

# SPECIALTY CONCEPTS MARK III/10 (SC3/10)

## Photovoltaic Battery Charge Controller Installation and Operation Manual

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### GENERAL DESCRIPTION

The Specialty Concepts Mark III/10 (SC3/10) is a battery charge controller and system monitoring unit designed for use in mobile or stationary photovoltaic (PV) energy systems. Lights are included to indicate system status and a front panel fuse provides over-current protection. The SC3/10 is available for 12 volt systems with charging current up to 10 amps.

This unit uses a solid state pulse type charge controller to safely reach and maintain a full state of charge for the battery. A blocking diode is provided to eliminate losses through the solar panels (array) at night. LED lights indicate "Solar Charging", "Battery Up", and "Low Battery". The fuse provides over-current and reverse polarity protection. This model is available for 12 volt systems with charging currents up to 10 amps. The SC3/10 can be mounted flush in the wall or on a standard, double gang electrical switch box.

### FEATURES

#### **CHARGE REGULATION**

- 10 amp charge current, 12 volt
- Switching shunt, pulse charging

#### **DESIGN FEATURES**

- 100% solid-state
- Designed for rugged mobile use
- Over-current protection - battery fuse
- Reverse leakage protection - blocking diode
- Lightning protection
- Input noise suppression
- Low power consumption

#### **MONITORING**

- "LOW BATTERY" light
- "SOLAR CHARGING" light
- "BATTERY CHARGED" light

#### **MOUNTING**

- Flush mount
- Wall mounting on standard electrical double switch box

SPECIFICATIONS		
PARAMETERS	UNITS	VALUE
Nominal Voltage	(Volts)	12
Short Circuit Current, Continuous	(Amps)	10
Short Circuit Current, Max (60 seconds)	(Amps)	13
Array Voltage, Max Voc	(Volts)	26
Operating Voltage @ Battery, Minimum	(Volts)	0
Quiescent Current	(Milliamps)	10
Current Consumption, Charging, Typ.	(Milliamps)	15
Voltage Drop, Array to Battery, Typ.	(Volts)	.4
Charge Termination	(Volts)	14.3 ± .2
Charge Resumption	(Volts)	13.5 ± .3
Low Battery Warning Light (On)	(Volts)	11.5 ± .2
Operating Temp. Range	(°C)	-40 to 50
Storage Temp. Range	(°C)	-55 to 85

## RELATED SYSTEM EQUIPMENT

The SC3/10 is an integral part of a solar electric power system that includes a PV solar array, a battery and a load. The load is considered the item or equipment that the PV system is powering. These items should be installed according to the instructions provided by the equipment supplier, and this manual assumes that the rest of the equipment installation has been properly completed.

**PANELS:** The SC3/10 is compatible with all makes and models of PV panels, provided the open circuit voltage (Array Voc, Max) does not exceed 26 volts and the short circuit current of the array (Current, Short Circuit, Max) does not exceed 10 amps.

**BATTERIES:** The SC3/10 is calibrated for proper charging of standard batteries that are normally used in recreational vehicles, boats, and remote stand alone systems. These include wet cell batteries using lead antimony and/or lead calcium grids and sealed, maintenance free batteries. For sealed batteries left unattended and charging for prolonged periods, the SC3/10 may require different charge termination set-points. Contact your supplier for more information.

**LOADS:** System loads such as lights, radios, DC/AC inverters, etc. must be rated for 12 volt DC input. The loads should be fused as recommended and connected directly to the battery or to a load center/circuit breaker box. See "INSTALLATION" section.

**OTHER CHARGING SOURCES: DO NOT** use the SC3/10 to regulate a power source other than a photovoltaic array, such as a hydro or wind generator/alternator or an AC battery charger. This could result in damage to the SC3/10 and/or the generating equipment. Other charging sources must have their own charge regulation devices.

The SC3/10 and array can remain connected to a battery that is being charged by an additional source, (alternator, battery charger, etc.) without damage to the controller or solar panels.

# INSTALLATION

## WARNINGS / CAUTIONS

**WARNINGS:** Electricity, even low voltage electricity, can be dangerous. Installation should be performed by a licensed electrical contractor or other qualified personnel only. The requirements of the U.S. National Electrical Code should be followed.

**WARNING:** Follow all safety precautions of the battery manufacturer. Proper ventilation must be provided for vented batteries. Most vented batteries produce hydrogen gas when charging, which is extremely explosive. **DO NOT** expose the battery to open flame, matches, cigarettes or sparks.

