

Solar Converters Inc.
(Since 1994)

MANUAL
Model: GS-1AC Generator Starter
Solar Converters Inc. - Rev. E

Warning: To prevent inadvertent operation of the generator, connect the battery only to the unit and set-up the start/stop voltages to the required levels before connecting any of the relay controls.

1.0 Specification

1.1 Electrical

Nominal battery voltages	12 - 48V DC
Maximum Input (V)	63
Minimum Voltage	10
Relay:	8 amps @ 12/24V, 2 amp @ 48V, 5 amps @ 120 VAC Basically rating of Potter and Brumfield T72 series relay For more current, use these relays to drive larger relays
Self-Consumption	
Relay Power	0.5W per relay coil when powered, voltage independent
Quiescent less than	<25 mA
Fusing	0.5A resetable fuse, internal electronics only

1.2 User Controls

MID Scale Set Voltage: 1.4V
 Generator Stop Set Voltage: 1.6V
 Generator Start Voltage: 1.2V
 Manual start/stop toggle switch overrides remote smart stop control
 Remote start/stop
 Crank Time (1-10sec)
 Run Time (approx. 0.6 – 3 hrs)

1.3 LED Display

Generator start/stop
 Relay position for precrank, crank, load, run, 2x stop, fault

1.4 Mechanical

Weight: 1 lb.
 Size: 7" X 6" X 2" Open frame, mounted to aluminum plate.

Connections:
 Power: Euro-style Terminal Strip # 14 AWG

Operating Temperature: -40 to 60 deg. C
 Humidity: 0 - 90% non-condensing,

2.0 Power Connections

Warning: This unit operates from multiple **Hazardous** energy sources. Ensure that all power sources are inactive before making any connections to this unit. Ensure proper procedures and the appropriate electrical codes are followed. To be serviced and operated only by qualified personnel.

2.1 Ground

Using wire of sufficient amperage (min. #12 AWG) connect the ground of unit to appropriate system ground as required by the appropriate electrical code. Note this ground is not internally connected to any of the unit's terminals.

2.2 Battery Connection

Output voltage: 10- 63 V

Output current: 0 - .5A max., Standby 25 ma,

Warning: Ensure the battery is disconnected and/or safe operating procedures are followed when making battery connections. Extreme care must be taken to ensure the battery is not shorted. BE SAFE. Make sure all strands are inside their respective terminals. The battery must be fused. Qualified personnel only to connect and operate this unit.

Using wire of sufficient amperage for the battery connection #16 AWG or better connect the positive of the battery (through the strain relief) to the positive battery connection of the control unit marked BAT +. Similarly connect the negative of the battery to the negative battery connection of the solar regulator terminal block.

2.3 Generator Start Sense Connection

Using wire of sufficient amperage for the connection, #20 AWG or better and an in-line 1/2 amp fuse (AGC 0.5 or similar, connect the LD+ terminal of the unit to the generator Output hot or line connection. The crank relay will disengage and the generator will stop cranking when the unit sees 3 cycles of 60 Hz Over 60 Vac.

Also there is an option to connect a 12V Class 2 transformer to detect the AC voltage. This transformer is hooked up to the AC output of the generator to drop the voltage to 12V AC which is hooked up to the 12 VAC connector on the generator starter. When the 12V AC is detected the generator will stop cranking.

SETUP the generator start and stop battery voltages See Section 4.1

WARNING: SETUP the generator start/stop voltage BEFORE connecting to the relays to prevent inadvertent or wrong commands sent to the generator via the relays. This unit uses the measured battery voltage compared to the desired start/stop voltage and its logic is setup to act accordingly.

2.4 Relay Connections

WARNING: SETUP the generator start/stop voltage BEFORE connecting to the relays to prevent inadvertent or wrong commands sent to the generator via the relays. This unit uses the measured battery voltage compared to the desired start/stop voltage and its logic is setup to act accordingly.

This unit has many features and can perform a number of generator care taking functions. Evaluate the basic functions that are required and connect to the appropriate relays to actuate the various functions. See the section of start-up and shutdown sequence for the relay timing.

ALL relays are NO (Normally Open) contacts. If more power is required than the relay rating, these relays may drive the coils of larger relays to actuate the required function.

Fault:

If the generator dose not start and the battery continues to drop, when the battery reaches approximately 0.25V below the low set point the generator starter will reset and go through the start up sequence. If this attempt fails and the battery continues to drop, at approximately 0.5V below the low set point the generator starter will reset and go through the start up sequence again. If this final attempt fails the fault relay will come on at 0.75V below the low set point to signal that there is something wrong with the generator. It will also be actuated if the start/stop toggle switch is left in the start position.

Precrank:

The precrank relay is actuated for 20 seconds before any generator control relays are actuated. It can be used to signal generator start, heat glow plugs, start air compressors, and fuel pumps etc.

Crank:

This relay is actuated to crank the generator

Run:

This relay is actuated anytime the generator is cranking or expected to run. For many generators or for single wire start generator, this would be the normal connection.

Load:

This relay is actuated and is used to control the timing of loading the generator. It waits a few seconds to allow the generator to get up to speed before applying the battery-charging load on start-up. Conversely it works with the stop relay on generator stop to unload the generator for a few seconds before the generator actually is shutdown. A common use of this function is when chargers are used and it is not desirable to subject the battery charger to low generator voltage conditions.

Stop:

The stop relay is used to signal the generator to stop.

2.5 Temperature Compensation

This regulator is designed to use the voltage of a temperature sensitive zener (National Semiconductor # LM335Z or equiv.) attached at the battery location (hence battery temperature). This unit is available from Solar Converters Inc. as Model No. TC-2.

Connect a resistor in the TC-set terminals to instruct the unit what temperature compensation is required. A 36.5 K resistor (shipped with unit) gives temperature compensation of 4.5 mv / deg C / Cell for a typical 12 V battery. A 24 V battery uses 18 K and a 48 V battery uses 9.1k. The temperature compensation scales directly. For double Temp - comp - or 9 mv/deg C / Cell for a 12 V battery, take 1/2 the resistance or 18.2 K for TC set.

Warning: If temperature compensation is not used, a TL431 zener regulator must be connected between the TC+ and TC- terminals (its default condition). Lack of this part will not harm the regulator, but will require re-adjustment of the battery setup voltage.

If temperature compensation is being used, remove the TL431 regulator from TC+ and TC-. Using a wire of sufficient amperage (#24 AWG or better) connect the TC+ terminal to the anode (the red lead) of the temperature sensitive zener. Similarly connect the TC- terminal to the cathode (the black lead) of the temperature sensitive zener (LM335Z).

Warning: This connection is not line isolated. Do not expose to any voltage not reference to the low voltage ground of the regulator.

Note: Shielded twisted pair is recommended if the batteries are a "substantial" distance from the regulator.

2.6 Remote Stop/Start

The generator may be started and stopped remotely by momentarily shorting (for a couple of seconds) the start and stop terminal positions on the start/stop terminal block. Note that the toggle switch overrides this function. **The normal position for this terminal block is to have none of the terminals shorted.** If left shorted, this will offset the generator start and stop voltages, making these settings inaccurate.

Note: The stop on the remote connector will reset the onboard time delay and stop the generator immediately.

3.0 LED Indicators

This unit has LEDs to signal to relay position and start/stop sequence.

Start LED:

The unit is in its start sequence and is running the generator.

Stop LED:

The unit is in its stop sequence, and the generator is stopped.

Fault, Precrank, Crank, Run, Load, Stop LEDs:

The unit's relays with the same name are actuated with the corresponding LED. See the section on relay connections, section 2.3.

4.0 User Controls

4.1 SETUP the generator start and stop battery voltages

WARNING: SETUP the generator start/stop voltage BEFORE connecting to the relays to prevent inadvertent or wrong commands sent to the generator via the relays. This unit uses the measured battery voltage compared to the desired start/stop voltage and its logic is setup to act accordingly.

Note: The set points should not be set if the input voltage is below 11V.

The unit has 3 adjustment pots for mid scale, Generator start and generator stop setpoints.

Note: Adjust the midscale pot first.

The set points have a 1/10-scale factor. To set a setpoint to trip at 12 V for example, set the set point to 1.2V. To set it to trip at 48.5 V, set the setpoint to 4.85 V.

- 1) Power the unit with any source 11 V to 60 V connected to its Bat + and BAT - of the terminal blocks.
- 2) With a voltmeter connected to the test point ground (GND) and the TPm setpoint, adjust the midscale set point pot such that the voltmeter reads 1/10th the voltage that the generator's start and stop. For example start: 12V and stop: 16V, midscale voltage would be 14, which is 1.4V.
- 3) With a voltmeter connected to the test point GND and the TP- setpoint, adjust the Gen Start set point pot such that the voltmeter reads 1/10th the voltage that the generator is to turn start at.
- 4) With a voltmeter connected to the test point GND and the TP+ setpoint, adjust the Gen Stop set point pot such that the voltmeter reads 1/10th the voltage that the generator is to turn off at.

4.2 Adjustable Crank Time

Crank time is adjustable by a pot near the centre of the board. Adjustable range is between 2 and 10 seconds. Turning pot all the way clockwise is 10 seconds and turning all the way counter clockwise is 2 seconds.

4.3 Adjustable stop time delay

A timer is provided to delay the stop sequence of the generator starter in order to keep charging the batteries after the voltage has reached the high set point. This feature is useful in situations where there is a small battery bank and a large generator that is capable of bringing up the battery voltage quickly but not necessarily completely charging the battery. The run time pot on the board is user adjustable to increase or decrease the amount of the time delay. Turning the pot all the way to the left sets the minimum time, which is approximately 6 minutes. Turning the pot all the way to the right is the maximum time of approximately 3 hours.

4.4 Generator Stop/Start

IMPORTANT NOTE: For normal operation, this switch is left in the middle or “**Normal**” position. If left in the stop position, the generator will never start, never charging the battery. If left in the start position, the generator will never stop, overcharging the battery.

A toggle switch located in the upper left corner may be used to override the setup voltages and force the unit into its start or stop sequence.

Start: **NOTE:** DO NOT LEAVE IN THE START POSITION

To start the generator at any time, move the toggle switch to the start position. The Fault light and relay will come on (Warns of this position) and approx. 25 seconds later the generator start light comes on and the unit generator start up sequence begins. Once the start-up sequence is started, move the toggle switch back to its “normal” position.

Stop:**NOTE:** DO NOT LEAVE IN THE STOP POSITION

To stop the generator at any time, move the toggle switch to the stop position for approx. 2 seconds and the generator stop sequence will begin. Once the stop sequence is started, move the toggle switch back to its "normal" position.

Note: The stop position of the toggle switch will initiate the stop sequence **which includes the time set by the run time pot.** If a quick shutdown is required without the time delay the remote stop must be used.

Reset: By shorting the **RST** pin to battery +, all the logic function are reset to start-up state and the unit goes through its stop sequence.

5.0 Generator Function**5.1 Sequence of operation on start-up**

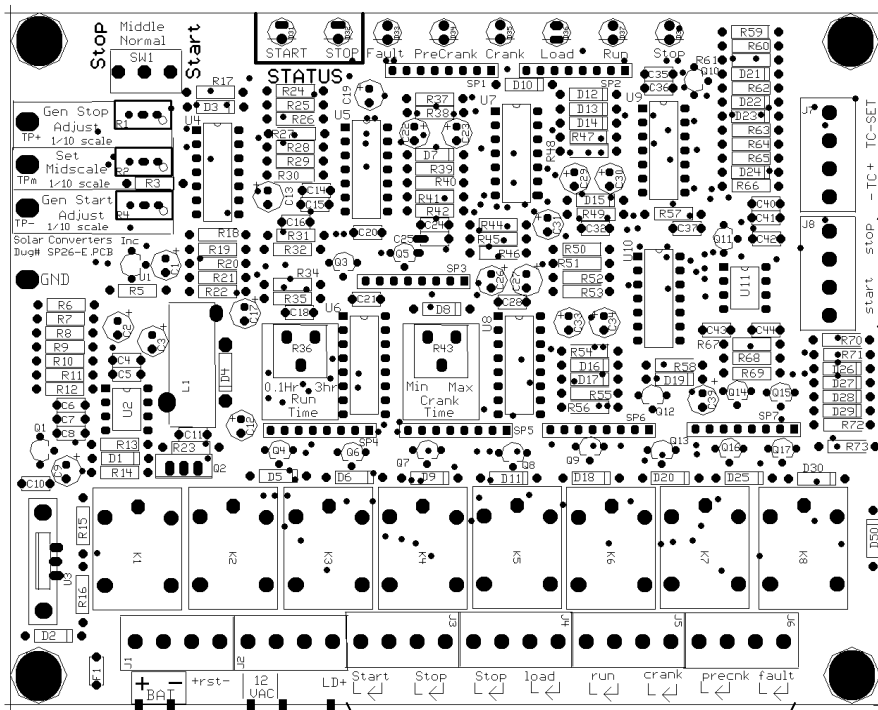
When the battery voltage is detected as too low per user adjustable setpoint, or the toggle switch or the remote start-up is actuated, the generator goes through its start sequence:

