SPECIALTY CONCEPTS SYSTEM

(SCS/50, SCS/90)

Photovoltaic Battery Charge Controller
Installation And Operation Manual

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GENERAL DESCRIPTION

The SPECIALTY CONCEPTS SYSTEM (SCS) is a versatile, industrial quality charge controller for the efficient use of photovoltaic energy and the protection of expensive batteries.

The SCS is a series-relay battery charge controller using mercury relays, remote temperature compensation, adjustable charging set-points, low-voltage load disconnect, circuit breakers, and digital metering. Lights indicate "CHARGING" and "LOAD DISCONNECT" conditions and the meter displays battery voltage, charging and load current, and current from an external shunt.

FEATURES

CHARGE REGULATION
- Available for 12,24,36 or 48 volt systems
- 50 amp charge current: SCS/50
- 90 amp charge current: SCS/90
- Two-step, series charging, 12,24 v
- Single step, series charging, 36,48 v
- Adjustable charging set-points
- Temperature compensation

LOW-VOLTAGE LOAD DISCONNECT (LVD)
- 30 amp LVD, 12 volt
- 20 amp LVD, 24 volt
- 15 amp LVD, 36 and 48 volt
- Adjustable disconnect set-points
- Manual override switch

MOUNTING
- Indoor wall mount enclosure (standard)
- Outdoor enclosures (optional)

MONITORING
- Digital volt / amp meter
- “CHARGING” light

DESIGN FEATURES
- Mercury Relays
- Array, battery and load circuit breakers (providing over-current protection and manual disconnects)
- Maximum array usage
- Reverse polarity protection
- Reverse leakage protection
- Lightning protection
- Input noise suppression
- Remote battery voltage sense
- “LOAD DISCONNECTED” light

SPECIFICATIONS

PARAMETERS	UNITS	NOMINAL VOLTAGES			
		12 v	24 v	36 v	48 v
Charge Current, Continuous	(Amps)	50	50	50	50
Charge Current, Max. (60 seconds)	(Amps)	65	65	65	65
Load Current, Continuous (1)	(Amps)	30	20	15	15
Load Current, Max. (60 seconds) (2)	(Amps)	39	26	20	20
Array Voltage, Max. Voc	(Volts)	22	44	66	88
Operating Voltage @ Battery, Min.	(Volts)	8.5	17.0	25.5	34.0
Quiescent Current (3)	(Milliamps)	40	40	40	40
Current Consumption, Charging, SCS/50 (4)	(Amps) .5	.3		.25	.2
Current Consumption, Charging, SCS/90 (4)	(Amps) 1	.5		.4	.25
Current Consumption, Load Disconnected (5)	(Amps) 1	1		1	1
Voltage Drop, Max. (Array to Battery),SCS/50	(Volts @ Max. rating)	.4	.4	.4	.4
Voltage Drop, Max. (Array to Battery),SCS/90	(Volts @ Max. rating)	.8	.8	.8	.8
Voltage Drop, Max. (Battery to Load)	(Volts @ Max. rating)	.1	.1	.1	.1
Full Charge Termination (6)	(Volts)	14.8 ± .2	29.6 ± .4	44.4 ± .6	59.2 ± .8
Full Charge Resumption	(Volts)	12.8 ± .2	25.6 ± .4	38.4 ± .6	51.2 + .8
Load Disconnect (7)	(Volts)	11.5 ± . 2	23.0 ± .4	34.5 ± .6	46.0 ± .8
Load Disconnect Adjustment Range	(Volts)	11.0 to 12.0	22.0 to 24.0	33.0 to 36.0	44.0 to 48.0
Load Reconnect	(Volts)	13.0 ± .3	26.0 ± .6	39.0 ± .9	52.0 ± 1.2
Float Voltage	(Volts)	14.1 ± .2	28.2 ± .4	NA	NA
Float Current, Max.	(Amps)	3	1	NA	NA
Low Alarm Set-point (factory set)	(Volts)	11.8 ± .1	23.6 ± .2	35.4 ± .3	47.2 ± .4
High Alarm Set-point (factory set)	(Volts)	15.5 ± .1	31.0 ± .2	46.5 ± .3	62.0 ± .4
Alarm Relay Contact Current, Max.	(Amps)	3	3	3	3
Meter Accuracy, Voltage		1 %	1 %	1 %	1 %
Meter Accuracy, Current		1 %	1 %	1 %	1 %
Temp. Compensation coef.(from 25°C)	(Volts/°C)	-.03	-.06	-.09	-.12
Operating Temp. Range, Control circuit	(°C)	-20 to 50	-20 to 50	-20 to 50	-20 to 50
Operating Temp. Range, Metering	(°C)	0 to 50	0 to 50	0 to 50	0 to 50
Storage Temp. Range	(°C)	-20 to 70	-20 to 70	-20 to 70	-20 to 70

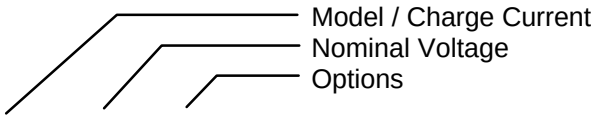
Notes:
(1) Non-inductive.
(2) Carry only, Non-switching
(3) Both relays unenergized, red LEDs off, typical value.
(4) Charge relay energized, red L.E.D. on, typical value.
(5) LVD relay energized, red L.E.D. on, typical value.
(6) Set-point adjustable. Refer to table.
(7) Decreases by 10 mv for every amp of load current

FULL CHARGE TERMINATION SET-POINTS

Controller Voltage	SWITCH POSITIONS A	B	C	D
12	15.3	14.8	14.3	13.8
24	30.6	29.6	28.6	27.6
36	45.9	44.4	42.9	41.4
48	61.2	59.2	57.2	55.2

PART NUMBERING KEY

EXAMPLE:



SCS/50 - 12 - 4X

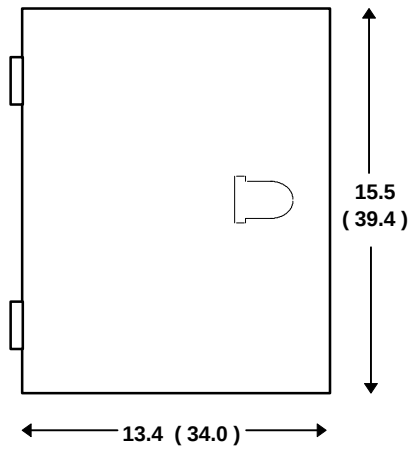
MODEL	NOMINAL VOLTAGE	OPTIONS
SCS/50	12	H - Generator Start
SCS/90	24	W - Positive Ground Load
	36	3R - Outdoor enclosure - *moderate protection*
	48	4X - Outdoor enclosure - *maximum protection*

Specifications and product availability subject to change without notice.

DIMENSIONS (SCS/50)

In Inches (cm)

STANDARD ENCLOSURE (NEMA 1)



Depth: 6.0 Inch (15.2 cm)
Shipping weight: 30 lb. (13.5 Kgs.)

R E L A T E D S Y S T E M E Q U I P M E N T

The SCS 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 (NEC) or other applicable code, and with the instructions provided by the equipment supplier.

SOLAR ARRAY PANELS: The SCS is compatible with all makes and models of PV panels, provided the voltage and current specifications of the SCS are not exceeded. These are the maximum open circuit voltage of the array (Array Voltage, Max. Voc: *see Specifications*) and the maximum power current of the array (Charge Current, continuous: 50 or 90 amps).

HIGHER CHARGING CURRENTS : For arrays exceeding the maximum power current of the SCS, the array can be divided into smaller parallel sub-arrays. A SCS can be wired in parallel to each sub-array, provided the sub-arrays do not exceed the rating of the individual SCS.

BATTERIES: The SCS is factory set for the most common lead-acid batteries. These are wet cell batteries using pure lead, lead antinomy and/or lead calcium grids. For sealed, maintenance free batteries, or vented pocket plate nickel-cadmium batteries, the charging set-points should be adjusted to maximize performance and battery life. Note: For sealed, maintenance free batteries or nickel cadmium batteries, consult the battery manufacturer for recommended set-points and refer to Table 2 for appropriate settings.

LOADS: The load is considered the item or equipment that the PV system is powering. System loads such as lights, radios, DC/AC inverters, etc. must be rated for the proper DC input voltage. DC loads not exceeding the rated SCS load current (see specification section) can be connected to the load terminals of the SCS and they will automatically be disconnected in the event of a low-voltage condition. Higher current, or inductive loads such as pumps, motors or inverters should be connected directly to the battery, using properly rated over-current/disconnect devices (fuses or circuit breakers).

OTHER CHARGING SOURCES: Do not use the SCS 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 SCS and/or the generating equipment. Connect other charging sources with their own regulation devices directly to the battery, using properly rated over-current protection devices.

The SCS and array can remain connected to a battery being charged by other sources, (alternator, battery charger, etc.) without damage to the controller or solar array.

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. It is recommended that the requirements of the U.S. National Electrical Code (NEC) or other applicable code should be followed.

WARNING: Follow all safety precautions of the battery manufacturer and the NEC. 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.

WARNING: Install properly DC rated, high interrupt over-current protection between the SCS and the battery. Refer to the current NEC or other applicable code for recommendations.

WARNING: On higher voltage units (36, 48 volt), exercise extreme care during installation. These voltages can be extremely dangerous in that they can create large arcs, which can burn or cause other injuries.

WARNING: To remove all power from the controller, all three circuit breakers must be turned off (including the load).

CAUTION: DO NOT subject the controller to voltages greater than the "Array Voltage, Max. Voc" as stated in the SCS specifications. This is the open circuit voltage (Voc) of the solar panel, or the sum of the open circuit voltages of all modules connected in series.

CAUTION: DO NOT exceed the 50 or 90 amp current rating of the SCS. This is the sum of the max. power currents of all modules in parallel.

INSTALLATION INSTRUCTIONS:

1. **LOCATION:** - A suitable location must be found for mounting the SCS. The unit features mercury relays that require the unit to be mounted on a vertical surface. This unit should also be as close as possible to the batteries to avoid errors in battery voltage reading. The temperature sensor wire is 10 feet long and should reach the battery bank if possible.

2. **PROTECTION REQUIREMENTS: -** The unit should not be placed in direct sunlight or close to any heat generating source to avoid extreme temperature increases. It must receive adequate protection from rain, dust and insects. The standard SCS is supplied in an indoor NEMA 1 enclosure, or optional outdoor enclosures are available.

3. **INSPECT UNIT / PREPARE AND MOUNT THE SCS ENCLOSURE:** - Remove the inner panel of the SCS by unscrewing the four acorn nuts in the four corners. Inspect the circuitry and hardware for connections that may have become loose during transit. Determine the size and location of holes needed in the enclosure for conduit hubs or strain relief feed-throughs for the wiring. Proceed with making holes in the enclosure by punching out the knock-outs in the steel NEMA 1 and 3R enclosures, or drilling holes in the plastic NEMA 4X enclosure. Return the inner panel.

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. **SELECT WIRE**

   WIRE TYPE: - It is recommended to follow the NEC requirements for wiring methods. 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.

   WIRE SIZE: - The SCS/50 terminal block accepts bare wire up to 6 AWG. The SCS/90 terminal block accepts bare wire up to 1/0 AWG. Wire should be sized of sufficient gauge to safely handle the rated current of the system and to limit voltage drop. Consult wire sizing tables and local alternative energy system suppliers for information on wire type and sizing.

6. **REMOVE POWER FROM BATTERY / PANELS:** - Disconnect power from the batteries and panels prior to running the wires to the controller to prevent accidental damage and/or bodily harm.

7. **SET CIRCUIT BREAKERS TO “OFF”: -** Make sure all three circuit breakers on the SCS are “OFF”.

INSTALLATION INSTRUCTIONS (continued):

8. RUN SYSTEM WIRING: - After disconnecting the power sources, refer to wiring diagram (FIGURE 1) and run the system wiring to the location of the SCS. The wires should reach the location of the SCS with a little extra for strain relief loops.

9. NOTE WIRE POLARITY: - Insure that the polarity of the wires is correctly marked, using colored wires or tags. Incorrect polarity should not damage the SCS, but incorrect operation would result.

10. COMPLETE ARRAY AND BATTERY CONNECTIONS: - Connections to the SCS terminal block should be made with just the bare wire (not crimped spade or ring lugs unless the lugs are crimped AND soldered).

11. COMPLETE LOAD CONNECTIONS: - Refer to wiring diagram (FIGURE 1). DC loads not exceeding the rated SCS load current (see specification section “Load Current, Continuous”) can be connected to the load terminals of the SCS and they will automatically be disconnected in the event of a low-voltage condition. Higher current, or inductive loads such as pumps, motors or inverters should be connected directly to the battery, using properly rated over-current protection devices (fuses or circuit breakers).

12. BATTERY VOLTAGE SENSE CONNECTIONS: - The factory has installed two jumpers onto the terminal block. They connect the "VOLTAGE SENSE" (positive and negative) terminal to their respective "BATTERY" terminals. These jumpers should remain in place if the SCS is located within 5-10 feet of the batteries and if large enough wire is used to minimize voltage drops to less than 2%.

If the SCS is at a greater distance from the batteries and/or if the voltage drop in the battery wires exceeds 2%, then the jumpers should be removed and replaced with another circuit running directly to the battery terminals. This is a low current, voltage sensing circuit that can be wired in 16 AWG wire. Proper over-current protection should be added on the positive side. This connection will allow the SCS to accurately measure battery voltage.

13. INSTALL FUSING AS NEEDED: - Add circuit protection where needed. A 50 amp fuse (SCS/50) or 90 amp fuse (SCS/90) should be installed on the Battery (+) run of the SCS. Fusing is also advised for the battery voltage sense connection, if included. The load is already protected by the built-in circuit breaker of the SCS.

14. ATTACH TEMPERATURE COMPENSATION CABLE: - *SEE TEMPERATURE COMPENSATION section*

15. MAKE HIGH / LOW VOLTAGE ALARM CONNECTIONS: - *See VOLTAGE ALARMS section*

16. AUX CURRENT CONNECTION (using external shunt): - If needed.
The SCS can be modified to allow the user to 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. This requires an external shunt to be added to the system and connected to the circuitry behind the plate. Contact a technical representative for information.