**CAUTION: DO NOT** exceed the maximum current rating (Current, Short Circuit, Continuous) of 10 amps. This is the sum of the short circuit currents of all the modules in parallel.

**CAUTION: DO NOT** subject the controller to voltages (Array Voltage, Max Voc), greater than 26 volts. This is the open circuit voltage (Voc) of the array, or the sum of the open circuit voltages of all modules connected in series.

**CAUTION: DO NOT** reverse battery "PLUS" and "MINUS" connections to the SC3/10. Reverse polarity or accidental contact to the battery in reverse polarity will cause the fuse to blow, and may damage the unit.

**CAUTION: DO NOT** connect the array directly to the battery when the array is connected to the SC3/10 at the same time. This will cause damage to the SC3/10 when the battery reaches full charge voltage.

**CAUTION: DO NOT** wire the SC3/10 in such a way that it can be connected to an alternator (or other charging source) while the battery is disconnected, even if momentarily.

## INSTALLATION INSTRUCTIONS

- 1. LOCATION:** - The SC3/10 should be mounted where it can be easily seen and reached to take the best advantage of the status lights. Carefully consider how the wires are to be run from the solar panel to the controller, and from the to the battery. The SC3/10 should be mounted as close to the battery as possible, and should be mounted on a vertical surface to aid in cooling.
- 2. PROTECTION:** - The unit should be mounted indoors, out of the weather, unless a weatherproof enclosure is used. Avoid mounting in direct sunlight or in a hot environment. Basically, do not mount anywhere you would not put a TV or stereo.
- 3. MOUNTING OPTIONS:** - The SC3/10 is designed to be recessed into the side of a cabinet or wall where the wiring can be accessed from the back. Allow 2 - 3 inches behind the unit. The SC3/10 can also be mounted onto a standard, double gang electrical switch box available at any hardware or electrical supply store. Install the switch box as for standard electrical wiring, run the wires into the box and after connection of the SC3/10, fasten it to the box as you would an electrical switch.
- 4. COMPLETE THE INSTALLATION OF PANEL, BATTERIES AND LOAD:** - Follow the manufacturer's instructions for mounting and wiring the solar panel, batteries and the load.

**5. WIRE SELECTION:** - It is recommended to use stranded wire rather than solid wire whenever possible, because stranded wire does not fatigue and cause loose connections over time as easily as solid wire does.

The wiring from the array and to the batteries can be a larger gauge than the wires in the SC3/10. The wiring in the controller is of sufficient gauge to handle the currents carried, and the length of these wires is short so it will not reduce the voltage. Larger gauge may be appropriate for the long runs to the array to minimize voltage losses.

<b>Recommended Wire Size:</b>	<u># Solar Panels</u>	<u>Minimum Wire Gauge</u>
	1	# 14
	2	# 12
	3	# 10

**6. REMOVE POWER FROM BATTERY / PANELS:** - Disconnect power from the batteries and panels prior to running the wires to the controller.

**7. RUN SYSTEM WIRING:** - Run the wires from the battery and solar panel to the location selected for the controller.

**8. NOTE WIRE POLARITY:** - Make sure to correctly mark the polarity of the wires using colored wires or tags. Incorrect polarity may blow the front panel fuse or damage the SC3/10.

Some vehicles or solar kits use black and white wires for connection to the battery. These kits will label the white wire as battery negative and the black wire as battery positive. Black and red wiring systems will label the black wire as negative and the red wire as positive. When these systems interconnect, the black wire does not connect to the black wire. **CAREFULLY NOTE BATTERY POLARITY AND WIRE COLORS!**

**9. PREPARE THE LOCATION FOR INSTALLATION:** -

**FLUSH MOUNT (No junction box):** - Mark a cut-out 3½ inches wide and 2¾ inches high, this should be centered in the area chosen for the controller. Make the cut-out using a key hole or jig saw. Start by drilling holes in the corners, then saw between the holes. Mark and drill the four mounting holes.

**MOUNTING WITH JUNCTION BOX:** - Make any necessary preparations to the surface as needed for the particular junction box.

**10. SC3/10 CONNECTION:** - Wire the SC3/10 according to Figure 1. When possible, solder the wires before installing the wire nuts, then wrap the wire nuts and wires with electrical tape.

**11. INSTALL FUSING IF NEEDED:** - Add additional circuit protection if needed.

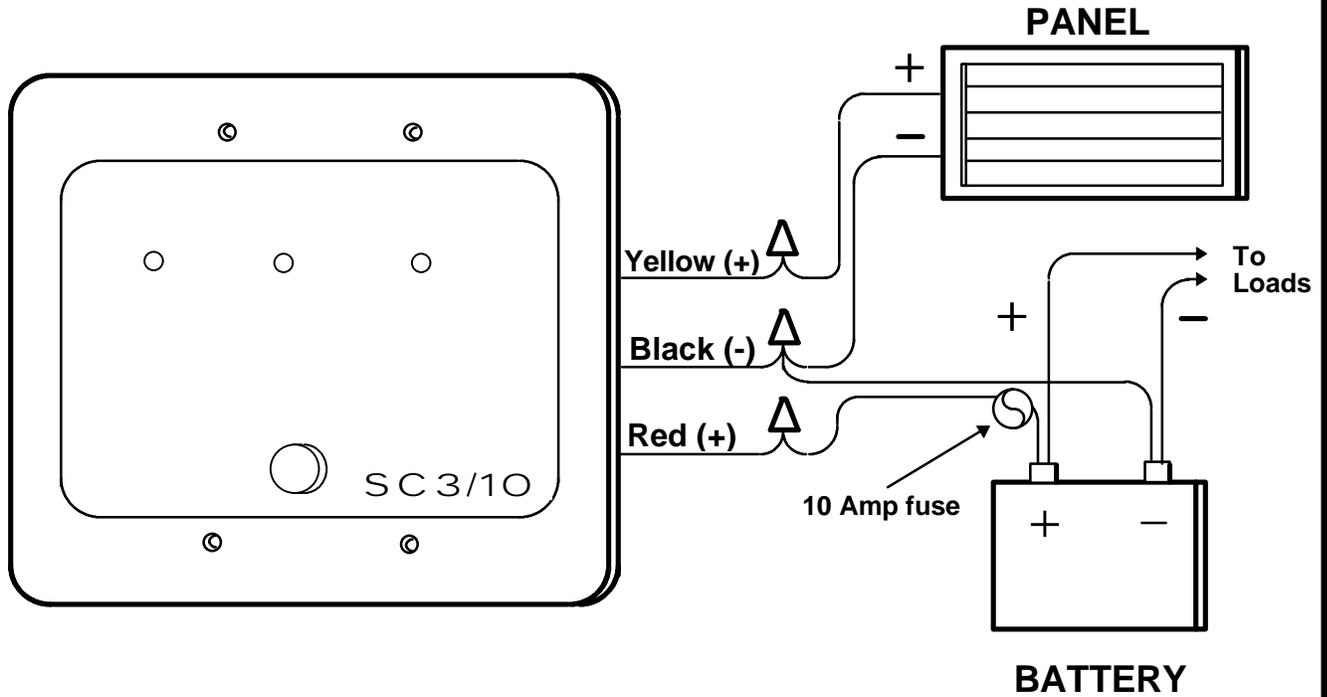
**12. SC3/10 MOUNTING:** - Mount the SC3/10 to the wall or box front using the four screws provided or other suitable fasteners. Slip the washers (supplied) over the screws so the washers are between the back of SC3/10 and the wall (or box). This provides an air gap for added cooling. **INSTALLATION OF THESE WASHERS IS REQUIRED FOR PROPER COOLING DURING OPERATION.**

**13. RECONNECT BATTERY AND ARRAY POWER -**

**14. OPERATION:** - Operation of the SC3/10 is now fully automatic. The SC3/10 will now regulate the charging of batteries during conditions of heavy usage, or when left unattended for long periods of time. If the battery voltage is below the Full Charge Termination set-point (14.3 volts) and power is available from the array, the SC3/10 should start up in the charge mode.

**NOTE:** During operation, it is normal for the SC3/10 to get warm (but not too hot to touch)

**Figure 1 : Wiring diagram for the SC3/10**



**Wire color code**

Yellow: Panel (+)  
 Black: Panel (-) / Battery (-)  
 Red: Battery (+)

1. Make sure wire nuts are on tight
2. Wires from battery(s) should be less than 15 feet in length.
3. Connect loads directly to the battery and NOT the SC3/10

## OPERATION DESCRIPTION

SWITCHING SHUNT, PULSE CHARGE REGULATION: When in the charge mode, the SC3/10 allows maximum available array current to flow into the battery through a blocking diode, lighting the yellow "Solar Charging" light. As the battery charges, the voltage will rise slowly until it reaches the "charge termination" set-point. At this point, battery charging stops, the "Solar Charging" light goes out and the green "Battery Charged" light goes on. When charging stops the battery voltage will fall, and when the battery voltage drops to the "charge resumption" set-point, the SC3/10 will resume charging.

## MONITORING

**"SOLAR CHARGING" LIGHT:** The "Solar Charging" light will be on when the array is active (generating voltage) and the battery needs charging.

When the battery is at a low state of charge, the "Solar Charging" light will be on continuously during the day. When the battery charges up, the light will go out for a while (until the voltage drops a little) and then will be on again. When the battery is close to full charge, the light will be on for short periods of time, and off for longer.

**"BATTERY CHARGED" LIGHT:** The "Battery Charged" light will be on when the array is active and the battery has already reached the charge termination voltage.

Systems with a high charge rate (more than 1 panel per battery), or with old batteries may see the "Battery Charged" light on sooner or more often. In this case batteries may not be fully charged, but the controller is preventing overcharging by switching off for a brief period.

Systems with a low charge rate (1 panel to 2 or 3 batteries or low output from the panels due to shading or low sun angle) may not see the "Battery Charged" light on even though the batteries are actually fully charged. In this case, the batteries are not being overcharged so the controller does not need to shut the array off.

**NOTE:** The charging light will be on when there is voltage from the solar panel and the battery can use more charging. This could result in the "Solar Charging" light being on when the panels are under lights or a full moon at night.

**"LOW BATTERY" LIGHT:** This is a low battery voltage warning light. The "Low Battery" light will turn on if the battery voltage drops to 11.5 volts. At this point, system usage should be minimized and an alternative method (alternator, generator, AC battery charger) should be used to bring the battery voltage up. Once the voltage increases a little bit (by charging or turning off large loads), the light will go off.

## " Q U I C K " T R O U B L E S H O O T I N G

### **IF THE CONTROLLER IS NEWLY INSTALLED, CHECK THESE THINGS FIRST:**

- 1) Re-check system wiring to insure proper installation and polarity .
- 2) Check all system fuses and circuit breakers. Before replacing a blown fuse, locate and correct the cause.
- 3) Check to see that modules and batteries are in the correct series-parallel configuration for proper system voltage and current.
- 4) Review the controller specifications, operation and set-points, particularly the charge termination and reconnect voltage set-points. If possible, check set-points while the controller is in operation, monitoring the battery voltage with a multi-meter.
- 5) Review controller specifications, array output, load ratings and system sizing to insure that ratings are not exceeded.

### **IF THE CONTROLLER HAS BEEN INSTALLED AND WAS PREVIOUSLY WORKING PROPERLY, CHECK THESE THINGS FIRST:**

- 6) Check all system fuses and circuit breakers. Before replacing a blown fuse, locate and correct the cause.
- 7) Confirm that all connections are sound. In particular, check crimp connections that have been crimped but not soldered as these connections tend to deteriorate over time.
- 8) If you have an accurate volt meter, check for a voltage drop between the controller and the battery when maximum charging is occurring. Drops often occur through old fuses, fuse holders or circuit breaker boxes and at loose or corroded connections.
- 9) High voltage from nearby lightning strikes or unregulated charging sources can damage the controller, in spite of the built-in lightning protection.
- 10) Check output from the array, and that the array is not partially shaded or dirty.

# TROUBLE SHOOTING

The following section can assist in the troubleshooting of a solar system. Please review the section below titled "**HELP NOTES**" which lists some common problems with a solar system.

- **SC3/10 Charge Controller:** - If a possible problem is suspected based on the observations of the SC3/10 controller, refer to the chart titled **SC3/10 PROBLEM CHART** and the "Case Note" for each condition on the following pages.
- **Battery:** - If you feel your batteries are not being adequately charged or are consistently being over-charged, refer to the section **BATTERY PROBLEMS**.
- **Solar Panels:** - If you feel that the solar panels are not performing adequately, refer to the section **SOLAR PANEL PROBLEMS**. You may be asked to perform a test using a voltage multi-meter to assist with the diagnosis.

