Technical Documentation

MORNINGSTAR
WORLD'S LEADING SOLAR CONTROLLERS & INVERTERS

SunSaver (Gen3) Functional Testing Procedure

Operational Verification

v01

Abstract:

This document outlines the procedure for verifying correct operation of the SunSaver controller.

All SunSaver units are subject to calibration and functional testing at the factory before shipment. This procedure assumes the same.

⚠ **CAUTION:** The following outlined procedures assume a basic working knowledge of electrical circuits. Exercise the necessary precautions when dealing with live electrical circuits present in solar energy systems.

☞ **NOTE:** Due to the fabrication process of the SunSaver controller, an exact damaged component may not be evident. It may only be possible to determine if the unit is functioning properly. However, other factors may be apparent that will assist the technician in determining the cause of the failure.

1.0 Tools and Equipment Required

- 12 or 24V battery bank
- Solar panel/array, or power supply input voltage greater than battery voltage - see Section 7B(1) for specific recommendations.
- Small DC load (<2A) - **DO NOT** connect motors, compressors, inverters, or pumps to load terminals.
- Multi-meter
- Clamp-type DC ammeter

2.0 System Information

Record system specifications in the table below:

System voltage (12 or 24V)	
Array open-circuit voltage (Voc)	
System grounding (+) or (-)	
Solar module make and model	
# of modules (per controller)	
Total array wattage (per controller)	
Load current (or Wattage)	
Load description (application)	

3.0 Visual Inspection

Examine terminals and casings for any signs of water damage, excessive heat, burning, loose components or infestation - note details for technical support.

4.0 Pre-Startup Measurements – no connections to the SunSaver

If any of the following measurements are out of tolerance, contact Morningstar Technical Support for assistance.

A) Measure the resistance between the (3) negative (-) terminals. Resistance should be < 0.5 ohms.

B) Measure the resistance between battery (+) and negative (-) terminals on SunSaver. Confirm no short-circuit (zero ohm reading).

C) Measure the resistance between solar (+) and negative (-) terminals on SunSaver. Confirm no short-circuit (zero ohm reading).

D) Measure the resistance between load (+) and negative (-) terminals on SunSaver. Confirm no short-circuit (zero ohm reading).

E) Measure the resistance between load (+) and battery (+) terminals on SunSaver. Confirm no short-circuit (zero ohm reading).

F) Measure the resistance between load (+) and solar (+) terminals on SunSaver. Confirm no short-circuit (zero ohm reading).

G) Measure the resistance between battery (+) and solar (+) terminals on SunSaver. Confirm no short-circuit (zero ohm reading).

5.0 Startup Measurements

A) Measure the DC voltage across the battery bank and record in 5(A) of Appendix.

B) Observing correct polarity, and with battery voltage above 6 Volts, connect a 12 or 24 battery bank to a 12 or 24V SunSaver's battery (+) and negative (-) terminals.

C) Watch and verify that the Charging Status LED lights solid green, and then turns OFF. Next, the battery SOC LEDs should cycle green-yellow-red one time, indicating proper boot-up. The LEDs should then settle on any combination of G, G/Y, Y, Y/R, R depending on battery voltage. If a SOC LED is not lit, check the battery polarity (+/–) and battery voltage. NOTE: At least one of the Battery Status LEDs should be ON, and the green Charging Status LED should be OFF, otherwise: FAILURE.

D) Measure DC voltage across the SunSaver battery (+) and negative (-) terminals, and record in 5(D) of Appendix. 5(A) and 5(D) readings recorded in Appendix should match.

E) Measure DC voltage across the SunSaver solar (+) and negative (-) terminals, and record in 5(E) of Appendix. This reading should be less than 2.5 VDC. If the green Charging Status LED is ON, or battery voltage from 5(A)(D) is measured at solar terminals, the input FETs are damaged and the unit will not properly regulate battery voltage: FAILURE.

F) Measure DC voltage across the SunSaver load (+) and negative (-) terminals, and record in 5(F) of Appendix. This reading should be very close to the SunSaver battery terminal voltage reading recorded in 5(D). If load voltage is greater than 1 Volt lower than battery voltage, LVD FETs or the power traces inside the SunSaver are damaged: FAILURE.