- 1) The Generator start LED comes on.
- 2) Precrank: 20 seconds relay closure (with LED on) prior to generator start/crank.
- 3) Crank: relay closure (with LED on) for **adjustable for 1 to 10 seconds** or until Genset start detected defined by generator/battery voltage starting to rise.
- 4) Run: Relay closure (with LED on) whenever generator is cranking or running.
- 5) Load: load relay closure (with LED on) 30 seconds after run relay closure.
- 6) If the generator dose not start and the battery continues to drop, when the battery reaches approximately 0.25V below the low set point the generator starter will reset and go through the start up sequence. If this attempt fails and the battery continues to drop, at approximately 0.5V below the low set point the generator starter will reset and go through the start up sequence again. If this final attempt fails the fault relay will come on at 0.75V below the low set point to signal that there is something wrong with the generator.

5.2 Sequence of operation on shutdown

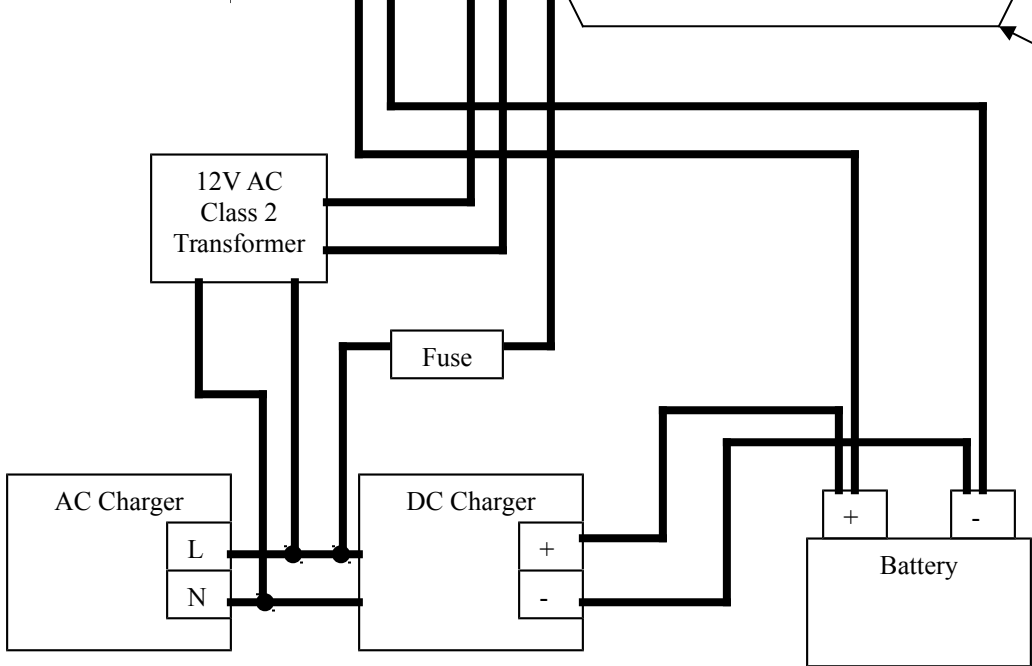
When the battery has charged to the user adjustable setpoint, or the toggle switch or the remote start-up is actuated, the generator goes through its stop sequence:

- 1) Once the battery reaches the high set point a timer will start that will delay the shut down sequence for a user settable amount of time, minimum time being approximately six minutes and the maximum time being 3 hours.
- 2) The Generator Stop LED comes on, start light turns off.
- 3) Load: Load Relay opens (with LED off).
- 4) Run: Run relay opens (with LED off) 20 seconds after load relay opens.
- 5) Stop: Relay Closes (with LED on) for 10 seconds after run relay opens.
- 6) All internal logic resets itself upon completion of the stop cycle.



Remote generator start/stop control

Connect generator start/stop controls here



Notes:

Pre crank: Usually used to light a warning or for glow plugs

Run: In 2 wire systems is the main control line. When on, the generator is either commanded or expected to be running.

Stop: is used in a 3 wire systems to signal the top function, run signals the start function

Load: is used to delay the application of the load on the generator to allow warm up. On shutdown it is typically used to protect a charge controller from under voltage as the generator winds down after being stopped by the stop command.

Fault: is used to signal the generator likely did not start. Before this signal turns on there were 3 attempts at starting the generator that failed. This signal can be used for remote telemetry.

Crank Time: controls the crank time of the crank relay.

Run Time: Sets the time delay between the battery reaching the high set point voltage and shutting off.

The unit is temperature compensated with the T Comp set at -4 mv/deg C/cell . For remote temperature compensation use the TC-2 temperature sensor available from Solar Converters Inc.

WARRANTY

The product is warranted to be free from defects in material and workmanship for a period of one (1) year from the date of purchase by a retail customer. The purchase date must be evidenced by a valid and original sales receipt. In lieu of sales receipt, factory will use code date on its label. Removal of the Solar Converters Inc. label or serial number will void the warranty.

Product liability, except where mandated by law, is limited to repair or replacement at the manufacturer's discretion. No specific claim of merchantability or use shall be assumed or implied beyond what is printed on the manufacturers printed literature. No liability shall exist from circumstances arising from the inability to use the product, or its inappropriateness for any specific purpose or actual use, or consequences thereof for any purpose. **It is the user's responsibility to determine the suitability of the product for any particular use.** Solar Converters Inc. shall not be liable for any damages or any kind including without limitation, special, incidental or consequential obligations and liabilities of Solar Converters Inc. and the remedies of Buyer set forth herein shall be Solar Converters Inc. sole and exclusive liability.

Failure to provide a safe and correct installation, safe operation, or care for the product will void the warranty. Personal safety, and compatibility with any other equipment is the ultimate responsibility of the end user. Any returned product that shows significant evidence of abuse may not be covered by this warranty. Installation must be performed by a person with qualification to insure safe and effective operation and the installation thereof certifies that the installer has the technical qualifications to do so.

Solar Converters Inc. cannot guarantee the compatibility of its products with other components used in conjunction with Solar Converters Inc. products, including, but not limited to, solar modules, batteries, and system interconnects, and such loads as inverters, transmitters and other loads which produce "noise" or electromagnetic interference, in excess of the levels to which Solar Converters Inc. products are compatible. Solar Converters Inc. shall not assume responsibility for any damages to any system components used in conjunction with Solar Converters Inc. products nor for claims for personal injury or property damage resulting from the use of Solar Converters Inc. products or the improper operation thereof or consequential damages arising from the products or use of the products.

The warranties set forth herein are Solar Converters Inc. sole and exclusive warranties for or relating to the goods. Seller neither makes nor assumes any warranty or merchantability, any warranty fitness for any particular purpose, or any other warranty of any kind, express, implied or statutory. Solar Converters Inc. neither assumes nor authorizes any person or entity to assume for it any other liability or obligation in connection with the sale or use of the goods, and there are no oral agreements or warranties collateral to or affecting the sale of the goods.

WARRANTY CLAIM PROCEDURE

In the event of product failure, follow this warranty claim procedure.

1. Make sure the problem you are having is actually due to the suspected product and not some other part of the system. You may call technical support for advanced troubleshooting assistance.
2. If you determine that a Solar Converters Inc. product is actually defective, describe on paper, in detail the exact nature of the failure.
3. The product must be accompanied by proof of the date of purchase satisfactory to Solar Converters Inc.
4. Return the product and description to the business office address, along with your address and a daytime phone number. Purchasers must prepay all delivery costs or shipping charges as well as any other charges encountered, in shipping any defective Solar Converters Inc. product under this warranty policy. **No shipment will be accepted Freight Collect.**
5. Any return shipment from Solar Converters Inc. will be via Canada Post. Foreign shipments will ship best way. Special shipping arrangements are available at the customer's expense.