17. MAKE NEEDED ADJUSTMENTS TO SETTINGS: - *See Setting/Adjustments section*

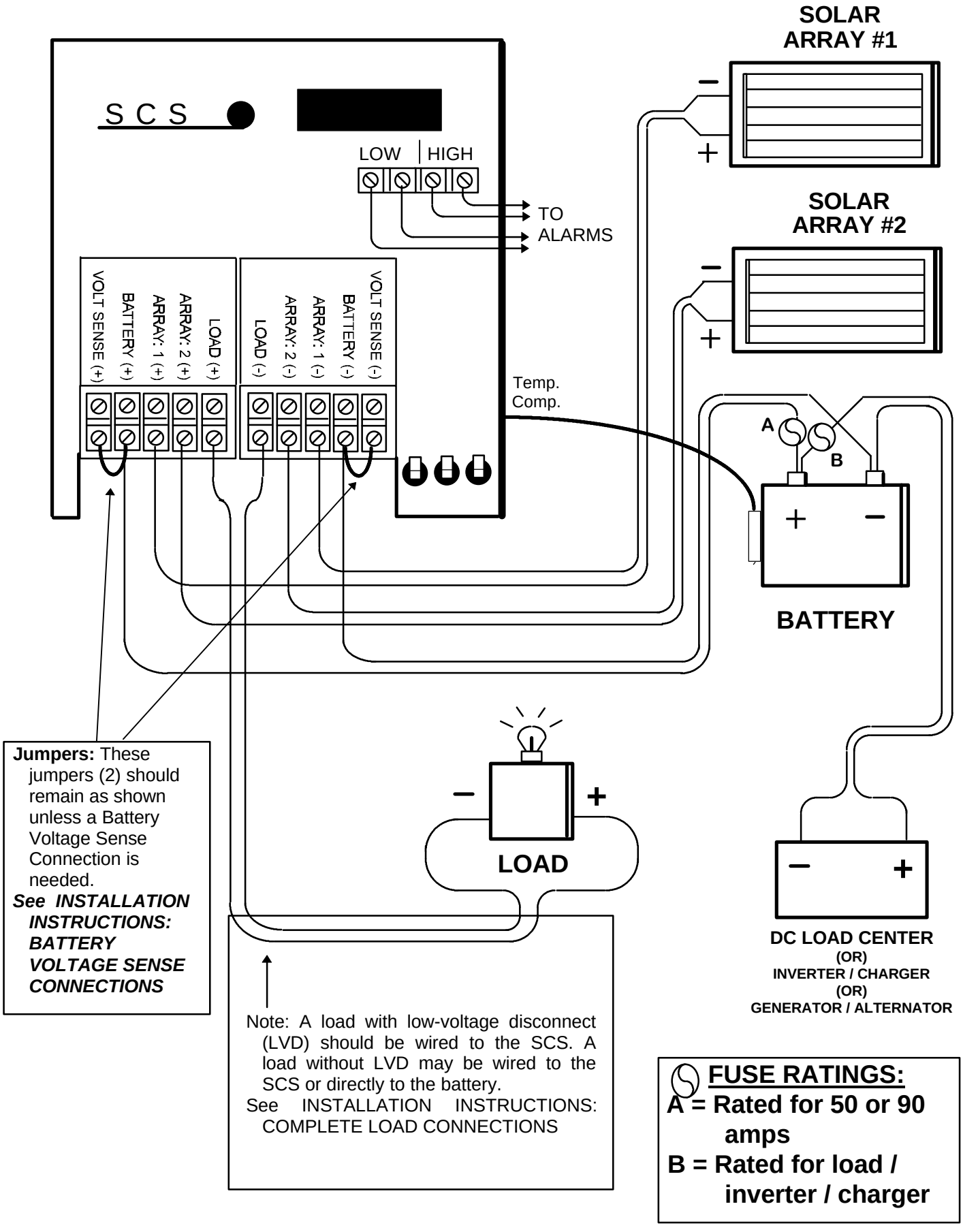
18. RECONNECT BATTERY AND ARRAY POWER - With the 3 circuit breakers in the "OFF" position, reconnect both power sources. Then turn on the "BATTERY" circuit breaker first. After, the remaining two circuit breakers can be turned on.

19. OPERATION: - Operation of the charge controller is now fully automatic. If the battery voltage is below the Full Charge Termination set-point (*see SPECIFICATIONS*) and power is available from the array and the power connect sequence (step #18) was followed, the SCS should start up in the charge mode. If the battery voltage is above the Load Disconnect voltage, the loads connected to the LOAD terminals should go on.

20. 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 SCS 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 SCS connection. Then note the voltage at the SCS terminals labeled "BATTERY (+)" and "BATTERY (-)". Ideally, the difference in voltage should be no more than ¼ 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 or additional wires for your run and/or run a separate wire for the Battery Sense connection. See "BATTERY VOLTAGE SENSE CONNECTION" (*see #12 above*).

FIGURE 1
SCS Wiring Diagram



Jumpers: These jumpers (2) should remain as shown unless a Battery Voltage Sense Connection is needed.
See INSTALLATION INSTRUCTIONS: BATTERY VOLTAGE SENSE CONNECTIONS

Note: A load with low-voltage disconnect (LVD) should be wired to the SCS. A load without LVD may be wired to the SCS or directly to the battery.
See INSTALLATION INSTRUCTIONS: COMPLETE LOAD CONNECTIONS

FUSE RATINGS:
A = Rated for 50 or 90 amps
B = Rated for load / inverter / charger

T E M P E R A T U R E C O M P E N S A T I O N

DESCRIPTION: - The SCS has a small sensor on a ten foot cable that is wired into the controller to adjust the charging thresholds according to battery temperature. The rate of compensation is -5mv/°C per battery cell in series from 25° 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°F (10°C) or above 90°F (32°C).

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 plastic-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.

DAMAGED SENSOR: If the sensor is damaged or lost, the controller will no longer function. By adding a 4.7 K Ω resistor, the temperature sensor feature can be removed from the unit and the unit will operate without temperature compensation.

Table 1 : Voltage change in charging set-points by temperature

CONTROLLER VOLTAGE	TEMPERATURE °C (°F) 0 (32)	10 (50)	20 (68)	25 (77)	30 (86)	40 (104)	50 (122)
12 VOLT	+ .75	+ .45	+ .15	0	-.15	- .45	- .75
24 VOLT	+ 1.50	+ .90	+ .30	0	-.30	- .90	-1.50
36 VOLT	+ 2.25	+ 1.35	+ .45	0	-.45	-1.35	-2.25
48 VOLT	+ 3.00	+ 1.80	+ .60	0	-.60	-1.80	-3.00

S E T T I N G S / A D J U S T M E N T S

ADJUSTABLE CHARGE TERMINATION SET-POINTS ("CHARGE SET-POINT SELECT"): Four different charge termination voltage set-points are available with this switch.

Table 2 : Charge termination set-points by switch position

CONTROLLER VOLTAGE	SWITCH POSITION A	B	C	D
12 VOLT	15.3	14.8	14.3	13.8
24 VOLT	30.6	29.6	28.6	27.6
36 VOLT	45.9	44.4	42.9	41.4
48 VOLT	61.2	59.2	57.2	55.2

The controller is factory set at position B. To change the set-point, locate the adjustment switch on the front panel. Using a slotted screwdriver, turn the switch until the slot is pointing at the desired position.

If problems develop, refer to the "TROUBLE SHOOTING" section of this book.

LOW-VOLTAGE LOAD DISCONNECT SETTINGS:

NO LVD: - For an override of the load disconnect function, push the switch up. No load disconnect will occur with the switch in the "NO LVD" position.

AUTO LVD: - When the "Load Disconnect" switch is in the "AUTO" position, the load control circuit will operate automatically. Refer to the "OPERATION: LOW-VOLTAGE DISCONNECT" section for a description of this operation. If a load disconnect occurs, the loads will be automatically reconnected when the batteries charge up to the Load Reconnect voltage, or they can be reconnected manually with the "Load Disconnect" switch.

MANUAL RESET: - For a temporary reset, push the switch down. The battery voltage must remain above the Load Disconnect voltage for the load to stay connected after reset.

ADJUSTING LVD SET-POINTS ("LOAD DISCONNECT ADJUST"): The Load Disconnect and Reconnect set-points are factory set as listed in the specifications section, and are adjustable. To alter the voltage at which the load disconnect and reconnect occur, turn the adjustment pot on the front of the unit labeled "LOAD DISCONNECT ADJUST" clockwise to decrease and counter-clockwise to increase *(for the range of adjustment, refer to the specifications section: "Load Disconnect Adjustment Range*"). Both set-points will change, with the span value fixed.

NOTE : When adjusting this controller, it is important to use the proper size screwdriver. Do not force the adjustment beyond the end stops, it will damage the controller.

VOLTAGE ALARM CALIBRATION: *Refer to VOLTAGE ALARMS section below*

C I R C U I T B R E A K E R S

LOAD CIRCUIT BREAKER : - A 15 amp load circuit breaker is included with the SCS. This provides over-current and short-circuit protection for the load and can be used as an on/off switch for the load.

ARRAY CIRCUIT BREAKER : - A 50 amp array circuit breaker is included with the SCS. This provides over-current and short-circuit protection for the SCS from the array and can be used as an on/off switch for the array in order to stop additional charging.

BATTERY CIRCUIT BREAKER : - A 50 amp battery circuit breaker is included with the SCS. This provides over-current and short-circuit protection for the SCS from the battery. This breaker can be used in conjunction with the ARRAY and LOAD breakers to remove the power sources in the system. **To remove all power to the SCS, all three circuit breakers must be turned off.** To provide power to the load only, turn ARRAY and BATTERY breakers off (LOAD breaker on). The ARRAY breaker should be switched off whenever the BATTERY breaker is off to stop the internal relay from oscillating. When turning the breakers back on, be sure to turn on the Battery switch first and then the Array and Load switches. This will assure the loads will come on immediately.

V O L T A G E A L A R M S

ALARM LIGHTS The "HIGH ALARM" and "LOW ALARM" lights will indicate any abnormal battery voltages. The voltage set-points for these alarms can be adjusted by using the two access holes labeled "Alarm Adjust"". The alarm relays operate in conjunction with the alarm lights.

ALARM RELAYS High and low-voltage alarm relays give separate dry contact relay closures for high and low voltage conditions. The low alarm is a normally closed contact, being energized at normal operating voltages and closing on low voltage to provide a signal in the event of a complete battery failure. The high alarm is a normally open contact. Each relay is rated at 10 amps, and consumes 30 milliamps when energized. Access to the contacts is via a terminal block on the front plate.

ALARM CONTACTS / INSTALLATION Wire to the terminal strip below the display. Small gauge wire can be used.

MODIFYING THE ALARM VOLTAGES:

a. Refer to the 3 sets of pins in the ALARM CALIBRATION window on the front plate. Put the SCS into Program Mode by installing the Programming Jumper across PROG MODE pins (center two pins).
b. Set the MONITOR FUNCTION SELECT knob to “AUX CURRENT” (position 3).
   Note: If the AUX CURRENT position is currently being used to monitor an auxiliary current using an external shunt, it has to be temporarily disconnected to free up the display for the alarm calibration. Access the rear of the front plate and disconnect the two wires from the external shunt where they are connected to the display circuit board. After the alarm calibration, this connection can be replaced.
c. For Low-Voltage Alarm: Place a Programming Jumper across the LOW ALARM pins
d. With a small screwdriver, turn the LOW ALARM Adjust dial and set the new voltage set-point as indicated on the display.
e. For High-Voltage Alarm: Repeat the above two steps using the HIGH ALARM pins and the HIGH ALARM Adjust dial.
f. When finished, place the Programming Jumpers back into their storage positions (attached to only one pin). Reconnect AUX CURRENT wires, if needed**.**

O P E R A T I O N

CHARGE REGULATION (12 and 24 volt units): The two-step control circuit regulates the charging of storage batteries by monitoring battery and solar panel voltage. **STEP 1: CONSTANT CURRENT (FULL) CHARGE MODE**: At sunrise, the charging relay energizes and closes, connecting the solar panel directly to the battery and lighting the "CHARGE MODE" light. The battery will accept as much current as the solar panel will provide, and battery voltage will rise. **STEP 2: CONSTANT VOLTAGE (FLOAT) CHARGE MODE**: When the battery reaches the full charge termination voltage, the charging relay will open and the "CHARGE MODE" light will go out. At this point the float controller takes over to keep the battery below the float voltage and supply limited current (maximum float current). As the battery approaches the float voltage, the current will taper off, eventually falling to the battery's maintenance current.

CHARGE REGULATION (36 and 48 volt units): The operation of a 36 and 48 volts unit is identical with the exception that no float circuit is included.

MAXIMUM SOLAR PANEL USAGE : If a load is applied when the controller is in the float mode, the controller will supply up to its maximum float current to maintain the battery charge. If the load is less than the maximum float current the batteries will still be receiving a net charge from the float controller. If the load current is more, the battery will supply what the float controller cannot and the battery voltage will fall. When it falls below the full charge resumption voltage, the charging relay will re-close, re-initiating the full charge mode. This insures that if a large load is applied during the day, maximum use will be made of the power available from the solar panel.

LOW-VOLTAGE DISCONNECT : The low-voltage disconnect (LVD) of the SCS prevents damage from deep discharge of the batteries by automatically disconnecting the loads. The disconnect threshold is load current compensated by a factor of 10 mv/amp, and a minimum time of 3 seconds is applied to prevent false disconnect. When a disconnect occurs, the load relay is energized and opens, and a red "LOAD DISCONNECTED" light, visible on the front panel, will light to indicate that the loads have been disconnected. Normal battery charging will continue. When the battery voltage rises to the reconnect threshold, the loads will automatically be reconnected to the battery and the red light will go off. The LVD function has a reset/disable switch and user adjustable set-points.

Note: The amount of time required to recharge the battery sufficiently to reconnect the loads depends upon the battery size, solar panel current and weather conditions. In some cases, it can take several days or longer. The loads can be manually reset prior to the reconnect voltage by pressing the "MANUAL RESET" switch.

REVERSE CURRENT PROTECTION : The SCS uses a timing circuit to disconnect the solar panel from the battery at night, preventing reverse leakage current loses through the solar panel. About 12 hours after sunrise the charging relay will open. If the battery is below the reconnect threshold and voltage is still available from the solar panel, the relay will re-close and continue charging. It will open again about every 2 hours thereafter to determine if power is still available for charging. The relay will stay open after the 12 hour period if the battery is above the reconnect threshold or if there is no power available from the solar panel. This results in the relay being open every night. Note: The relay may be closed ("CHARGING" light on) for a few hours in the evening after the sun has gone down.

M O N I T O R I N G

"CHARGING" LIGHT: The "CHARGING" light will be on when the controller is in the full charge mode. In this mode, the charging relay is closed, connecting the array directly to the battery. This light should go on first thing in the morning, and will go off if the battery reaches the Full Charge Termination voltage set-point. If the light is off after morning, the batteries have reached the full charge voltage some time that day. The light may go on again if the battery drops below the reconnect voltage and the controller goes into the full charge mode again. It is not uncommon for the light to remain on, for several hours after dark. Refer to the operation section for details on controller operation.

"LOAD DISCONNECTED" LIGHT: When the "LOAD DISCONNECTED" light is on, the low-voltage disconnect (LVD) circuit is activated and any DC loads connected to the "Load" terminals will be disconnected. This occurs at the LVD voltage set-point. The light will go out when the voltage rises above the reconnect voltage and the load is reconnected automatically, or if the reset switch is pushed to “MANUAL RESET" or “NO LVD". Refer to the operation section for details on LVD operation.

DIGITAL DISPLAY: The Digital display on the front of the SCS provides metering of four parameters, selected by a slide switch to the right of the display, labeled: 1, 2, 3, 4.

“SWITCH POSITIONS”

POSITION 1 - "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 (12 volt battery). 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 indicates an overcharging battery. It is best to keep the batteries above 11.5 and below 14.8 for maximum battery life and performance.

POSITION 2 - "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 current 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 3 - "AUX CURRENT": This position is used to calibrate the alarm voltages. *See VOLTAGE ALARMS section.*

This position can also be used to display 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 INSTALLATION INSTRUCTIONS: ”AUX CURRENT CONNECTION” (step #16) (above)*.

POSITION 4 - "LOAD CURRENT": This position displays the current being consumed by any DC load connected to the load terminals of the SCS. This position will not monitor current to loads connected directly to the battery, such as an inverter.

O P T I O N S

OPTION H - GENERATOR START : The generator start option is for systems designed with a stand-by generator that has an autostart circuit. A voltage-free contact closure is provided to signal the generator to start and stop charging, based on battery voltage. Access to the relay contacts is via a terminal block on the face plate. The start and stop set-points are factory set at 11.5 volts start and 13.5 volts stop (for a 12 volt system) and are adjustable. Adjustments are made via the pots labeled "SPAN ADJ." and “START ADJ.” The range of adjustment for the start voltage is from 11.0 to 12.0 volts, and the range for the stop is from 12.8 to 14.0 volts for a 12 volt system.

RECALIBRATION PROCEDURE FOR GENERATOR START SET-POINTS:

Equipment required : Power supply, variable, with sufficient voltage range for system voltage (i.e. 0-15 volts for 12 volt system).

1. With battery sense jumpers in place, connect power supply positive to "BATTERY +"
2. Connect power supply negative to "BATTERY -"
3. Turn selector switch on the SCS face plate to "BATTERY VOLTAGE"
4. Vary power supply voltage in the area where the generator start is set, observing when the red "GEN.START" light goes on and off.
5. Subtract value of desired start voltage from desired stop voltage.This becomes the "SPAN" value.
6. Turning the "SPAN ADJ." pot clockwise increases the span. Turning it counter-clockwise decreases the span.
7. Vary power supply voltage once again to determine new span value.
8. Repeat steps 6 and 7 until desired span is achieved. Start voltage set-point will be incorrect.
9. Turning the "START ADJ." pot clockwise decreases the set-point, and turning it counter-clockwise increases it.
10. Vary the power supply voltage to determine the new start value.
11. Repeat steps 9 and 10 until the desired start set-point is set.
12. Repeat step 4 to verify accuracy of new set-points.

OPTION W - POSITIVE GROUND LOAD : The Low-voltage Load Disconnect is in the negative leg of the load circuit. Array connections should be floating (not grounded).

OPTION 3R - OUTDOOR ENCLOSURE (NEMA 3R) : This enclosure is intended for use indoors or outdoors for rain proof applications.

OPTION 4X - OUTDOOR ENCLOSURE (NEMA 4X with Clear Door) : This enclosure is intended for use indoors or outdoors for watertight, dust tight and corrosion-resistant applications and provides a clear door for viewing metering and status lights without opening the enclosure.