## **HELP NOTES:** *(Normal Conditions and Common Problems)*

### **NORMAL CONDITIONS:**

1. **NORMAL OPERATION: CHARGING / NOT CHARGING** - Depending on your system, the SC3/10 may go for long periods of constant charging or long periods with no charging. The SC3/10 is designed to prevent over-charging of the battery. It does this by stopping the charging at about 14.3 volts. It will then turn the solar panel off. Charging will resume when the battery voltage drops to about 13.5 volts. If the battery is fully charged, additional charging may not be needed. If the charge current is not strong enough to over-charge the battery, the controller may not turn the panel charging off.
2. **BATTERY WATER LOSS** - Vented batteries will need some water from time to time in the natural course of events. Minor water loss is not a problem, just top the level up when needed. Excessive water loss (a quart or more in a period of a month) may indicate a more serious problem.
3. **BATTERY GASSING** - In vented batteries, some gassing is good. Gassing stirs up the battery acid and allows the battery to fully charge. A little bubbling in the batteries is not necessarily a problem. See **BATTERY WATER LOSS** above.
4. **TEMPERATURE** - Temperature can affect the performance of batteries. They will tend to over-charge easier when hot, and will not have as much capacity when cold.

## **HELP NOTES:** (continued)

### **PROBLEM CONDITIONS :**

5. **SYSTEM IS NOT SIZED CORRECTLY** - The solar system batteries will tend to be under-charged if the solar panel array is too small, or if the battery bank is too small, or if the usage is too high.
6. **PROBLEMS WITH SOLAR PANELS** - Solar panel output is dependent upon the amount of sun-energy reaching the panel. This can be seriously affected by panel angle of orientation, minor shading, high level haze (barely visible) and dust or dirt on the panel. At the time of installation, a solar array can have an incorrect series-parallel configuration for the proper system voltage and current. A panel can also become less productive or defective over time. **TEST:** To check array voltage, disconnect the ARRAY(+) connection on the SC3/10, and measure the voltage at the array using the positive and negative wires. In sunny conditions, this should be 18-24 volts. A lower value could indicate a problem with the solar panel array. To check array current, contact a local solar dealer.
7. **PROBLEMS WITH BATTERIES** - At the time of installation, a battery bank can have an incorrect series-parallel configuration for the proper system voltage and current. A battery can also go bad and unable to maintain a charge. **TEST:** If the battery is going bad, a little charging or discharging will cause a large change in the battery voltage.
8. **BAD CONNECTION: PANEL** - The panel connection to the controller may be weak or completely out. This may include problems with the connections at the SC3/10, both panel connections (“+” or “-”) or fuses and unsoldered crimp connectors in these lines. Also, wire that is too small for the length of the run may cause a voltage drop.
9. **BAD CONNECTION: BATTERIES** - The SC3/10 needs to read an accurate battery voltage to regulate the charging correctly. The battery connection to the controller may be weak or completely out. Connection problems can be found with the connections at the SC3/10, the SC3/10 fuse, both battery terminals (“+” or “-”) or other fuses and unsoldered crimp connectors in these lines. Also, wire that is too small for the length of the run may cause a voltage drop
10. **CONTROLLER MISWIRED** - This may include reversing the polarity from the panels or batteries, or switching the array and battery connections.
11. **CONTROLLER DEFECTIVE** - The SC3/10 may no longer be functional. It could have been exposed to high voltage (such as a lightning strike nearby), too much current from the panels or reverse polarity from the batteries. *Refer to SC3/10 FIELD TEST PROCEDURE*

**SC3/10 PROBLEM CHART:** - Refer to this chart and the **SC3/10 PROBLEM DESCRIPTIONS** (next page), to help diagnose potential problems based on the observations of the SC3/10 and actual battery voltage. The use of a voltage multi-meter may be helpful.

**Problems with charging**

<u>CASE</u>	<u>BATTERY VOLTAGE</u> <u>(use multi-meter at</u> <u>battery terminals)</u>	<u>CHARGE</u> <u>LIGHT</u>	<u>OTHER</u>	<u>SC3/10</u> <u>CASE NOTES</u> <u>(next page)</u>
1 →	Low voltage (9.0 - 13.2 volts)	ON	Day time	See <b>Case 1</b> (next page)
2 →	Low voltage (9.0 - 13.2 volts)	OFF	Day time	See <b>Case 2</b>
3 →	Moderate voltage (13.2 - 14.0 volts)	Turns OFF (too soon)	Day time	See <b>Case 3</b>
4 →	High voltage (14.4 - 15.0 volts)	ON		See <b>Case 4</b>
5 →	High voltage (14.4 - 15.0 volts)	OFF		See <b>Case 5</b>
6 →		ON - at night		See <b>Case 6</b>
7 →		Light going on and off rapidly		See <b>Case 7</b>
8 →			SC3/10 buzzing	See <b>Case 8</b>
9 →			SC3/10 hot	See <b>Case 9</b>