6.0 Load Verification

NOTE: Load terminal use is optional.

A) Re-check DC voltage across the SunSaver load (+) and negative (-) terminals. This reading should match 5(F), and be approximately equal to battery voltage in 5(A)(D).

B) With the load breaker or fuse holder OPEN, and observing correct polarity, connect a small 12V-2A test load, set to OFF, to the SunSaver load terminals. For a 24V system, wire 2-12V test loads in series.

C) CLOSE the load breaker, or insert the fuse, and verify that the load(s) power ON. With the load(s) ON, measure the voltage at the SunSaver load terminals; then measure the voltage at the SunSaver battery terminals. Record these two readings in Appendix - 6(C). These two readings should be within 20-30mV of each other. If the load voltage is greater than 0.25V lower than the battery voltage, the LVD FETs are damaged: FAILURE.

D) Turn OFF the load(s), or OPEN the load circuit

7.0 Charging Verification

A) If field-testing with a solar array, measure the array open-circuit voltage, and record the reading in 7(A) of Appendix. This voltage must be greater than battery voltage in 5(A)(D), and a maximum of 30 Volts for a 12V SunSaver, or 60 Volts for a 24V SunSaver. This reading should match that of the system specification section.

Follow (B) Array OR B(1) Power Supply

B) With an OPEN solar breaker or fuse holder, and observing correct polarity, connect the solar array to the SunSaver solar (+) and negative (-) terminals. CLOSE the solar breaker or INSERT the fuse. **GO TO (C)**

B(1) Depending on system voltage, adjust a regulated power supply to 20 Volts for a nominal 12V system, or 40 Volts for a nominal 24V system. Turn OFF the power supply and, then, observing correct polarity, connect the power supply leads to the SunSaver solar (+) and negative (-) terminals. Turn ON the power supply. **GO TO (C)**

C) If the battery is not charged, the Charging Status LED should light solid green with a heartbeat off every five seconds. One of the battery SOC LEDs should be ON, but any combination of flashing LEDs indicates an fault. See product manual Section 5 - Troubleshooting - for details.

D) Measure DC voltage across the SunSaver battery (+) and negative (-) terminals and record in 7(D) of Appendix. If the battery has reached regulation voltage, the Charging Status LED will blink at 1Hz.

E) Measure DC voltage across the SunSaver solar (+) and negative (-) terminals and record in 7(E) of Appendix. If the battery bank has not reached regulation voltage, the voltage across the solar terminals should be the same as the voltage across the battery terminals in 7(D).

F) If the battery bank has reached regulation voltage, there will be a voltage difference between the solar (+) and battery (+). If your multi-meter has a frequency measurement setting, a 300Hz AC signal should also be measured between the solar (+) and battery (+). The duty cycle of this signal provides a rough indication of the battery state-of-charge. A lower duty-cycle indicates a higher state of charge.

G) Using a clamp-type DC ammeter, measure battery cable current, and record in 8(G) of Appendix. If the battery bank readings from 5(A)(D) are below regulation voltage, AND if charging is seen as in 7(C)(E), AND if design Voc input is present, measured charging current should be approximately equal to the controller's nameplate current capacity.

8.0 Power-down

A) Disconnect solar array from SunSaver

B) Disconnect battery from SunSaver

C) Disconnect load from SunSaver

IN CASE OF ANY FAILURE IN PERFORMANCE VERIFICATION, CONSULT PRODUCT OPERATOR'S MANUAL, OR MORNINGSTAR TECHNICAL SUPPORT.

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APPENDIX - TEST READINGS

5(A) Battery bank voltage:

5(D) SunSaver battery terminal voltage:

5(E) SunSaver solar terminal voltage:

5(F) SunSaver load terminal voltage:

6(C) SunSaver [loaded] load terminal voltage:

SunSaver [loaded] battery terminal voltage:

7(A) Solar array open-circuit voltage:

7(D) SunSaver battery terminal voltage:

7(E) SunSaver solar terminal voltage:

7(G) Battery charging current: