



samlexsolar

A Division of Samlex America Inc.

**SunCharger
Portable Solar Panel**

**Models:
SC-05
SC-10**

**Owner's
Manual**

Please read this
manual before
operating the
units

SAFETY INSTRUCTIONS

Please ensure the following:

- Do not reverse the polarity of the connections – ensure that the Red Positive wire is connected to the Positive terminal of the battery and the Black Negative wire is connected to the Negative terminal of the battery
- Do not flex or bend the panel as this could cause damage to the PV cells and the encapsulation layers
- Do not attempt to charge non-rechargeable batteries. This charger is meant only for 12 V, re-chargeable batteries
- Contact the battery manufacturer for questions on the battery specifications
- Always charge lead-acid batteries in a well-ventilated area.

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GENERAL INFORMATION

Description

The SunChargers SC-05 and SC-10 are portable solar panels designed for trickle charging of 12 V nominal rechargeable Lead Acid batteries like those used in cars, boats, RV's, motorcycles, All Terrain Vehicles (ATV) and Powered Water Crafts (PWC). These can also be used as DC power sources to charge small electronic devices like cell phones, iPods, iPhones, PDAs etc. The rechargeable batteries inside these small electronic devices are charged through their charging adapters.

Self Discharge and Trickle charging of Lead Acid Batteries

Self-discharge of a battery is the electrical Ampere Hour (AH) capacity that is lost when the battery simply sits idle or in storage without any external load connected to it. Self-discharge is caused by electrochemical processes within the battery and is equivalent to the application of a small external load. For example, a lead-acid battery stored at 30°C / 86°F would self discharge at around 1% per day. The self discharge increases with rise in temperature.

In order to compensate for the above self-discharge, a fully charged battery that is idle or is in storage will require trickle charging at a very low Trickle Charge Current of around C/100 Amps (where C is the Ampere Hour Capacity of the battery) to maintain the fully charged state.

For example, an 80 to 100 Ah automotive SLI battery (Starting, Lighting and Ignition) will require trickle charging current of around 0.8 to 1 A



NOTE: As explained above, the trickle charging current provided by a Trickle Charger is a very low current with a value of around $C/100$ A and this very low value current will just be sufficient to compensate for the self discharge current. This current will not be able to charge a discharged battery. For full scale charging of a battery, a standard charger will be required.

Features

- Efficient Design and Superior Quality
 - Efficient poly-crystalline PV cells – 34 cells in series for the 4.8 W, SC-05 Panel and 36 cells in series for the 9.6 W, SC-10 Panel
 - Solar cells are encapsulated by layers of EVA and fiberglass that provide excellent moisture resistance and electrical isolation.
 - A Blocking Diode is built-in thus preventing current from flowing back from the battery to the solar panel in darkness. Hence, the panels can be connected directly to the battery without using an external Blocking Diode
 - Top layer of clear, UV resistant, PVF (Poly Vinyl Fluoride – Trade Name – Tedlar) provides good light transmission and protection from cuts and scratches

GENERAL INFORMATION

- Sealed junction box (houses the blocking diodes) has 3M of UL listed, sunlight resistant output cable terminated with a Cigarette Lighter Plug (with 10 A fuse) for convenient connection to any battery through the on-board 12 VDC Cigarette Lighter Receptacle
 - 12 V batteries can be charged directly without use of a Charge Controller provided that the capacity of the battery is > 33 Ah for the 4.8 W, SC-05 panel and > 60 Ah for the 9.6 W, SC-10 panel
 - Every module is fully inspected and tested to ensure compliance with electrical, mechanical and visual requirement
 - Weatherproof - includes UV protection and protection from weather effects of -35°F to 175°F (-37°C to 79°C).
- Easy Installation
 - Slim-line and lightweight – No metal frame
 - 4 grommet finished holes in the 4 corners for fixing the panel
 - 12 VDC Cigarette Lighter Plug for convenient connection to the vehicle battery through the on-board 12 VDC Cigarette Lighter Receptacle
 - Color coded wires for easy field wiring – Positive (Red), Negative (Black)

Applications

These chargers can be used for the following:

- To trickle charge 12 VDC Lead Acid batteries.
- To compensate for battery drain due to low currents drawn by small instrumentation in vehicles. Electronics such as clocks, vehicle alarms etc add to the drain of the battery, even when the ignition is off.
- To charge small electronic devices like cell phones, iPods, iPhones, PDAs etc. These devices come with associated charging adapters that allow charging of their batteries through a 12 V DC power source. These charging adapters come with a Cigarette Lighter Plug for connecting to a DC power source through a Cigarette Lighter Receptacle. As the Sun Charger comes with a Cigarette Lighter Plug, a suitable adapter will be required to convert the Cigarette Lighter Plug of the SunCharger to a Cigarette Lighter Receptacle (this adapter is not provided with the SunCharger).



NOTE: The 4.8 W, SC-05 and 9.6 W SC-10 panels are not large enough to power laptop computers

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PRINCIPLES OF OPERATION

Electrical operating parameters of a solar panel

A solar panel can be considered as a current limited source of electrical power with a voltage versus current relationship as shown in Fig. 1.

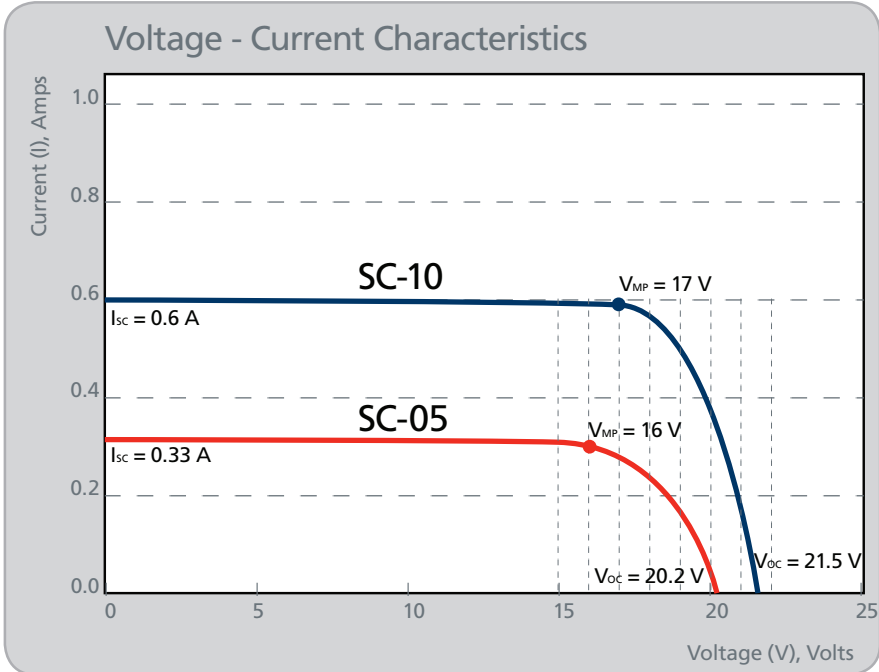


Fig. 1. Voltage versus Current characteristics.

When exposed to the sun and without any load connected, the solar panels will generate an Open Circuit Voltage (V_{oc}). As soon as a load is connected to the panel, the voltage at the load will drop and the value of the voltage at the load will be determined by the current (I) drawn by the load. Please note that at the Open Circuit Voltage V_{oc} , the output current (I) is zero.

The electrical power (P) in Watts fed to the load = Voltage (V) X Current (I).

If the output of the panel is short circuited, the output current will be limited to the maximum current that the panel can provide. This Short Circuit Current is designated as I_{sc} .

The maximum power P_{MP} is fed to the load when the operating point is near the knee of the curve as shown. At this operating point for maximum power output, the voltage is designated as V_{MP} and the current is designated as I_{MP} .

Please note that for the portion of the curve between V_{oc} to V_{MP} , the current drops at a faster rate. After that, the current is almost constant and equal to the Short Circuit Current I_{sc} .

Factors affecting voltage and current output of a solar panel

The following factors affect the voltage and current of a solar panel:

- The output voltage is not affected very much by the light conditions - under shaded / cloudy condition, the output voltage will not vary very much as compared to bright sunshine
- The output current is very sensitive to the intensity of light and will drop considerably under shaded or cloudy conditions
- Variation in temperature has a sizable effect on the output voltage – a Negative Temperature Coefficient of $-2.3 \text{ mV} / ^\circ\text{C} / \text{Cell}$ resulting in increase in the voltage at lower temperature and decrease in the voltage at higher temperature
- Variation in temperature has negligible effect on the current output
- The output current can increase by 25 % due to what is known as the “Edge of the Cloud Effect”. As the sun moves between a hole in the clouds, the solar panel will see the full direct sunlight combined with the reflected sunlight from the clouds

Battery charging operation using a solar panel (See Fig 1).

When a battery is directly connected to the solar panel, the voltage of the loaded panel will be equal to the initial battery voltage. At this point, the charging current (I) will be equal to the corresponding value of the initial battery voltage on the V-I Curve

The current (I) fed from the panel will start charging the battery and the battery voltage will start rising. As the battery is always connected to the panel, the panel voltage will be the same as the battery voltage. It will be seen from the V-I curve that as the battery voltage rises, the charging current will start reducing.

When a battery is fully charged, it will not require any further current for charging except the very low self discharge current. If a charging current higher than the self discharge current is continued to be fed to a fully charged battery, it will lead to damage to the battery due to overcharging resulting in overheating and loss of water due to excessive electrolysis (conversion of water to oxygen and hydrogen).

Charging a battery by a solar panel using a Charge Controller

For full scale charging of a battery from a solar panel, the output of the solar panel is required to be fed to the battery through a Charge Controller. The Charge Controller transforms the input power from the solar panel to regulated voltage and current necessary to safely charge the battery as per the required charging algorithm e.g. 2/3/4 Stage Charging Algorithm.

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INSTALLATION & OPERATION

Charging a battery from a solar panel directly (without using a Charge Controller)

For trickle charging a battery, a Charge Controller is not necessary as long as it is ensured that the Short Circuit Current I_{sc} of the solar panel is less than the Trickle Charge Current specified for the battery that is being charged. As stated earlier, the Trickle Charge Current of a Lead Acid Battery is around $C/100$ (where C is the Ampere Hour Capacity of the battery).



CAUTION! In view of the above, direct trickle charging of batteries using the SC-05 and SC-10 SunCharger panels should be selected as follows:

SC-05: The Short Circuit Current is 0.33 A. Hence, the capacity of the battery to be trickle charged should be more than 33 Ah.

SC-10: The Short Circuit Current is 0.6 A. Hence, the capacity of the battery to be trickle charged should be more than 60 Ah.

As the standard automotive SLI batteries (Starting, Lighting and Ignition) are around 80 to 110 Ah, these can be trickle charged directly from the above 2 solar panels.



NOTE 1: The overall performance of the Solar Panel is dependent on a variety of conditions including season, orientation with direct sunlight, cloudy conditions, temperature, and shadowing. As a result, specified performance parameters will be dependent of the placement of the Solar Panel.

NOTE 2: For safety against excessively high short circuit current flow from the battery to a short in the panel circuit, a 10 A fuse is provided inside the Cigarette Lighter Plug.

Placement of the panel

- Securely place the solar panel facing the sun. Maximum power is generated when the top surface of the panel is oriented perpendicular to the sun. Hence, tilt the panel in such a way that it will be perpendicular to the strong midday sun, between 10 a.m. and 2 p.m. This will change with the seasons. In spring and the fall, a tilt between 40 and 45 degrees from the ground will suffice for most North American residents. A little less in the summer (about 20 - 30 degrees) and a little more in the winter (about 60 - 70 degrees from the ground).
- Use the 4 grommet finished holes in the corners for fixing the panel in the appropriate orientation
- Make sure that the panel is not shaded by shadows
- When using the panel in a vehicle, the panel may be placed on the dashboard and facing the sun as explained above

Trickle charging the vehicle battery through vehicle's on-board Cigarette Lighter Receptacle

When using the solar panel inside a vehicle, connect the Cigarette Lighter Plug provided with the solar panel to the Cigarette Lighter Receptacle in the vehicle. Make sure that the plug is pushed in completely.



CAUTION 1! In some vehicles, the Cigarette Lighter Receptacle gets connected to the vehicle's starter battery only when the Ignition Switch is turned to the Accessories (ACC) Position. In this case, the Ignition Switch will have to be turned to the Accessories (ACC) Position to enable trickle charging of the battery.

CAUTION 2! Please note that when the Ignition Switch is turned to the Accessories (ACC) Position, power is available to the built-in accessories like radio, CD / DVD Player etc. Hence, please ensure that all these accessories are switched off to prevent drainage of the battery.

Trickle charging an external battery

When NOT used inside a vehicle, connection to the battery can be made using one of the following methods:

- Use separate Adapter Cable (not provided) that has a Cigarette Lighter Receptacle on one end and Battery Alligator Clamps on the other end. Plug the Cigarette Lighter Plug of the panel to the Cigarette Lighter Receptacle of the Adapter Cable. Then connect the Battery Alligator Clamps to the battery ensuring correct polarity by matching the red clamp which is Positive (+) to the Positive (+) terminal on the battery. Connect the black Clamp which is Negative (-) to the Negative (-) Terminal on the battery.

Directly powering small electronics devices like cell phones, iPods, iPhones, PDAs, etc

Please use the following method for directly powering small electronics devices like cell phones, iPods, iPhones, PDAs etc. (As mentioned earlier, laptop computers are not included as the 4.8 W, SC-05 and 9.6 W, SC-10 solar panels are not large enough to power laptop computers):

- Use separate Adapter Cable (not provided) that has Cigarette Lighter Receptacles on both the ends. Plug the Cigarette Lighter Plug of the solar panel to the Cigarette Lighter Receptacle of the Adapter Cable. Then connect the electronic device to the other Cigarette Lighter Receptacle of the Adapter Cable.

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SPECIFICATIONS

MODEL NO.	SC-05	SC-10
TYPE OF CELLS	Poly-crystalline	Poly-crystalline
NO. OF CELLS IN SERIES IN ONE STRING	34	36
NOMINAL RATED POWER	4.8 W	9.5 W
OUTPUT VOLTAGE (OPEN CIRCUIT), V_{oc}	20.2 VDC	21.5 VDC
OUTPUT VOLTAGE (AT MAXIMUM POWER POINT), V_{MP}	16.0 VDC	17.0 VDC
OUTPUT CURRENT(SHORT CIRCUIT), I_{sc}	0.33 A	0.60 A
OUTPUT CURRENT (AT MAXIMUM POWER POINT), I_{MP}	0.30 A	0.56 A
CONNECTING CABLE	3 M , AWG #18, Sunlight Resistant	
CIGARETTE PLUG	Standard Cigarette Plug with replaceable 10 A fuse Type AGC-10	
OPERATING TEMPERATURE	-35°F to +175°F (-37°C to + 79°C)	
DIMENSIONS, MM (L x W x H)	304 x 254 x 13.5	304 x 381 x 13.5
DIMENSIONS, INCHES (L x W x H)	12 x 10 x 0.53	12 x 15 x 0.53
WEIGHT, KG	0.55	0.9
WEIGHT, LB	1.2	2.0

NOTE: Specifications are subject to change without notice.