

SPECIALTY CONCEPTS Mark III/20

(SC3/20)

**Photovoltaic Battery Charge Controller  
Installation & Operation Manual**



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GENERAL DESCRIPTION

The Specialty Concepts Mark III/20 (SC3/20) is a battery charge controller and system monitoring unit designed for use in mobile or stationary photovoltaic (PV) energy systems. This controller is designed to be used with standard lead acid batteries that are normally supplied for use in stand alone or mobile applications.

The SC3/20 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. A digital meter is included for battery voltage, solar charge current, charge set-point calibration, and a position for an external shunt (supplied separately) to read an additional current. The fuse provides over-current and reverse polarity protection. "Charging", "Charged", and "Low Voltage" lights indicate battery state. This model is available for 12 volt systems with charging currents up to 20 amps. The SC3/20 can be mounted flush or an additional knockout box (4x7 BOX) can be purchased for wall mounting.

# S P E C I F I C A T I O N S

PARAMETERS	UNITS	VALUE
Nominal Voltage	(Volts)	12
Short Circuit Current, Continuous	(Amps)	20
Short Circuit Current, Max (60 seconds)	(Amps)	26
Load Current, Continuous (1)(3)	(Amps)	10
Load Current, Max (60 seconds) (1)(3)(5)	(Amps)	13
Array Voltage, Max Voc	(Volts)	26
Operating Voltage @ Battery, Min. ( Charging)	(Volts)	0
Operating Voltage @ Battery, Min. ( LVD )(1)	(Volts)	8.5
Operating Voltage @ Battery, Min. ( Meter )	(Volts)	10
Quiescent Current	(Milliamps)	15
Current Consumption, Charging, Typ.	(Milliamps)	25
Current Consumption, Load Disconnected, Typ. (1)(4)	(Milliamps)	40
Voltage Drop, Array to Battery, Typ.	(Volts)	.40
Voltage Drop, Battery to Load, Typ. (1)	(Volts) @ 10 amps	.06
Charge Termination, Factory Set	(Volts)	14.3 ± .2
Charge Termination, Adjustable Range (6)	(Volts)	13.8 to 14.9
Charge Resumption, Factory Set (7)	(Volts)	13.0 ± .3
Low Battery Warning Light, On	(Volts)	11.7 ± .3
Load Disconnect (LVD) (1)	(Volts)	11.5 ± .2
Load Reconnect (1)	(Volts)	13.0 ± .3
Meter Accuracy, DC current (int. shunt)		2 %
Meter Accuracy, DC current (ext. shunt)		1 %
Meter Accuracy, DC voltage		1 %
Operating Temp. Range	(°C)	0 to 50
Storage Temp. Range	(°C)	-20 to 70
Temperature Comp. Coef. (from 25°C) (2)	(Volts/°C)	-.03

- Notes:
- (1) Low-voltage Load Disconnect Option
  - (2) Temperature Compensation Option
  - (3) Non-inductive.
  - (4) LVD relay energized, red L.E.D. on, typical value.
  - (5) Carry only, Non-switching
  - (6) Set-points can be adjusted beyond this range but are not recommended
  - (7) The charge termination / reconnect span is fixed. Reconnect set-point changes during charge termination set-point adjustment.

## P A R T N U M B E R I N G K E Y



**SC3/20 - 12 - A**

MODEL	NOMINAL VOLTAGE	OPTIONS
SC3/20	12	A - Temperature Compensation E - Low Voltage Disconnect (LVD)

### ACCESSORIES

4x7 BOX

Specifications and product availability subject to change without notice.

# SC3/20 FEATURES

## **CHARGE REGULATION**

- 20 amp charge current, 12 volt
- Switching shunt, pulse charging
- Adjustable charging set-points
- Temperature compensation (option)

## **LOW VOLTAGE LOAD DISCONNECT (LVD) (option)**

- 10 amp LVD Relay

## **DESIGN FEATURES**

- 100% solid state charge control
- Designed for rugged mobile use
- Over-current protection - Battery fuse
- Reverse leakage protection - Blocking diode
- Reverse polarity protection
- Lightning protection
- Input noise suppression
- Low power consumption

## **MONITORING**

- Efficient Liquid Crystal Display (LCD)
  - Measures battery voltage
  - Measures charging current
  - Measures second current with external shunt (external shunt supplied separately)
  - Indicates charging set-point
- Charging light
- Charged light
- Low Voltage light

## **MOUNTING OPTIONS**

- Flush mount
- Knock-out box available for wall mounting (4x7 BOX accessory)

## RELATED SYSTEM EQUIPMENT

The SC3/20 is an integral part of a solar electric power system that includes a PV solar array, a battery and a load. These items should be installed in accordance with the National Electrical Code, and with the instructions provided by the equipment supplier.

**SOLAR ARRAY PANELS:** The SC3/20 is compatible with all makes and models of PV panels, provided the open circuit voltage (Voc) does not exceed 26 volts and the short circuit current (Isc) of the array does not exceed 20 amps.

**BATTERIES:** The SC3/20 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 (with filler caps) and the sealed, maintenance-free batteries. A battery disconnect switch should be installed on the Battery (+) run to the controller. This will allow a safe way to disconnect the battery during installation.

**TWO-BATTERY SYSTEMS & SYSTEMS WITH BATTERY ISOLATORS :** If solar charging of two separate batteries is desired, a switch can be installed to allow manual selection of one battery or the other. In installations that use a diode battery isolator with two batteries, the SC3/20 can be connected to one of the outputs from the isolator, or at one of the batteries itself to charge that battery only. Do not connect the SC3/20 to the input of the isolator, the SC3/20 will not operate properly when charging batteries through a diode.

**LOADS:** System loads such as lights, radios and DC/AC inverters must be 12 volts DC (unless an inverter is being used). The loads should be fused as recommended and connected directly to the battery or to a load center/circuit breaker box. See the diagrams in the "INSTALLATION" section.

**OTHER CHARGING SOURCES:** The SC3/20 can be used only as a photovoltaic (solar) charge controller. **DO NOT** use the SC3/20 to regulate other power sources , such as a hydro or wind generator/alternator or an AC battery charger. This could result in damage to the SC3/20 and/or the generating equipment

The SC3/20 **CAN** remain connected to a battery that is also being charged by an another source (alternator, battery charger, etc.) without damage to the SC3/20 or to the solar panels. Connect all other charging sources, with their own charge regulation devices, directly to the battery. No isolation diode or transfer switch is required. NOTE: Some battery chargers or converters powered by 110 volt sources are not properly regulated and can overcharge batteries if left unattended.

# I N S T A L L A T I O N

## **WARNINGS / CAUTIONS**

**WARNING:** 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 the batteries. Most batteries produce hydrogen gas when charging, which is extremely explosive. Provide adequate battery ventilation. **DO NOT** expose the battery to open flame, matches, cigarettes or sparks.

**WARNING:** Install properly DC rated, high interrupt, current limiting, over-current protection and disconnect equipment between the SC3/20 and the battery. Suitable fused disconnect switches are low cost and provide protection from fire and damage due to over-current. Refer to the current National Electrical Code or your local alternative energy vendor for recommendations.

**CAUTION: DO NOT** reverse battery "PLUS" and "MINUS" connections to the SC3/20. 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 SC3/20 at the same time. This will cause damage to the SC3/20 when the battery reaches full charge voltage.

**CAUTION: DO NOT** wire the SC3/20 in such a way that it can be connected to an alternator (or other charging source) while the battery is disconnected, even if momentarily. Other charging sources should have independent connections to the battery.

## **INSTALLATION INSTRUCTIONS:**

**1. MOUNTING CONSIDERATIONS:** - The SC3/20 is designed to be mounted flush against a wall. It can be mounted onto a wall by adding the optional knockout box (4x7 BOX). Flush mounting or wall mounting require different installation and mounting considerations.

**FLUSH MOUNT:** The flush mounted unit requires a rectangular cut-out in the mounting surface with sufficient space (2-3 inches) immediately behind to accommodate the controller. Electrical connection is made to the back of the controller via wires.

**WALL MOUNT:** The wall mounted unit (SC3/20 with the 4x7 BOX) is installed onto a wall surface via four mounting screws. Electrical connections are made through knockouts in the box to the wires on the back of the controller.

## **2. ACQUIRE TOOLS AND MATERIALS**

### **TOOLS AND MATERIALS NEEDED:**

#### **FLUSH MOUNT:**

Slotted screwdriver

Wire cutter/strippers

Drill with 3/32" and 3/8" bits

Keyhole saw or saber saw

Pencil, scratch awl or other marker

Soldering iron and solder (if available)

Electrical tape

Wire of sufficient gauge to run from the panels, to the SC3/20, and to the battery  
(See WIRING INSTRUCTIONS: WIRE SIZE)

Mounting fasteners of appropriate type for wall material (3/4 - #6 screws provided)  
Included are wire nuts, four 3/4 - #6 screws and washers, a spare fuse and a spare programming jumper.

External shunt (if needed). Refer to "EXTERNAL SHUNT FOR 2ND CURRENT READING"

#### **WALL MOUNT (SC3/20 with 4X7 BOX):**

Slotted screwdriver

Wire cutter/strippers

Pencil, scratch awl or other marker

Soldering iron, solder (if available)

Electrical tape

Wire of sufficient gauge to run from the panels, to the SC3/20, and to the battery  
(See WIRING INSTRUCTIONS: WIRE SIZE)

Mounting fasteners of appropriate type to mount the box to the wall

1/2 inch Romex strain relief clamps

Included are wire nuts, four 3/4 - #6 screws and washers, a spare fuse and a spare programming jumper.

External shunt (if needed). Refer to "EXTERNAL SHUNT FOR 2ND CURRENT READING"

**3. LOCATION:** - The SC3/20 should be mounted where it can be easily seen and reached to take the best advantage of the metering. Carefully consider how the wires are to be run from the solar panel to the controller, and from the controller to the battery. The SC3/20 should be mounted as close to the battery as possible, and should be mounted on a vertical surface to aid in cooling.

**FLUSH MOUNT:** The SC3/20 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.

**WALL MOUNT:** The SC3/20 with 4x7 BOX is designed to be mounted on the surface of a cabinet or wall. Wiring can be run down the wall or through a hole in the wall directly below the controller.

**4. PROTECTION REQUIREMENTS:** - 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.

**5. PREPARE THE LOCATION PRIOR TO WIRING:**

**FLUSH MOUNT:** Use the template provided to position and mark the cut-out and the four mounting holes. Make the cut-out using a key hole or jig saw. Start by drilling holes in the corners, then saw between the holes.

**WALL MOUNT:** Mount the knock-out box to the wall using suitable fasteners.

**6. COMPLETE THE INSTALLATION OF PANEL, BATTERIES AND LOAD:** - Follow the manufacturer's instructions for mounting and wiring the solar panel, batteries and the load.

**7. SELECT WIRE:**

**WIRE TYPE:** - It is recommended that stranded wire rather than solid wire be used whenever possible, because stranded wire does not fatigue and cause loose connections over time as easily as solid wire does.

**WIRE SIZE:** - Wire should be sized of sufficient gauge to safely handle the rated current of the system and to limit voltage drop. The wiring used within the controller is of sufficient gauge to handle the currents carried, and these wires are short enough that voltage drops are not a concern, but larger gauge may be appropriate for runs to the array or battery.

<b>Recommended Wire Size:</b>	<u># Solar Panels (50 watt)</u>	<u>Minimum Wire Gauge</u>
	1	# 14
	2	# 12
	3 - 6	# 10

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

**9. RUN SYSTEM WIRING:** - After disconnecting the power sources, run the wires from the battery and solar panel to the location selected for the controller.

**WALL MOUNT:** Run the array and battery wires into the box through the knockouts, using a 1/2 inch Romex cable clamp for strain relief.

**10. 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 SC3/20. 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!**

**11. SC3/20 CONNECTION:** - Wire the SC3/20 according to Figure 1. When possible, solder the wires before installing the wire nuts, then wrap the wire nuts and wires with electrical tape.

**12. EXTERNAL SHUNT CONNECTION:** - If needed.

#### **EXTERNAL SHUNT FOR 2nd CURRENT READING**

The SC3/20 can monitor a current to or from another source, such as a charger or alternator or for monitoring loads such as a DC source center or an inverter. The reading is displayed on the fourth position labeled "CURRENT, EXT SHUNT". To use this feature, a shunt must be added to system. The shunt value should be 1 amp per 1 mv for proper reading, for example 100 amp/100 mv. If a higher current reading than 100 amps is desired, use a 500 amp/50 mv shunt and remove the Programming Pin Jumper on the back of the digital display board. The shunt needs to be installed on the negative leg of the subject you are monitoring. *Refer to Figure 3 for wiring instructions for the external shunt and Figure 4 for location of Decimal Point Programming Pin Jumper.*

**13. INSTALL TEMPERATURE COMPENSATION (OPTION A):** - If included. *Refer to OPTIONS section.*

**WALL MOUNT:** Run the temperature compensation cable through the holes in the knock-out box.

**14. SC3/20 MOUNTING:** - Mount the SC3/20 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 SC3/20 and the wall (or box). This provides an air gap for added cooling. **INSTALLATION OF THESE WASHERS IS REQUIRED FOR PROPER COOLING DURING OPERATION.**

**15. INSTALL FUSING AS NEEDED:** - Add circuit protection where needed. A 20 amp fuse and disconnect switch should be installed on the Battery (+) run of the SC3/20.

## **16. RECONNECT BATTERY AND ARRAY POWER**

**17. CHARGE SET-POINT ADJUSTMENT (RE-CALIBRATION) TO NON-STANDARD SET-POINTS:** - Usually not needed. It is recommended that any adjustment be done by users with electronic experience. Incorrect settings can lead to the over-charge or undercharge of batteries or damage to the SC3/20. Access to the rear side of unit is needed and all adjustments should be performed at times of mild or “room” temperature to insure accurate settings. *Refer to “CHARGE SET-POINT ADJUSTMENT” section below.*

**18. OPERATION:** - Operation of the charge controller is now fully automatic. If the battery voltage is below the Full Charge Termination set-point (14.3 volts) and power is available from the array and the Power Connect Sequence (above) was followed, the SC3/20 should start up in the full-charge mode.

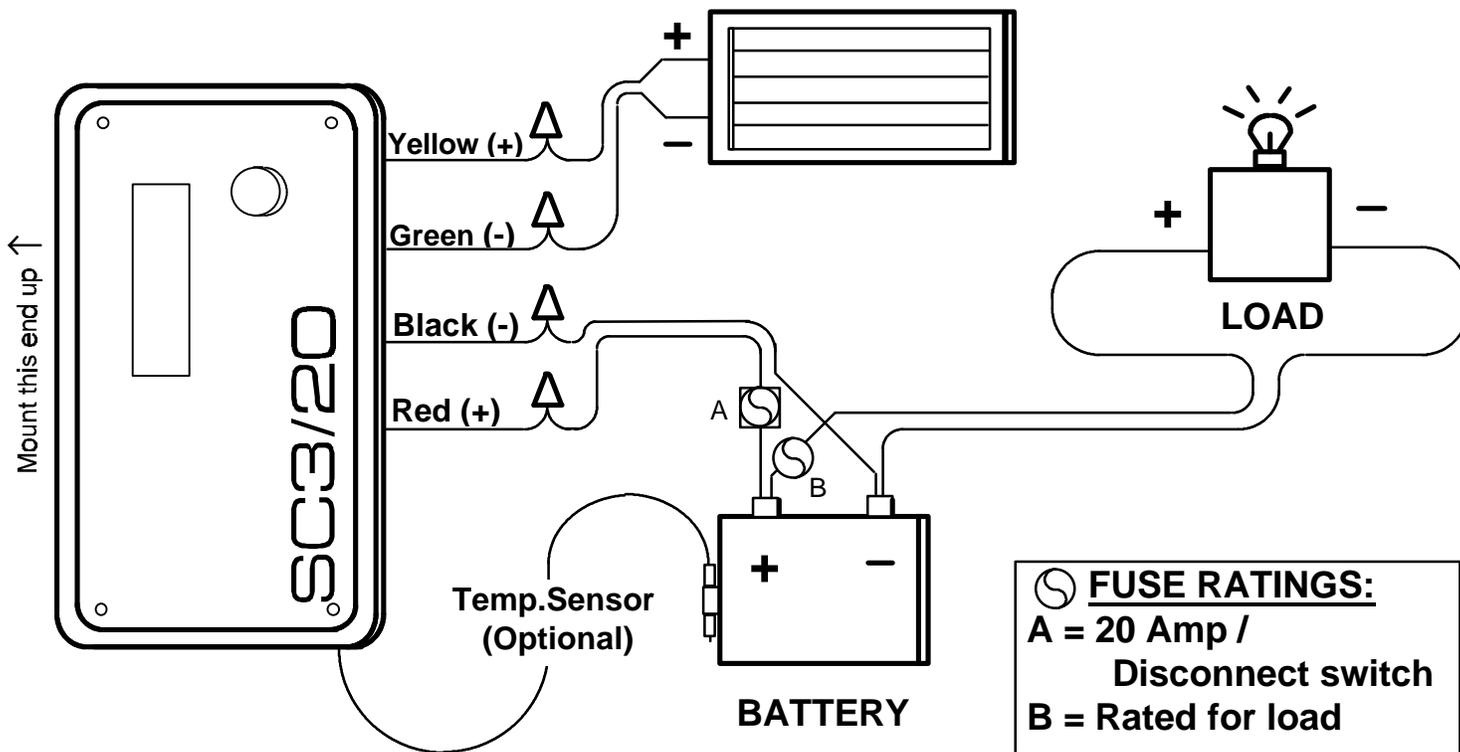
During operation, it is normal for the unit to feel warm.

**19. CHECK FOR VOLTAGE DROP (OPTIONAL):** - Once the system is installed and operational, a check on the battery connection is recommended. A poor battery connection will result in a voltage loss that will cause the batteries to be under-charged and/or result in excessive heat generated at the location of poor connection (wire connection or terminal block). A voltage multi-meter is required and the SC3/20 must be charging with maximum expected charge current.

First, note the voltage at the battery terminals. Select the positive and negative terminals that are used for the SC3/20 connection. Then note the voltage at the SC3/20 connections for “BATT (+)” (red) and “BATT (-)” (black). The difference in voltage should be no more than 1/4 volt. If the voltage drop is more, suspect crimp connections that have not been soldered or loose terminals. If no location of voltage drop is found, consider using larger wires for your run or double-up the number of wires on each run.

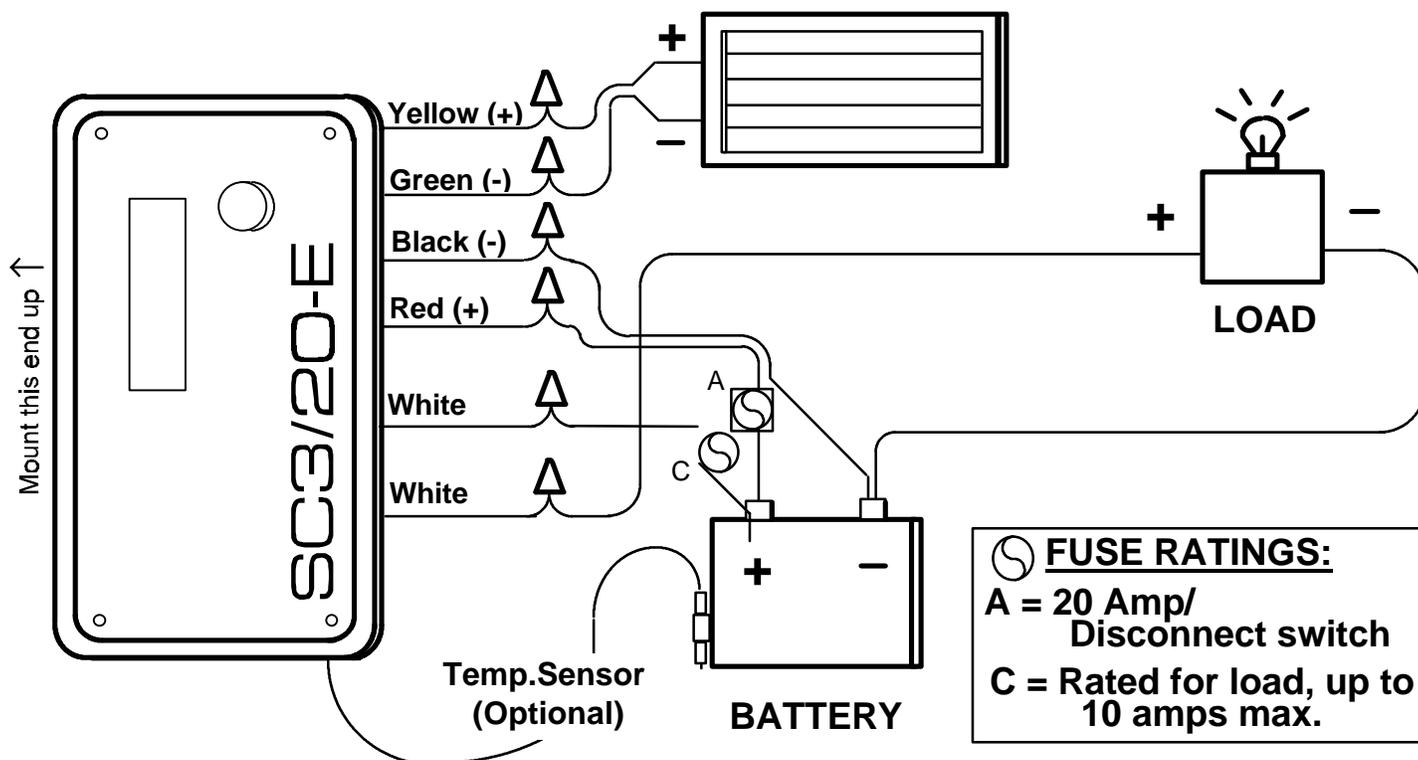
**FIGURE 1 SC3/20 CHARGE CONTROLLER**

SOLAR PANEL ARRAY

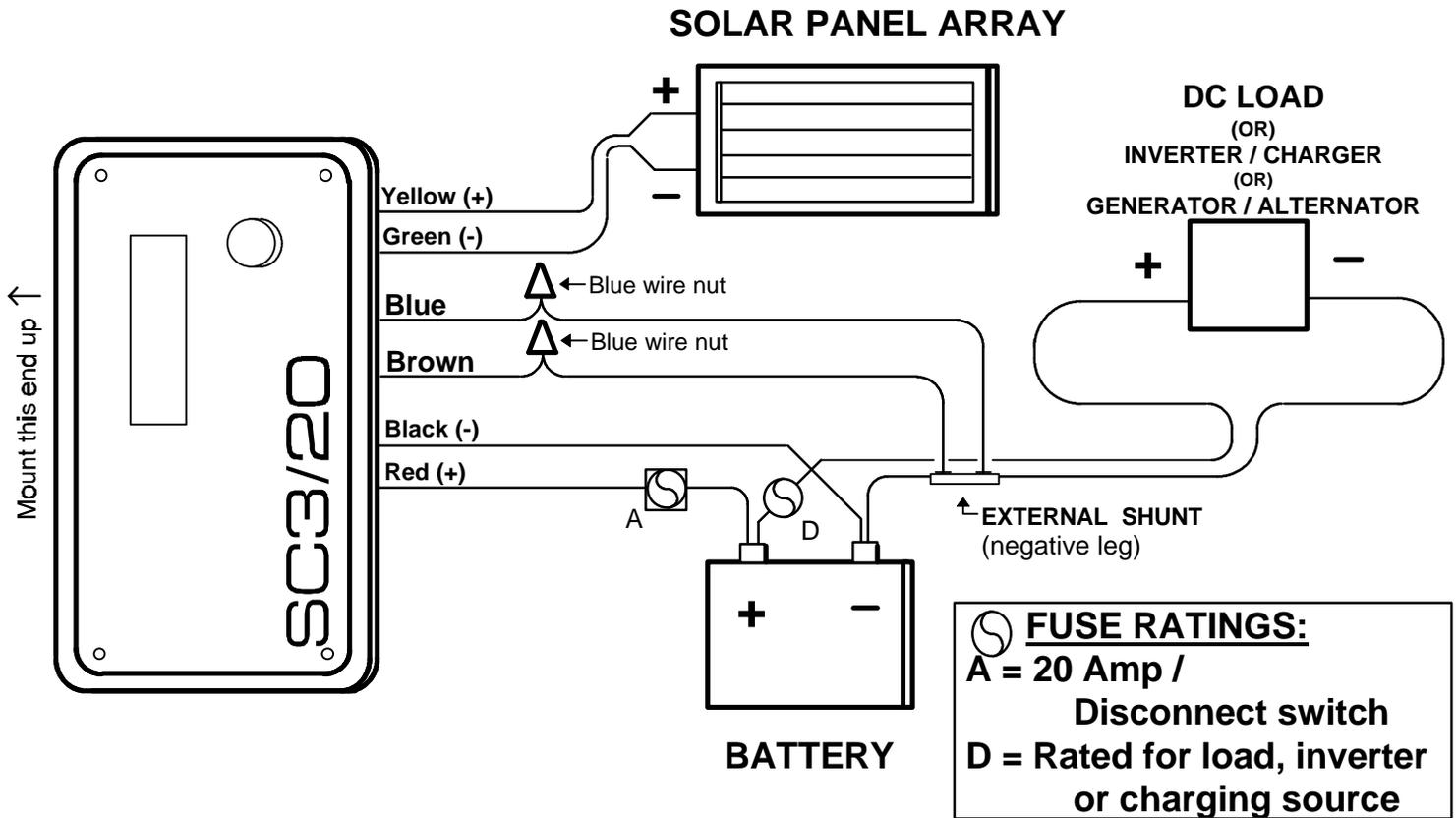


**FIGURE 2 SC3/20 with E-OPTION (LVD)**

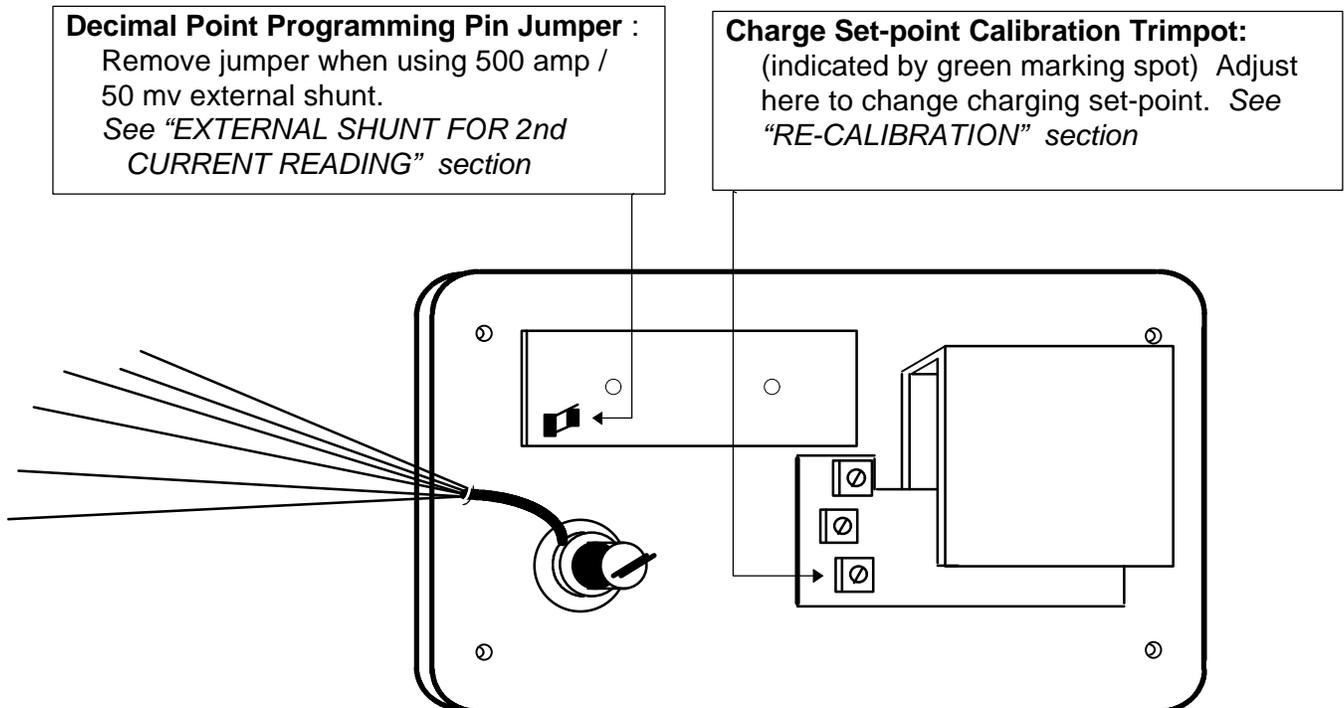
SOLAR PANEL ARRAY



**FIGURE 3 SC3/20 using External Shunt**



**FIGURE 4 SC3/20 BACK VIEW**



## OPERATION

The charge regulation aspects of the SC3/20 are completely automatic. No user interface is required after installation. This controller will regulate the charging of batteries during conditions of heavy usage, or when left unattended for long periods of time.

**SWITCHING SHUNT, PULSE CHARGE REGULATION:** When in the charge mode, the SC3/20 allows maximum available array current to flow into the battery through a blocking diode, lighting the yellow "CHARGING" light. As the battery charges, the voltage will rise slowly until it reaches the charge-cutoff set-point. At this point, the "CHARGING" light goes out, the green "CHARGED" light goes on and battery charging stops. When charging stops the battery voltage will fall, and when the battery voltage drops to the charge resumption set-point, the SC3/20 will resume charging.

**A TYPICAL DAY:** A typical daily cycle will be as follows. As the charging starts for the day and battery capacity is low, charging will be continuous and the "CHARGING" light will be on all the time. As the battery charges up, current will pass into the battery for awhile and eventually stop. Later, charging will resume and the system will continue this cycle throughout the day. During the course of the day, the duration of the charging period of each cycle will get shorter (cycling on for shorter periods and staying off longer). When the battery is close to full charge, it will pulse current into the battery to achieve and maintain full charge. This pulse charging is indicated by the "CHARGING" light occasionally turning on and off, and the "CHARGED" light turning off and on.

## BATTERY FUSE

**"BATTERY FUSE"** - A battery fuse is included for the SC3/20. This will protect the controller from over-current from the solar panels, reverse polarity from the batteries and a short circuit in the system. Fuse type: 20 AMP AGC.

# CHARGE SET-POINT ADJUSTMENT

**CHARGE SET-POINT ADJUSTMENT SHOULD BE ATTEMPTED ONLY BY QUALIFIED PERSONNEL. IMPROPER CALIBRATION CAN RESULT IN BATTERY AND EQUIPMENT DAMAGE.**

The standard charging set-points of the SC3/20 will be proper for a majority of the applications, however the SC3/20 allows field adjustment of charging set-points. Caution should be used, and calibration should not be attempted if there is any doubt about the procedure or ultimate set-points required. The controller can be returned to the factory or authorized representative for calibration at any time.

**WHEN RE-CALIBRATION IS RECOMMENDED:** The standard charge cutoff set-point for the SC3/20 is 14.3 volts. Adjusting the charge set-points is recommended for certain situations which might otherwise result in under or over charging the batteries. These recommendations are approximate and can be influenced by specific conditions. Contact the battery manufacturer or supplier to verify proper settings.

**SOME BATTERIES REQUIRE DIFFERENT CHARGING VOLTAGES:** Sealed, maintenance free batteries may require a lower charging voltage. Generally, for these batteries, the controller should be set for 14.1 to 14.3 volts.