## **SC3/10 PROBLEM DESCRIPTIONS** *(from the SC3/10 PROBLEM CHART)*

**SC3/10 Case 1** - A continuous low voltage condition with good charging during the day would indicate that the controller is functional but a problem exists with one of the following:

- A problem exists with the system sizing. See **SYSTEM IS NOT SIZED CORRECTLY** (*Help Note #5*)
- A problem exists with the solar panels. See **SOLAR PANEL PROBLEM SECTION**
- A problem exists with the batteries. See **BATTERY PROBLEM SECTION**

**SC3/10 Case 2** - A low voltage condition with no charging during the day would indicate one of the following:

- The system has no panel input. See **BAD CONNECTION: PANEL** (*Help Note #8*)
- The SC3/10 may be defective. See **CONTROLLER DEFECTIVE** (*Help Note #12*)

**SC3/10 Case 3** - A moderate voltage condition where the charging appears to stop too soon (below 14.1 volts) would indicate one of the following:

- The SC3/10 may have a bad battery connection. Somewhere in the battery connection there could be a voltage drop that would cause the controller to sense a higher battery voltage than what actually exists. See **BAD CONNECTION: BATTERY** (*Help Note #9*)
- The SC3/10 may be defective. See **CONTROLLER DEFECTIVE** (*Help Note #12*)

**TEST:** - Try to monitor the voltage at the SC3/10 battery connection wires (Red and Black) when the controller actually stops charging (CHARGING light goes OFF). If the voltage at the SC3/10 terminals is about 14.3 volts then assume a voltage drop along the battery connection is causing the problem.

**SC3/10 Case 4** - A high voltage condition with additional charging would indicate one of the following:

- The battery voltage may be just under the charge termination set-point and not need to shut off. See **NORMAL OPERATION: CHARGING / NOT CHARGING** (*Help Note #1*)
- The SC3/10 may be defective. See **CONTROLLER DEFECTIVE** (*Help Note #12*)

**SC3/10 Case 5** - A high voltage condition (over 14.5 volts) with the solar charging terminated during the day would indicate the controller is functional but the batteries are being over-charged by a second charging source. Other charging sources should feature their own charge regulation.

**SC3/10 Case 6** - The "CHARGING" light can be on very dimly at night if the panels are under even very low levels of light (moonlight or street lights). The "CHARGING" light is on brightly at night would indicate one of the following:

- The controller is miswired. See **CONTROLLER MISWIRED** (*Help Note #10*)
- There is a blocking diode located within the solar panels or in the panel connection. This is not a serious problem, but should be removed if possible.
- The SC3/10 may be defective. See **CONTROLLER DEFECTIVE** (*Help Note #12*)

**TEST:** Disconnect the panel (ARRAY (+)), if the light goes off, then it may be possible that the panel is receiving enough light for a slight charge, or a diode exists in the connection.

**SC3/10 Case 7** - The "CHARGING" light going on and off rapidly can indicate one of the following:

- This could be a normal condition that results from a high charge rate, a full battery and a load on.
- The battery could be bad (one that is unable to maintain a charge). See **BATTERY PROBLEM SECTION**
- This could indicate a bad battery connection. - See **BAD CONNECTION: BATTERY** (*Help Note #9*).

**TEST:** Take a voltage reading at the battery with an accurate meter. If the voltage reading stays steady while the "CHARGING" light on the SC3/10 continues to go on and off, then suspect a bad battery connection. If the voltage here also moves up and down rapidly, this may indicate the battery bank is bad or too small. This may also indicate this normal condition: when the battery is fully charged, and the array can provide a lot of charge current, the controller can pulse on and off rapidly, particularly when there is current being used by a load. This is a normal operating condition and is not a problem.

**SC3/10 Case 8** - The buzzing sound is caused by the controller switching on and off very rapidly and is a problem relating to a bad battery connection. See **BAD CONNECTION: BATTERY** (*Help Note #9*).

