Field Testing Morningstar SunSaver Controllers

Updated 3/11/99

Notes:

- This testing procedure was developed for use in field conditions where no external power sources are available.
- Due to the nature of the SunSaver controllers, it is possible only to determine whether the unit is functioning properly. It is not always apparent what component has failed or the cause for the failure. It is left up to the technician to determine the cause for the controllers failure based on evidence present at the site (i.e. burned leads, excessive loads, evidence of short circuits on load leads, more PV current than the controller is rated for etc.)
- The procedures outlined below assume a basic knowledge of electric circuits and the necessary safety precautions to be used when working with live circuits present in solar energy systems.

Recommended Tools:

- Digital Multi Meter (frequency and duty cycle measurements are helpful)
- Phillips Screwdriver
- Flat Bladed Screwdriver
- 12V/2A load (Type 1156 Automotive Lamp with socket works well)
- A short length of 12AWG solid wire (6") with a hook in one end to pull cover plate off of SunSaver.

Testing Procedure:

1) No Power applied to the SunSaver
   A) With no power applied to the SunSaver, check for short circuits to ground between the following terminals:
      i) PV (+) and PV (-) terminals
      ii) Battery (+) and Battery (-) terminals
      iii) Load (+) and Load (-) terminals
   B) Check the LVD FET (if controller is equipped with LVD) by measuring a diode drop between the Battery (+) and Load (+) terminals. If no diode drop is present or if an open circuit is measured, the LVD FET is damaged. If no diode drop is present (a short circuit), the unit will still (most likely) regulate the battery voltage properly, however the controller will no longer have LVD capability.
   C) Check for continuity between the ground connections on the terminal strip (PV(-), Battery (-) and Load (-)).
   D) Remove cover from controller. Inspect for burns, damaged traces etc.

2) Battery power applied to the Battery terminals only. The green "Charging" LED should be off.

A) Measure the voltage at the battery terminals.
B) Measure the voltage at the load terminals. The voltage should be the same as the battery voltage. If it is significantly lower, the LVD FET's or the power traces inside the SunSaver are damaged.
C) Measure the voltage at the array terminals. The voltage should be about –2.5Vdc (negative due to the diode drop across the input FET's). If the Green LED is on and/or if battery voltage is measured, the input FET's are damaged and the unit will not regulate the Battery voltage properly.
D) A PC Board "via" is located to the left of the SunSaver terminal strip. This via carries the Gate drive signal to the PWM FET's during charging. With no PV Power connected, the voltage between this via and ground should be less than 1 Vdc. If there is more than 1 volt, then the PWM FET's are most likely damaged.

3) PV and battery power applied to the controller. The green "Charging" LED should be lit.
   A) The voltage across the PV terminals should be the same as the voltage across the Battery terminals if the batteries are not fully charged.
   B) If the batteries are charged, there will be a voltage difference between the Battery (+) terminal and the PV (+) terminal. If you DVM has a frequency measuring option, a 300Hz AC signal should be measured between Battery (+) and PV (+). The duty cycle of this signal can also be measured to give a rough indication of the battery state of charge. The lower the duty cycle, the more fully charged the battery.
   C) Measure the voltage at the via located at the left edge of the terminal strip. If the batteries are not fully charged, this voltage should be approximately 20-24Vdc. If the controller is in voltage regulation, this voltage will vary according to the state of charge of the battery. The frequency and duty cycle can be measured here as well.

4) PV, Battery and a small (2A) load connected to the controller, a standard 12V automotive brake lamp (type 1156) works well for this test. This will provide a simple system to verify the correct operation of the controller. With the lamp turned on, measure the load voltage, it should be within 20-30 mV of the battery voltage. If it is more than 0.25V lower than the battery voltage, the LVD FET's are damaged.

5) SunSaver installed in the Power system.
   A) Check the correct operation of the SunSaver based on the above tests.
   B) Check the condition of any fuses that might be in the power path.
   C) Verify the system wiring is correct and intact.
   D) Check all connections and terminals for good electrical contact.