**WHEN THE BATTERY WILL BE SEEING PROLONGED TEMPERATURE EXTREMES:** During prolonged temperature extremes (when the battery will be exposed to average temperatures below 50° F (10°C ) or above 90° F (32°C) for weeks at a time), the set-point should be raised .3 volts (14.6) for lower temperatures and lowered .3 volts (14.1 volts) for high temperatures.

**IN SYSTEMS WITH EITHER EXTREMELY HIGH OR LOW CHARGE RATES:** Systems with very low charge rates (1 amp per 100 amp hour of battery) should have the set-points lowered to about 14.0 to 14.2 volts and systems with very high charge rates (over 20 amps per 100 amp hours of battery) should increase the charging set-point to 14.8 to 15.0 volts.

**PROCEDURE** - All adjustments should be made at times of mild room temperature. At cool or warm times, the display reading will stray somewhat from the actual voltage set-point. To calibrate the SC3/20, proceed as follows.

- 1. COMPLETE BATTERY CONNECTION** - Connect the battery to the SC3/20 according to the normal installation instructions. The array may be connected or not, as desired. The SC3/20 can be calibrated after normal installation.
- 2. SET FRONT SWITCH TO "C"** - Move the metering switch selector to the "C- CHARGE SET-POINT" position.
- 3. LOCATE ADJUSTMENT POT** - There are three adjustment trimpots, the small, square, components with a slotted circle in the middle, located on the back of the controller on the left side of the charge control board (the one with the red/yellow/green LED's). The lowest of the three is the trimpot that adjusts the charging set-points of the controller. (*Refer to FIGURE 4 - BACK VIEW*)
- 4. DETERMINE NEW VOLTAGE SET-POINT** - Decide on a new voltage termination set-point. Note that changing the termination set-point will also change the "charge resumption" set-point by an equal amount. Do not set the controller for more than 16.5, or less than 13.5 volts. When calibrating above 15.0 volts, check to see what the operating limits of other equipment may be, as some electrical equipment (fluorescent lights, inverter) may be damaged or not operate at voltages over 15 volts.  
**CAUTION: DO NOT** calibrate the SC3/20 for a voltage in excess of 16.5 volts, as this can damage the controller.
- 5. ADJUST POT** - Turning the trimpot counter-clockwise increases the set-point, clockwise decreases it.  
**CAUTION:** This is a 270 degree trimpot. Do not turn the trimpot past the endstops, as this can disable the controller.

A small amount of rotation results in a large change in the set-point, and it is possible to adjust the set-points to an improper operating level. Carefully adjust the trimpot to change the voltage reading to the desired setting. The display will read a negative number, and will be in tenths of a volt, so a setting of 14.1 will be displayed as -141. It may require several attempts to set the trimpot to the desired setting.

<b><u>Example:</u></b>	<b><u>Charge Set-point</u></b>	<b><u>Monitor Reading at Position C (at room temp.)</u></b>
	14.1 volts	- 141
	14.3 volts (factory set)	- 143
	14.6 volts	- 146

# MONITORING

The system operation can be monitored by using the digital meter and the lights on the front of the controller.

**DIGITAL DISPLAY:** The Digital display on the front of the SC3/20 provides metering of four parameters, selected by a four position slide switch to the right of the display, labeled A, B, C and D.

**POSITION A - "BATTERY VOLTAGE":** This displays the system battery voltage. The battery voltage is a general indication of battery condition, or capacity. Battery voltage will change when the battery is being charged and discharged, with the amount of change depending on the amount of charge current or discharge current. A fully charged battery that is not being charged or discharged will be at about 12.6-12.8 volts. The normal range of a 12 volt battery is about 11 to 15 volts. A voltage below 11 volts would indicate a dead battery, and over 15 volts is definitely an overcharged battery. It is best to keep the batteries above 11.5 and below 14.5 for maximum battery life and performance.

**POSITION B - "ARRAY CURRENT":** This displays the amount of current the solar panel is generating. Any current generated by the solar panels will be used first to operate any loads that are on, and any left over will go into the battery for charging. The array current reading can be used to optimize the array tilt angle by moving the array (if possible) and noting when current is maximum. Consult the panel supplier or literature for rated output to see what the output should be for the total number of panels in the system under ideal conditions. Ideal conditions would be a bright sunny day, with the panel aimed right at the sun and no shadows or dirt on the panel.

**POSITION C - "CHARGE SET-POINT":** This position displays the charge termination voltage set-point that the controller is currently calibrated for. This display will have a negative sign, and will read in tenths of a volt. For example the setting of 14.3 will be displayed as -143. This setting can be used to verify the termination set-point, or for re-calibration. All monitoring or recalibrating should be performed at times of mild temperature (or "room temperature"). In a warm or cool condition, the display reading will stray from the actual voltage set-point. For re-calibration, refer to the "CHARGE SET-POINT ADJUSTMENT" section.

**POSITION D - "CURRENT, EXT. SHUNT":** This position displays the reading from an external shunt. This reading could be used for a charger or alternator or for monitoring loads such as a DC source center or an inverter. Refer to "EXTERNAL SHUNT FOR 2nd CURRENT READING" section.

**"CHARGING" LIGHT:** The "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 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.

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

**“CHARGED” LIGHT:** The "CHARGED" light will be on when the array is active and the battery has already reached the charge termination voltage. It will go out when the battery drops below the charge resume voltage.

Systems with high charge rate (more than 1 panel per battery), or with old batteries may see the “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 a low output from the panels due to shading low sun angle) may not see the “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.

**“LOW VOLTAGE” LIGHT:** This is a low battery voltage warning light. The “LOW VOLTAGE” light will turn on if the battery voltage drops to 11.7 volts. At this point, system usage should be minimized and if possible, an alternative method (alternator, generator, AC battery charger) should be used to bring the battery voltage up. Once the voltage increases a small amount (by charging or turning off large loads), the light will go off.

On units with the “E Option” (low-voltage load disconnect), the light will indicate disconnection of the loads, which occurs at 11.5 volts.

## **SC3/20 STATUS**

<u>BATTERY VOLTAGE</u>	<u>ARRAY CURRENT</u>	<u>CHARGING LIGHT</u>	<u>LOW VOLT LIGHT</u>	<u>OTHER - STATUS</u>
10-11.7 volts	0-20 amps	ON	ON	Day - Battery is low and is charging. Reduce usage and charge from other source if possible.
10-11.7 volts	No amps	OFF	ON	Night - Battery is low. Reduce usage and charge from other source if possible.
11.7-14.5 volts	0-20 amps	ON	OFF	Day - OK - Battery charging
11.7-14.5 volts	No amps	OFF	OFF	Night - Battery OK
13-14.5 volts	No amps	OFF	OFF	OK -Charging stopped. Battery at or near full charge
10-13 volts	No amps	OFF	ON or OFF	Day - Solar system should be charging. <b>Check trouble shooting section.</b>
14.7-up	0-20 amps	ON	OFF	Day - Solar system should be off. <b>Check trouble shooting section.</b>

# OPTIONS

The following are instructions for installing and using the options that are available on the SC3/20. These options must be specified at the time of an order; options can not be added to finished units.

## **OPTION A - Temperature Compensation:**

**DESCRIPTION:** On units equipped with temperature compensation, a small sensor on a ten foot cable is wired into the controller to adjust the charging thresholds according to battery temperature. The rate of compensation is  $-5\text{mv}/^{\circ}\text{C}$  per battery cell in series from  $25^{\circ}\text{C}$ .

**WHEN NEEDED:** Temperature compensation is recommended for stand alone systems with sealed batteries, or for systems that have no regular charging source other than PV **AND** where prolonged temperature extremes will be experienced during periods of charging. Temperature extremes would be when the battery will be exposed to average temperatures below  $50^{\circ}\text{F}$  ( $10^{\circ}\text{C}$ ) or above  $90^{\circ}\text{F}$  ( $32^{\circ}\text{C}$ ). Systems with other sources of charging, (alternators on RVs) or applications where the battery is on maintenance charge, normally do not need this option.

**CAUTION: SENSOR CABLE:** If the sensor is damaged or the cable is cut, the controller will no longer function.

## **INSTALLATION INSTRUCTIONS**

Provision must be made to attach the sensor unit to the battery. This must be done properly to insure that accurate temperature readings are made. It is important that ambient temperature not influence the sensor. To minimize this, attach the sensor to the battery as follows:

- 1. RUN SENSOR TO BATTERIES:** Run the sensor to the batteries, taking care to prevent damage to the actual sensor itself. When pulling the sensor through conduit, do not pull on the rubber-coated sensor, but instead on the gray cable just behind the sensor. Do not force the sensor. The sensor itself is made of glass, but it is encased in an aluminum tube, then coated with plastic. If the tube should pull off of the glass sensor, and if the sensor is not damaged, the tube can be slipped back over the sensor.
- 2. ATTACH SENSOR:** Use the adhesive sided foam pad (included) to cover the sensor (the plastic coated unit at the end of the cable) and attach it to the side of the battery approximately half-way up the side of the battery. Choose a battery that is shielded from drafts or sunlight by other batteries or by the battery shelter. **DO NOT** immerse the sensor directly in the battery's electrolyte, it will be severely damaged. Temperature compensation of charging voltage is now automatic.

## **OPTION E - Low-Voltage Load Disconnect (LVD):**

This option provides a relay that can be used as a switch to automatically disconnect loads at a low-voltage condition of the battery. Two additional wires are provided for connection to the Battery (+) and Load (+). *Refer to Figure 2: SC3/20 with E-OPTION (LVD)*

The relay activates at about 11.5 volts and deactivates at about 13.0 volts. The "LOW VOLTAGE" light will go on to indicate the LVD. To install this option, choose either white wire and connect it to the Battery (+) and connect the remaining white wire to the Load (+). Connect the Load (-) to Battery (-) terminal.

## 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. If a possible problem with the SC3/20 is suspected based on the observations and notes in the "MONITORING" section, refer to the chart titled **SC3/20 PROBLEMS** and the case note for each condition. If you feel your batteries are not being adequately charged or are consistently being over-charged, refer to the section **BATTERY PROBLEMS**. If you feel that the solar panels are not performing adequately, refer to the section **SOLAR PANEL PROBLEMS**. You may be asked to perform the **FUSE REMOVAL TEST** or other tests to assist with the diagnosis. The problem sections will often refer back to the **HELP NOTES** section.

