresholds, L2 will blink yellow. And if the voltage level is above the Auto Stop threshold, L1 will blink green. The system voltage is your TEG output voltage (V_{EXT}), unless Remote Sensing is enabled in which case the indicators will be based off the V_{SENSE} input voltage.

2.6 Sleep Mode

The Remote Start Board enters a low-power sleep mode when there is no power available from the TEG output. In sleep mode the heartbeat is very short and less frequent to conserve battery power. Pressing any button or receiving any SCADA input for five seconds will wake up the Remote Start Board. Note that SCADA Outputs are disabled when in Sleep Mode, but they will reenable when the board is woken up. If Auto Mode and Remote Voltage Sensing are both enabled, the board will continue to monitor V_{SENSE} voltage while sleeping to determine if an Auto Start should occur.

2.7 Cycle Count

Pressing both the up and down pushbuttons simultaneously while the Remote Start Board is in the display menu will cause it to read the total number of cycles the TEG has gone through. It will read [CYC] on the 7-segment display, followed by the cycle count number. The cycle count increments every time the TEG is started and runs uninterrupted for at least 15 minutes. Local Mode will also be forcibly turned off when viewing the cycle count; this can be utilized for system testing and commissioning.

2.8 Overvoltage Protection

The Remote Start board has built-in safety features for overvoltage protection. If it detects voltage to be above preset thresholds of 17V/34V/68V for 12V/24V/48V configuration, it will shut down the TEG. In this case indicator L1 will blink rapidly and the 7-segment display will show [HI] to inform users of the overvoltage condition.

2.9 Optional Temperature Sensor

The Remote Start Board performs temperature-compensation logic on station battery voltage measurements when a temperature sensor (GPT Part Number: 56980) is connected to the TEMP input connector. This ensures the best accuracy for Auto mode operation regardless of the environment conditions and is recommended for all systems utilizing Auto mode in harsh climates. The temperature sensor should be attached to one of the posts of the station battery. If not connected, the Remote Start Board defaults to 25°C (77°F).

3 BOARD CONNECTIONS, INDICATORS, AND SETTINGS

3.1 Operator Switches

Interface	Operation
S1 button - **Start**	Operator button to manually start the TEG.
S2 button – **Stop**	Operator button to manually stop the TEG.
S3 button – **Reset**	Operator button to manually reset the Lockout state.
S4 button – **Auto**	Operator button to manually switch Auto functionality ON or OFF.
S5 button – **Display**	Operator button to turn on the display and rotate through measured values.
S6 button – **Adjust**	Operator button to turn on the display and rotate through adjustable setpoints.
S7 button – **Up**	Operator button for incrementing a setpoint.
S8 button – **Down**	Operator button for decrementing a setpoint.

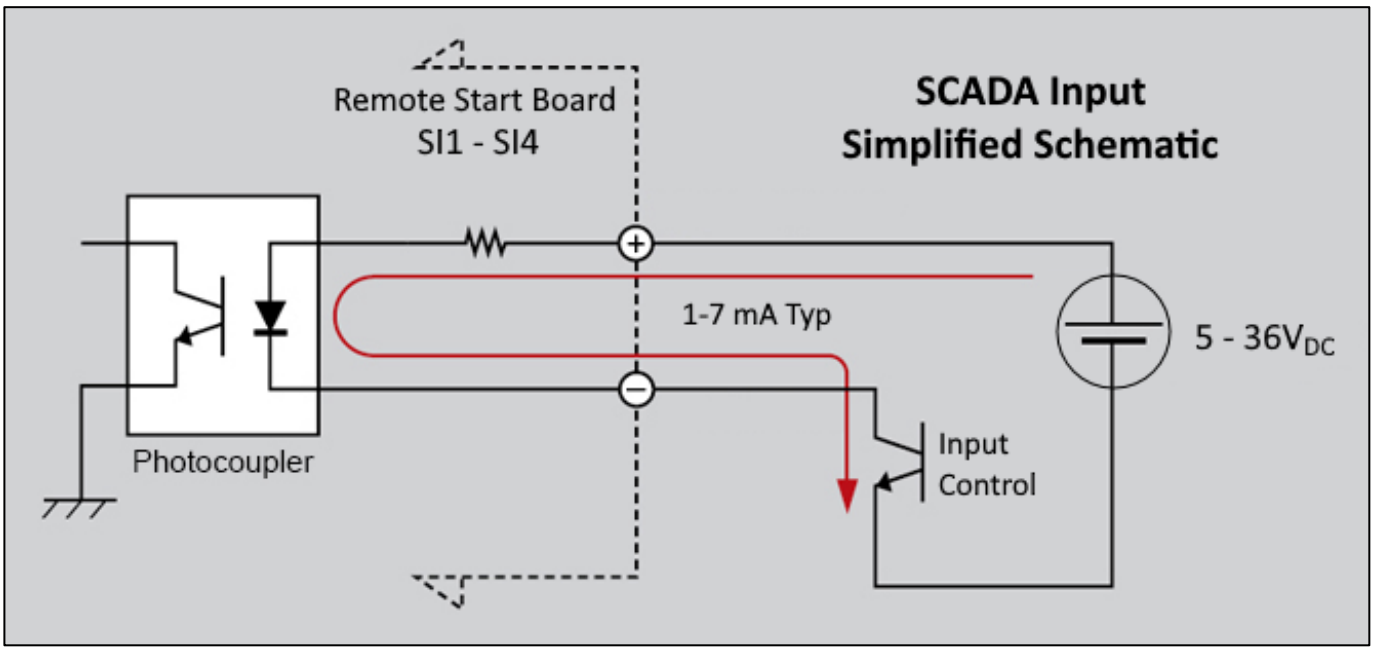
3.2 SCADA Connections

The SCADA connections are sinking digital inputs and outputs designed to interface with your application.

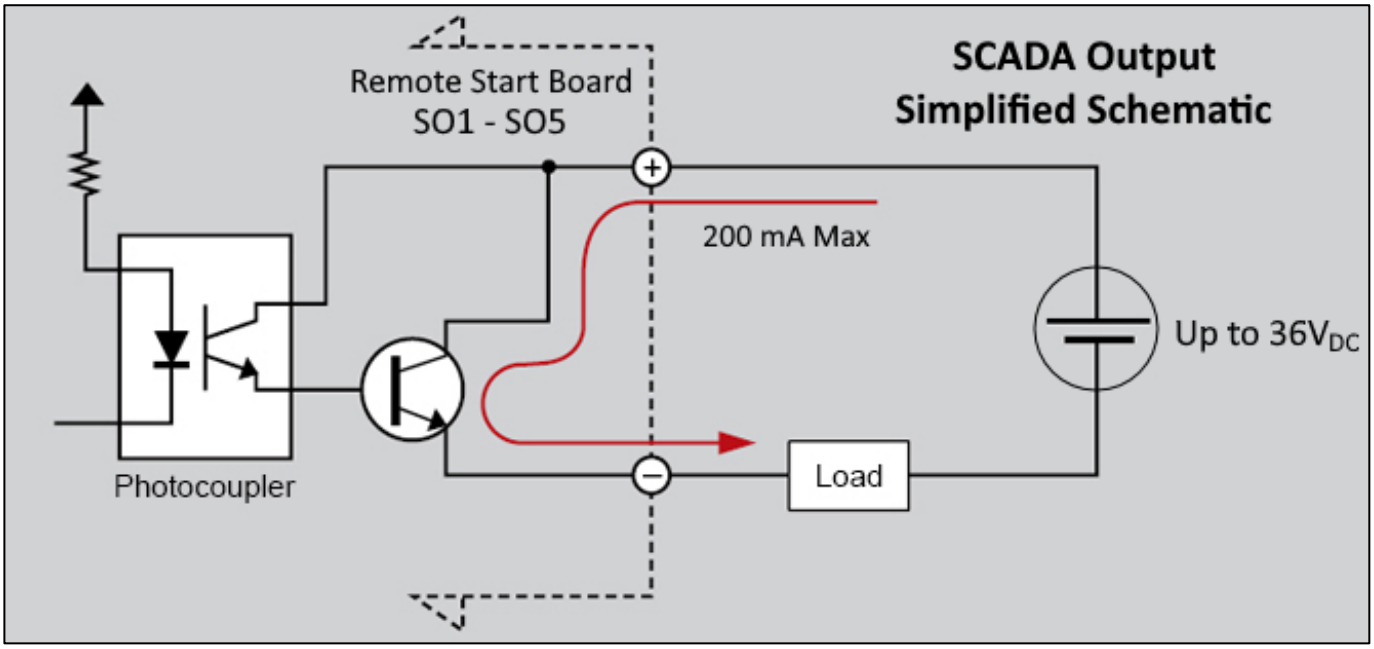
It is important to wire your SCADA connections with the correct polarity. If the polarity is reversed, a SCADA Input will act always-off, while a SCADA Output will act always-on.

Interface	Operation	Specs
SI1 - SCADA Start input	Signal received from the SCADA system to request a TEG start	5-36 V_{DC}
SI2 - SCADA Stop input	Signal received from the SCADA system to request a TEG stop	1-7mA
SI3 - SCADA Reset input	Signal received from the SCADA system to request a reset of the Lockout state	5 second minimum hold time (*if sleeping*)
SI4 - SCADA Auto input	Signal received from the SCADA system to toggle the Auto Functionality ON or OFF	
SO1 - SCADA Run output	Signal to the SCADA system that the TEG is running. Blinks during TEG startup, solid once TEG is fully online.	Up to 36 V_{DC} 200mA contact closure
SO2 - SCADA Fuel output	Signal to the SCADA system that the fuel pressure switch is closed, indicating fuel is available.	
SO3 - SCADA Lockout output	Signal to the SCADA system that the SI System failed to start after three spark attempts.	
SO4 - SCADA Auto output	Signal to the SCADA system that the Auto functionality is ON.	
SO5 - SCADA Local output	Signal to the SCADA system that the TEG is operating in Local mode. SCADA start signals are ignored until Local mode timeout.	

A reference SCADA Input schematic is shown below to assist with connecting your SCADA application. SCADA Inputs require a 5-36 V_{DC} wetting power source (such as a station battery or TEG output) and will sink 1-7 mA when active, based on the applied voltage. Commonly used input controls are switches, relay contacts, or PLC outputs. SCADA Inputs are floating and isolated from each other, so each individual input requires wetting. SCADA Inputs may be used with low side or high side control.



A reference SCADA Output schematic is shown below to assist with connecting your SCADA application. SCADA Outputs are optically isolated open-collector types. Each SCADA Output requires a power source (such as a station battery or TEG output) of up to 36 V_{DC} and is rated to 200 mA. SCADA Outputs can directly power light loads or can connect through a relay or PLC input to interface with control logic. An interposing relay should be used to drive heavier loads.



3.3 LED Indicators

Indicator	Operation
L1 Indicator – FULL	Station battery voltage status indicator. Blinks if voltage is above the Auto Stop voltage.
L2 Indicator – OK	Station battery voltage status indicator. Blinks if voltage is below the Auto Stop voltage but above the Auto Start voltage.
L3 Indicator – LOW	Station battery voltage status indicator. Blinks if voltage is below the Auto Start voltage.
L6 Indicator – AUTO START	Blinks during Auto Start setpoint adjustment *(Adjust Menu)*
L7 Indicator – AUTO STOP	Blinks during Auto Stop setpoint adjustment. *(Adjust Menu)*
L8 Indicator – V_{EXT}	Lights when TEG output voltage is being displayed. *(Display Menu)*
L10 Indicator – V_{SENSE}	Lights when voltage on the V_{SENSE} input is being displayed. *(Display Menu)*
L11 Indicator – TEMP	Lights when temperature on the TEMP input is displayed. *(Display Menu)*
L12 Indicator – NEG	Indicates the number displayed on the 7-segment display is negative.
L13 Indicator – LOCAL	Indicates the system is in Local mode and ignoring SCADA Start commands.
L15 Indicator – AUTO	Indicates that Auto functionality is ON.

FUSE EXT	TEG voltage supply 2A fuse has adjacent fuse-blown LED indicator.
FUSE BAT	Battery supply 2A fuse has adjacent fuse-blown blinking LED indicator.
L14 & **CM1**/**CM2** Indicators	*Used in manufacturing only. Can be ignored.*

3.4 Dipswitch Settings

If your Remote Start board came preinstalled on your TEG, then the dipswitches are already configured and will not need adjustment. If the Remote Start board is being field-installed, or your system voltage requires changing, these settings should be reviewed.

Dipswitches are only scanned during board powerup. After changing dipswitches, the power connector *must* be physically removed from the board for at least five seconds for the changes to take effect.

Looking straight at the board, a dipswitch is OFF if it is set RIGHT, and ON if it is set LEFT.

Dipswitch 1	Dipswitch 2	Dipswitch 3
System Voltage Selector	**48V Selector** *(overrides dipswitch #1)*	**Remote Voltage Sense** *(required for 48V systems)*
OFF = 12V **ON** = 24V	**OFF** = 12V or 24V **ON** = 48V	**OFF** = Auto Mode reads V_{EXT} **ON** = Auto Mode reads V_{SENSE}
Dipswitch 4	**Dipswitch 5**	**Dipswitches 6 / 7 / 8**
Minimum Run Timer Disable *(for commissioning only)*	**Legacy SI Controller Compatibility Switch**	*Reserved for future use*
OFF = 4 hour minimum **ON** = 15 minute minimum	**OFF** = 300065 or 64624 **ON** = 62585	**OFF**

Dipswitches **1** and **2** will select your system voltage configuration. If dipswitch 2 is on, dipswitch 1 will be ignored. For details on how to switch a P-5050 or P-5100 Limiter/Converter between 12V and 24V output, refer to the latest revision of the TEG operating manual.

Dipswitch **3** enables Remote Voltage Sensing. This is required for Auto Mode functionality with any 48V TEG, and also with 12V model S-8500 TEGs. When enabled, the board will make Auto Start and Auto Stop decisions based on the V_{SENSE} voltage input rather than the V_{EXT} voltage. This allows the Remote Start board to monitor station batteries that are at a different voltage than the TEG output voltage.

Dipswitch **4** will adjust the minimum runtime required between an Auto Start and Auto Stop. It is strongly recommended to leave this dipswitch on during normal operation to improve power unit lifetime, but the dipswitch may be turned off temporarily for system testing during commissioning.

Dipswitch **5** is used to select which version of Spark Ignition Controllers is being paired with the Remote Start board. TEG systems using the legacy 62585 SI Controller will need this dipswitch turned on. Look for the GPT part number label on the SI Controller board to determine which board your TEG uses.

Dipswitches **6**, **7**, and **8** are reserved for future use and should be left off.

3.5 Auto Mode Setpoints

System Voltage Configuration	Auto Minimum Value	Auto Start Default Value	Auto Stop Default Value	Auto Maximum Value	Overvoltage Threshold
12 V	11.0	12.2	13.6	15.0	17.0
24 V	22.0	24.4	27.2	30.0	34.0
48 V	44.0	48.8	54.4	60.0	68.0

When adjusting Auto Start and Auto Stop setpoints, the board will enforce a minimum of 0.5V between them. This increases to 1.0V for 48V Systems.

4 OPERATING INSTRUCTIONS

Common operating procedures are detailed below. Instructions are listed for Local operation on-site and Remote operation through SCADA Inputs, when applicable.

4.1 Starting the TEG

With the Remote Start board not in the Lockout state, press the Start button (S1).

-OR-

Apply a SCADA signal across the SCADA Start input (SI1) for at least 5 seconds. The SCADA Start command will be ignored if *any* of the following three conditions are true:

I. The board is in the Lockout state.
II. The board is in Local Mode.
III. The board is in Auto Mode, and the system voltage is already above the Auto Stop voltage.

4.2 Stopping the TEG

Press the Stop button (S2). This will also turn off Auto Mode if the TEG was running.

-OR-

Apply a SCADA signal across the SCADA Stop input (SI2) for at least 5 seconds. This will also turn off Auto Mode if the TEG was running.

4.3 Resetting TEG Lockout

Press the Reset button (S3).

-OR-

Apply a SCADA signal across the SCADA Reset input (SI3) for at least 5 seconds. Allow an additional 5 seconds before sending any subsequent SCADA signals.

4.4 Toggling Auto Mode

Press the Auto button (S4) to toggle Auto Mode on or off.

-OR-

Apply a SCADA signal across the SCADA Auto input (SI4) for at least 5 seconds to toggle Auto Mode on or off. Note that the current status of Auto Mode can be read from the SCADA Auto Output (SO4).

4.5 Display Menu Navigation

Press the Display button (S5) to enter the display menu. Subsequent presses of the Display button (S5) will rotate through the available measurements (listed below) and then exit the display menu. The corresponding LED indicator above the display will also light. When running off backup battery power, the board will time-out after a moment of inactivity and exit the menu.

I. L8: V_{EXT} – The TEG output voltage is displayed.
II. L10: V_{SENSE} – The voltage read from the Remote Voltage Sense input is displayed. This will be zero if the Remote Sensing Cable is unused or disconnected.
III. L11: TEMP – The temperature of the optional temperature sensor input is displayed. If no temperature sensor is connected, it will display [ERR] instead.

4.6 Adjusting Auto Setpoints

Press the Adjust button (S6) to enter the adjustment menu. Each subsequent press of the Adjust button (S6) will rotate through the available setpoints (listed below) and then exit the adjustment menu. The corresponding LED indicator above the display will also blink. When running off backup battery power, the board will automatically time-out after a moment of inactivity and exit the menu. Press the Up button (S7) or Down button (S8) to adjust the displayed setpoint. Any changes made will be saved when exiting the adjustment menu.

I. L6: Auto Start – The V_{EXT} or V_{SENSE} voltage level at which the TEG will start if in Auto Mode and not in Local mode.
II. L7: Auto Stop – The V_{EXT} or V_{SENSE} voltage level at which the TEG will stop if in Auto Mode, not in Local mode, and the minimum run timer has expired.

Auto Mode settings are based on your system voltage level. Refer to the Auto Mode Setpoints section of this manual and the Auto Mode feature description for further information.