**SC3/10 Case 9** - The SC3/10 may get warm during normal operation. If the unit should get too hot to touch, consider it defective. See **CONTROLLER DEFECTIVE** (*Help Note #12*)

**BATTERY PROBLEMS:** - Refer to this section to help diagnose potential problems based on battery observations.

<b>CASE</b>	<b>BATTERY</b>	<b>SEE CASE NOTE(S)</b>
1 →	Battery voltage low or does not hold a charge	See <b>Battery Case 1</b>
2 →	Battery seems to be over-charging	See <b>Battery Case 2</b>

**Battery Case 1** - **BATTERY UNDER-CHARGED:** If the batteries are always low and not able to be charged sufficiently, consider one of the following problems:

- **System not sized correctly** - (See *Help Note #5*). For too much usage, try charging the battery with another charging source (engine alternator, generator or AC battery charger). If the batteries are OK and hold the charge, an increase in the number batteries and panels may be needed to support the usage.
- **Solar Panels Problem** - Panel may be dirty, not aligned or other problem. (See *Help Note #6*)
- **SC3/10 Controller Problem** - A problem may exist with the charging input from the controller. This would delete or reduce the daily re-charging of the battery. A problem with the SC3/10 would **not** cause the battery to be drained of voltage. See the **SC3/10 PROBLEM** section.
- **A Problem with the Batteries** - The batteries could be configured incorrectly or be going bad. (See *Help Note #7*)
- **A Cold Battery** - Cold temperatures can affect the battery charging. See **TEMPERATURE** (*Help Note #4*). If the battery is cold much of the time, the battery's long-term performance and life may suffer.

**Battery Case 2** - **BATTERY OVER-CHARGING:** If there is evidence that the batteries have been over-charging, consider these points:

- **Normal Battery Condition:** The batteries may not be over-charging but only be experiencing normal water loss and normal levels of gassing. (See *Help Notes #2 and #3*)
- **Controller Problem:** The SC3/10 could be defective. If the charging light is on and the actual battery voltage (measured at the battery) is over 14.5 volts, the controller is likely to be defective.
- **A Problem with the Batteries** - The batteries could be configured incorrectly. (See *Help Note #7*)
- **Non-compatible Batteries:** The batteries may be a type that are not compatible with this system and require a lower full-charge voltage. Check battery specifications.
- **Other Charging Sources:** Another charging source could be the cause. Some 110 volt battery chargers are not well regulated and could over-charge batteries if left unattended.
- **A Hot Battery** - See **TEMPERATURE** (*Help Note #4*)

**SOLAR PANEL PROBLEMS:** - Refer to this section to help diagnose potential problems based on panel performance.

<b>CASE</b>	<b>PANELS</b>	<b>SEE CASE NOTE(S)</b>
1 →	Less charge than expected	See <b>Panel Case 1</b>

**Panel Case 1** - The panels should generate a charge current close to their max. power current as presented in their specifications. To reach this level assumes that all conditions are ideal. If the panel performance as measured at the panel inputs on the SC3/10 controller is much lower, consider the following potential problems.

- **Solar Panel Problem** - Panels may be dirty, not aligned or other problem. Panel may have shadows crossing it. The panels could be configured incorrectly or be defective. See ***Problem with the Solar Panels*** (Help Note #6)
- **Bad Panel Connection to the Controller** - See ***BAD CONNECTION: PANEL*** (Help Note #8).

# SC3/10 - FIELD TEST PROCEDURE

The following is a field test procedure for the standard SC3/10 charge controller. For **BENCH TESTING**, substitute a properly current-limiting power supply for the array.

## **TEST 1: Alternate A ( Active solar array required )**

This will test the basic operation of the SC3/10 by testing the FET's (not shorted or open).

**Requirements:** digital multi-meter (dmm)  
active solar array, Voc at least 17 volts

- 1) Connect the array plus and minus wires (yellow and black) to the appropriate wires on the SC3/10 (no battery connection).
- 2) Measure voltage at the battery connections (red and black wires) on the SC3/10. The reading should be between 14.0 and 15.0 volts. If this reading is very high, 16-20 volts, or very low, 2-5 volts, the unit is defective.

## **TEST 1: Alternate B ( If no active solar array is available )**

Tests for the most common failure condition: shorted FET's. This problem would cause a "no charging" condition.