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

#### **NORMAL CONDITIONS:**

1. **CHARGING MAY NOT NEED TO STOP** - The SC3/20 is designed to prevent over-charging of the battery. It does this by charging the batteries up to about 14.3 volts. It will then turn the solar panel off. Charging will resume when the battery voltage drops to about 13.0 volts. If the charge current is not strong enough to over-charge the battery, the controller may not need to 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 up the level 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.

#### **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.
7. **PROBLEMS WITH THE BATTERIES** - There are a few problems with batteries that can cause the system to malfunction. When batteries get old and start to fail, they do not accept charge current or deliver load current very well, and in fact act like a very small battery. A small amount of charging will cause the voltage to rise prematurely, and any discharge will make the voltage fall rapidly. This can be confusing to the controller and to anyone watching the battery voltage. Another condition, a shorted battery cell, can cause the system to charge continuously without any appreciable increase in overall battery voltage. The cells that are not shorted will tend to gas heavily. If the condition of the battery is suspect, a battery capacity test is recommended.

8. **BAD CONNECTION: PANEL** - This may include problems with the connections to the SC3/20 (yellow wire and green wire), at either array terminals (“+” or “-”) or in fuses and crimp connectors in these lines.
9. **BAD CONNECTION: BATTERY** - This may include a blown fuse at the front of the SC3/20 (See CONTROLLER FUSE BLOWN below). A bad battery connection could also be caused be a defective fuse, a bad fuse holder or problems with the connections in the system. Bad connections can be found at the SC3/20 (red wire and black wire), at either battery terminal or in fuses and crimp connectors in these lines.
10. **CONTROLLER FUSE BLOWN** - The fuse on the front panel of the controller can be blown and may need replacing. Replacement is a 20 amp AGC fuse. Before replacing a blown fuse, locate and correct the cause.  
Possible causes for blown fuses:
  - 1) Reverse battery connection
  - 2) Incorrect connection
  - 3) Array current is over 20 amps
11. **INCORRECT VOLTAGE SET-POINT** - The SC3/20 may be functional but the charge termination set-point may not be correct for your batteries. The factory set-point is around 14.3 volts and is designed to work for the majority of batteries. Set the front panel switch position to “C”. At times of mild temperature (“room temperature”) the display should read -142 to -144 (indicating 14.2 to 14.4 volts). If the reading is outside of this range, an adjustment may be necessary. *Refer to the ‘CHARGE SET-POINT ADJUSTMENT’ section.* Adjustments to the calibration should be performed by qualified personnel or at the factory.
12. **SYSTEM NOISE** - The SC3/20 can be subjected to electrical noise from a converter or inverter. This will cause the meter readings to be erratic. If the SC3/20 is connected to the converter, or to a buss that is connected to a converter, try connecting the SC3/20 directly to the battery instead.

### **Fuse Removal Test**

This test temporarily removes the battery connection to the SC3/20. By noting the reaction on the SC3/20’s volt-meter, one can receive additional information about the workings of your system.

First, during a sunny period, observe "BATTERY VOLTAGE" reading (it must be over 10 volts to perform this test). Then, remove the fuse, observe the "BATTERY VOLTAGE" reading again. Note the new reading and any changes and refer to the sections below.

NOTE: When the fuse is removed, it is normal for the “CHARGING” and the “CHARGED” lights to both go on (during the daytime) and to hear a faint buzzing. Remember to replace the fuse after testing.

**“BATTERY VOLTAGE” READING IS BLANK** - If the meter is blank, this means that the solar array is bad or disconnected or that the SC3/20 is defective. Check the **SOLAR PANEL PROBLEMS** section below before returning the SC3/20 for repair.

**VOLTAGE READING STAYS THE SAME** - If the meter stays the same before and after removing the fuse, that means that the controller may not be connected to the battery. See above Help Note #9 - **BAD CONNECTION: BATTERY** before returning the controller for repair.

**VOLTAGE MOVES HIGHER, READS FROM 12.0 TO 14.7** - This is the correct reaction and the unit is working properly.

**VOLTAGE READING IS HIGH (GREATER THAN 16.0 VOLTS)** - This means that the meter is trying to show the panel voltage, which is usually about 16-22 volts for a 12 volt panel. This would indicate that the SC3/20 is defective.

**BUZZING** - There may be a “buzzing” sound or high pitched whine from the controller. This is normal and is caused by the controller rapidly switching on and off while not connected to the battery.

**SC3/20 PROBLEMS:** - Refer to this chart and the **SC3/20 PROBLEM CASES** (next page) to help diagnose potential problems based on the SC3/20 readings.

<u>CASE</u>	<u>BATTERY VOLTAGE READING</u>	<u>ARRAY CURRENT READING</u>	<u>YELLOW CHARGING LIGHT</u>	<u>GREEN CHARGED LIGHT</u>	<u>RED LOW VOLTAGE LIGHT</u>	<u>OTHER</u>	<u>SC3/20 CASE (Next Page)</u>
#1 →	Display blank	Display blank	OFF	OFF	OFF	Day	See Case 1
#2 →	Display blank	Display blank	OFF	OFF	OFF	Night only	See Case 2
#3 →	10-13	00.0	OFF			Day	See Case 3
#4 →	12.0-14.7	00.0	ON	ON		Day	See Case 4
#5 →	13-14.7	00.0	ON	OFF		Day	See Case 5
#6 →	14.7 - 22.0		ON				See Case 6
#7 →			ON at night			Night	See Case 7
#8 →				ON	ON		See Case 8
#9 →	Reading changing rapidly	Reading changing rapidly	May be flashing	May be flashing		Day	See Case 9
#10 →	Voltage reading erratic						See Case 10
#11 →	Voltage reading higher than actual battery voltage						See Case 11
#12 →		Current less than expected	ON	OFF		Day	See Case 12
#13 →			Changes to ON or OFF	Changes to ON or OFF		Day - Front fuse taken out or pushed	See Case 13
#14 →						Day - SC3/20 buzzing	See Case 14
#15 →						SC3/20 hot	See Case 15
#16 →						Position "C" voltage setting drifts	See Case 16

## **SC3/20 PROBLEM CASES (from SC3/20 PROBLEMS chart)**

**SC3/20 Case 1** - Check the battery voltage. Minimum operating voltage for the display is about 10 volts. If the battery voltage is over 10 volts then this condition indicates that a bad connection exists to both the battery (See **BAD CONNECTION: BATTERY** (Help Note #9)) and the solar panel (See **BAD CONNECTION: PANEL** (Help Note #8)) or that the SC3/20 is defective.

**SC3/20 Case 2:** - This condition usually indicates a bad connection exists to the battery (See **BAD CONNECTION: BATTERY** (Help Note #9)). This could also be caused by a blocking diode or diode isolator in the battery connection (red wire line). If there is a blocking diode, remove it. If there is a diode isolator, modify the system so the SC3/20 charges only one battery bank.