4.7 Displaying Cycle Count and Exiting Local Mode

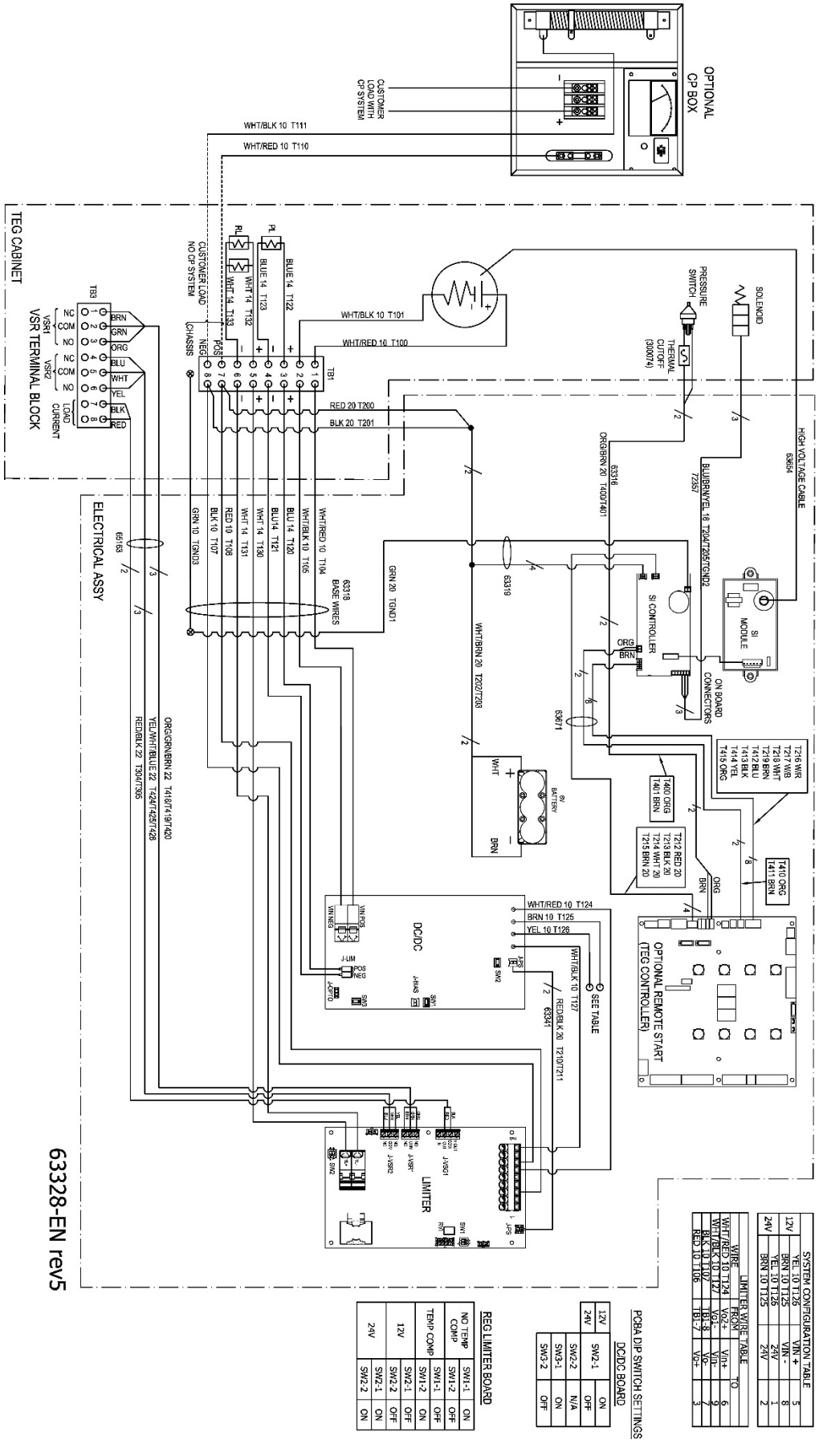
If Auto Mode is enabled as Local Mode is cleared, the TEG may immediately try to turn on if the system voltage is below the Auto Start setpoint. Be prepared for this, and exercise caution when manually exiting Local mode.

A. Press the Display button (S5) to enter the display menu.
B. While in the display menu, press the Up button (S7) and Down button (S8) simultaneously.
C. The display will briefly flash [CYC] and then a number [###], which represents the number of times the TEG has started and run uninterrupted for at least 15 minutes.
D. Local mode will be turned off a few seconds later as the system exits the display menu.

5 REMOTE START WIRING DIAGRAMS

These wiring diagrams can also be found in your respective TEG operating manual.

5.1 Model P-5050 & P-5100 Remote Start Wiring Diagram



SYSTEM CONFIGURATION TABLE		
12V	YEL 10 T125	VIN +
	BRN 10 T125	VIN -
24V	YEL 10 T125	24V
	BRN 10 T125	24V

LIMITER WIRE TABLE		TO
WIRE	PROM	
WHT/RED 10 T124	Vo2+	6
WHT/BLK 10 T127	Vo2-	9
BLK 10 T107	TB1-8	7
RED 10 T106	TB1-7	3

REG LIMITER BOARD		
NO TEMP COMP	SW1-1	ON
	SW1-2	OFF
TEMP COMP	SW1-1	OFF
	SW1-2	ON
12V	SW2-1	OFF
	SW2-2	OFF
24V	SW2-1	ON
	SW2-2	ON

PCBA DIP SWITCH SETTINGS DC/DC BOARD		
12V	SW2-1	ON
24V		OFF
	SW2-2	N/A
SW3-1		ON
SW3-2		OFF

5.2 Model S-8500 Remote Start Wiring Diagram