**Requirements:** digital multi-meter (dmm)

- 1) Remove all connections from the SC3/10
- 2) Set multi-meter to the 200 $\Omega$  resistance scale
- 3) Take measurements from SC3/10 wires. Contact positive lead of the meter to ARRAY (+) (yellow) and negative lead of meter to ARRAY (-) (black). Reading should be open (>200 $\Omega$ ). A short (<10 $\Omega$ ) indicates unit is defective.

## **TEST 2**

This procedure tests the condition of the blocking diode.

**Requirements:** digital multi-meter (dmm)

- 1) Remove all connections from the SC3/10
- 2) Set multi-meter to the 2K $\Omega$  resistance scale
- 3) Take measurements from SC3/10 wires. Contact positive lead of the meter to ARRAY (+) (yellow) and negative lead of the meter to BATT (+) (red). Reading should be less than 2K $\Omega$ . Above 2K $\Omega$  would indicate a defective unit.
- 4) Reverse contacts (positive lead to BATT (+) (red) and negative lead to ARRAY (+) (yellow)). Reading should be greater than 2K $\Omega$ . Below 2K $\Omega$  would indicate a defective unit

**LIMITED FIVE YEAR WARRANTY**  
**SPECIALTY CONCEPTS, INC.**

1. Specialty Concepts, Inc. warrants all its products for a period of five (5) years from the date of shipment from its factory. This warranty is valid against defects in materials and workmanship for the five (5) year warranty period. It is not valid against defects resulting from, but not limited to:
  - A. Misuse and/or abuse, neglect or accident.
  - B. Exceeding the unit's design limits.
  - C. Improper installation, including, but not limited to, improper environmental protection and improper hook-up.
  - D. Acts of God, including lightning, floods, earthquakes, fire and high winds.
  - E. Damage in handling, including damage encountered during shipment.
2. This warranty shall be considered void if the warranted product is in anyway opened or altered. The warranty will be void if any eyelets, rivets, or other fasteners used to seal the unit are removed or altered, or if the unit's serial number is in any way removed, altered, replaced, defaced or rendered illegible.
3. The five (5) year term of this warranty does not apply to equipment where another manufacturers' warranty is available. An example of such equipment may be, but is not limited to, an electronic enclosure. The time limit for this warranty may be for less than the Specialty Concepts limited warranty. Specialty Concepts will assist the claimant in attempts to seek warranty claims for such equipment, where appropriate.
4. Specialty Concepts cannot assume responsibility for any damages to any system components used in conjunction with Specialty Concepts products nor for claims for personal injury or property damage resulting from the use of Specialty Concepts' products or the improper operation thereof or consequential damages arising from the products or use of the products.
5. Specialty Concepts cannot guaranty compatibility of its products with other components used in conjunction with Specialty Concepts 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 Specialty Concepts products are compatible.
6. Warranty repair and/or evaluation will be provided only at Chatsworth, California facility of Specialty Concepts. Units for such repair and/or evaluation must be returned freight prepaid to Specialty Concepts with a written description of any apparent defects. Specialty Concepts will not be required at any time to visit the installation site wherein Specialty Concepts' products are subject to warranty repair and/or evaluation.
7. Only Specialty Concepts is authorized to repair any of its products, and they reserve the right to repair or replace any unit returned for warranty repair. The party returning a unit for repair is responsible for proper packaging and for shipping and insurance charges, as well as any other charges encountered, in shipping to and from Specialty Concepts.
8. This warranty supersedes all other warranties and may only be modified by statement in writing, signed by Specialty Concepts.

Warranty terms effective as of April 1, 1993

**REPAIR INFORMATION**

Directions for returning units needing repair.

1. Write up a note with the following information:
  - Name / Company Name
  - Return Address : (For USA/Canada: UPS Deliverable. Avoid PO Boxes)
  - Daytime Phone
  - Description the failure
  - Specify amount of repair charges preapproved (we will contact you if repair charges are larger than this amount.)
2. Box up unit with copy of sales receipt (if available).
3. Send by UPS or Parcel Post to :
  - Specialty Concepts, Inc.**
  - Attn : Repair Dept.**
  - 8954 Mason Ave**
  - Chatsworth, CA 91311 USA**

If the Repair is not covered under warranty, the repair charges will not exceed 30% of the value of a new unit. (shipping and handling not included) Domestic charges are collected via UPS-COD .  
For non-warranty repairs, repaired portion features an additional one-year warranty.

**SPECIALTY CONCEPTS, INC.**

8954 MASON AVE., CHATSWORTH, CA 91311 USA

PH: (818) 998-5238, FAX: (818) 998-5253