**SC3/20 Case 3** - This indicates that the system has no panel input, or the SC3/20 charge set-point has been modified or the unit is defective. Perform the **FUSE REMOVAL TEST** (above). If the volt reading remains unchanged, then the unit may be out of calibration (See **INCORRECT VOLTAGE SET-POINT** (Help Note #11)). If the voltage display goes blank, there is either a bad panel connection (See **BAD CONNECTION: PANEL** (Help Note #8)) or the unit is defective.

**SC3/20 Case 4** - This is a result of a bad battery connection. (Help Note #9).

**SC3/20 Case 5** - If the charge light is on with 0 amps on the array current reading, then this could indicate a condition of low light to the panels, a system problem or a controller problem. Perform the **FUSE REMOVAL TEST** (above). If the voltage changes a little, then the controller seems to be working OK and the panels are charging a small amount. If the voltage does not change, refer to **BAD CONNECTION: BATTERY** (Help Note #9). If the voltage reading is 16-22 volts, this would indicate a defective controller. If the meter does something else, then suspect a bad connection somewhere or another system problem.

**SC3/20 Case 6** - There are several possibilities for this. See **BAD CONNECTION: BATTERY** (Help Note #9), **INCORRECT VOLTAGE SET-POINT** (Help Note #11), or the unit can be defective. Perform the **FUSE REMOVAL TEST** (above). If the voltage goes up a little, the unit is functional but may be set for an incorrect voltage. If the voltage meter remains unchanged, this suggests there is a problem with the battery connection. If the voltage reading is 16-22 volts, the unit is defective.

**SC3/20 Case 7** - 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). If "CHARGING" light is on brightly at night, the controller is miswired or defective or there is a blocking diode located within the solar panels or in the panel connection. TEST: Disconnect the panel (yellow wire), if the light goes off, then this would indicate that there is not a serious problem; either the panel is receiving enough light for a slight charge or there is a diode in the panel connection causing the light to be on. If the light stays on, this suggests that the SC3/20 may be defective.

**SC3/20 Case 8** - See **INCORRECT VOLTAGE SET-POINT** (Help Note #11) or the unit is defective.

**SC3/20 Case 9** - This can be a normal condition or can indicate a bad battery. See **PROBLEMS WITH BATTERIES** (Help note 7) or **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 voltage reading on the controller is going up and down, then suspect a bad battery connection. If the voltage here also moves up and down rapidly, this would suggest the battery bank is bad or too small, or this may be a normal condition. When the battery is charged up, and the array can provide lots 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.

**SC3/20 Case 10** - This is a result of **SYSTEM NOISE** (Help Note #12)

**SC3/20 Case 11** - This can be a result a **BAD CONNECTION: BATTERY** (Help Note #9). The battery connection problem could be in the nature of corrosion, or a loose connection. TEST: Check the system at night or disconnect the yellow wire. If the difference goes away, suspect a bad connection or corrosion in the battery connection.

**SC3/20 Case 12** - Refer to the **Solar Panel Problems** section for a list of potential problems. Also, check to see that there is not an alternative path from the solar panel negative to the battery negative other than through the SC3/20.

**SC3/20 Case 13** - The charge control circuit will reset when power is removed. Pushing or removing the front panel fuse will momentarily cause power to be lost to the control circuit, causing it to reset. It may reset in the charging or non-charging mode, but most often in the charging mode. This is normal and does not indicate a problem.

**SC3/20 Case 14** - The buzzing sound is caused by the controller rapidly switching on and off and is a problem relating to a **BAD CONNECTION: BATTERY** (Help Note #9).

**SC3/20 Case 15** - The SC3/20 may get warm during normal operation, but not hot. If the unit should get too hot to touch, consider it defective.

**SC3/20 Case 16** - The reading of the charge termination set-point (Position “C”) will differ at warm or cool times. The actual voltage set-point remains unchanged. Monitor and adjust the set-point at times of mild ( or “room temperature”).

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

<u>CASE</u>	<u>BATTERY</u>	<u>SEE NOTE(S)</u>
1 →	Seems to be over-charging	See Battery Note 1
2 →	Does not fully charge batteries	See Battery Note 2

**Battery Note 1 - 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. Check the “BATTERY VOLTAGE” reading. Normal battery voltage for a wet cell battery can be up to 14.6 volts. (See Help Notes #2 and #3)
- **Controller Problem:** The SC3/20 could be defective. Perform the **FUSE REMOVAL TEST**. If “BATTERY” voltage moves up to between 14.0 and 15.0 volts and a buzz or high pitched whine is heard, then the unit is working. The batteries may not be seriously over-charged. Check for **INCORRECT VOLTAGE SET-POINT** (Help Note #11)
- **Non-compatible Batteries:** The batteries may be a type that are not compatible with this system and require a lower full-charge voltage. Refer to **INCORRECT VOLTAGE SET-POINT** (Help Note #11).
- **Other Charging Sources:** Another charging source could be the cause. If the SC3/20 “CHARGING” light is off and the “ARRAY CURRENT” reading is 0, then the solar system is off and overcharging can be from another source. Some 110 volt battery chargers are not well regulated and could over-charge batteries if left unattended.
- **A Hot Battery** - Hot temperatures can affect the battery charging (see Help Note #4). A hot location for batteries will tend to over-charge the batteries.

**Battery Note 2 - BATTERY UNDER-CHARGED:** If the battery voltage is low and they are not able to be charged sufficiently, consider one of the following problems:

- **Solar Panels Problem** - Panel may be dirty, not aligned or other problem. See Help Note #6
- **Bad Connection to the Solar Panel** - See Help Note #7
- **SC3/20 Controller Problem** - Perform the **FUSE REMOVAL TEST**. The voltage reading should increase. Also, see the **SC3/20 PROBLEM** section. Examine the readings from the SC3/20 meter to see if they indicate a problem.
- **A Bad Battery** - The batteries may be going bad. TEST: If the battery is going bad, a little charging or discharging will cause a large change in the battery voltage.
- **A Cold Battery** - Cold temperatures can affect the battery charging (see Help Note #4). If the battery is cold much of the time, the battery’s long-term performance and life may suffer.
- **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 PANEL PROBLEMS:** - Refer to this section to help diagnose potential problems based on panel performance.

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

**Panel Note 1** - The panels should generate a charge close to their rated short circuit 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 SC3/20 controller is much lower, consider the following potential problems.

- **Solar Panels Problem** - Panels may be dirty, not aligned or other problem. See Help Note #6. TEST: Monitor the "ARRAY CURRENT" reading before and after cleaning of the solar panels and orientation. Locate panel where no shadows will cross it.
- **Bad Connection to the Solar Panel** - See Help Note 7. TEST: Measure the voltage up at the solar panel, and then down at the battery itself during a sunny period of maximum charging. These voltage readings should not be more than 1 to 1.5 volts different. More than that would indicate a bad connection or other voltage drop in the system. Suspect crimp connections that have not been soldered.
- **Solar Panels may be defective** - TEST: At the SC3/20, disconnect the array(+) connection (yellow wire), and measure the solar array voltage between the array(+) (yellow wire connection) and the array(-) (green wire connection). In sunny conditions, this should be 18-24 volts (in a 12 volt system). A lower value could indicate problems with the solar panel.

## 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 eyelet, 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 pre-approved (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.

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