IF THE CONTROLLER IS NEWLY INSTALLED, CHECK THESE FIRST:

1) Re-check system wiring to insure proper installation and polarity .
2) Check all system fuses and circuit breakers. A 1 amp AGC fuse is located behind the front plate on the display circuit board. Before replacing a blown fuse, locate and correct the cause.
3) Check to be sure that there is a connection (voltage input) to the " VOLTAGE SENSE" terminals from the battery. This would be either a factory installed jumper strip on the controller terminal block from the "VOLTAGE SENSE" terminals to the "BATTERY" terminals, or a connection from the sense terminals directly to the battery itself.
4) Check to see that modules and batteries are in the correct series-parallel configuration for proper system voltage and current.
5) Review controller specifications relating to array output, load ratings and system sizing to insure that ratings are not exceeded.
6) Review the controller specifications relating to operation and set-points, particularly the charge termination and reconnect voltage set-points. If possible, check this with the operation of the controller, monitoring the battery voltage.
7) Some types of loads (fluorescent lights, inverters) can generate electronic "noise" that sometimes interferes with the operation of the controller. Check to see if strange behavior can be traced to operation of a certain appliance.
8) Inspect the temperature sensor and sensor wire. Check for a broker sensor or a cut or frayed sensor wire. *See TEMPERATURE COMPENSATION section.*
9) If possible, perform the "FIELD TEST PROCEDURE" and /or "BENCH TEST PROCEDURE" that follows.

IF THE CONTROLLER HAS BEEN INSTALLED AND WORKING PROPERLY FOR AWHILE, CHECK THESE FIRST:

10) Check all system fuses and circuit breakers. A 1 amp AGC fuse is located behind the front plate on the display circuit board. Before replacing a blown fuse, locate and correct the cause.
11) Confirm that all connections are clean and tight. Particularly check crimp connections that have been crimped but not soldered as these connections tend to deteriorate over time.
12) Some types of loads (fluorescent lights, inverters) can generate electronic "noise" that sometimes interferes with the operation of the controller. Check to see if strange behavior can be traced to operation of a certain appliance.
13) If you have an accurate digital volt meter, check for voltage drop between the controller and the battery by measuring voltage at the battery and at the controller when maximum charging is occurring. Drops often occur through old fuses, fuse holders or circuit breaker boxes and at loose or corroded connections.
14) High voltage from nearby lightning strikes or unregulated charging sources can damage the controller. The built-in lightning protection provides substantial protection, but it is sometimes overwhelmed.
15) Inspect the temperature sensor and sensor wire. Check for a broker sensor or a cut or frayed sensor wire. *See TEMPERATURE COMPENSATION section.*
16) Check output from the array, and that it is not partially shaded or dirty.
17) If possible, perform the "FIELD TEST PROCEDURE" and /or "BENCH TEST PROCEDURE" that follows.

PROBLEM DESCRIPTIONS

BATTERY UNDER CHARGED

CONTROLLER NOT CHARGING AT ALL, ALWAYS IN THE FLOAT MODE ("CHARGING" LIGHT OFF)

Check to see that the circuit breakers are all on, and that the controller is receiving voltage (at least about nominal system voltage) from the battery and the solar panels. If it is, momentarily disconnect and reconnect the panels, using the array circuit breaker. The controller should reset into the full charge mode ("CHARGING" light on). If it does not reset, the controller may be defective.

See number 8 above. A damaged sensor or wire will cause the controller to malfunction.

CONTROLLER STOPS CHARGING TOO SOON, AT TOO LOW A VOLTAGE

See number 6 above: Try to monitor the voltage at the "VOLTAGE SENSE" terminals when the controller actually switches. Most often, when a controller is operational, it is switching the correct voltage. If the battery is not reaching the charge termination set-point voltage before the controller switches, it is usually an error in the voltage that the controller is sensing, not a controller failure.

See numbers 11 and 13 above: A poor connection between the battery and the controller results in a voltage drop during charging periods (larger drop for higher current) that disappears when charging stops. This voltage drop results in a higher voltage being sensed at the controller than is actually at the battery.

CONTROLLER CLICKS AND CHATTERS, PARTICULARLY IN THE MORNING AND EVENING

See numbers 11 and 13 above: Check the connection to the battery. A poor connection at the battery will cause the relay to chatter under low light conditions and the controller to remain in float mode during full sun.

CONTROLLER NOT CHARGING, "CHARGING" LIGHT DIM, BATTERY VOLTAGE VERY LOW

See LVD trouble shooting section. If the LVD circuit is not operating, the battery can be discharged to a very low voltage. If the battery is extremely low, there might not be enough voltage to operate the controller. The charging relay requires a minimum operating voltage to engage and allow charging. If the battery is down to 9 volts or lower on a 12 volt system, (17 on a 24 volt) connect the battery directly to the array (or use an auxiliary charging source) until sufficient charging has occurred to increase the voltage. Note: Battery life depends on the number, time and the depth of the discharges. Severe battery damage can result when batteries are deeply discharged and not recharged immediately.

"CHARGING" LIGHT ON AT NIGHT

Review the "REVERSE CURRENT PROTECTION" and "CONNECTION SEQUENCE" sections of this manual. The reverse leakage timer may cause the "Charging" light to be on for a few hours each evening. Also, the light will stay on during the night of the first day of installation or if the array has been manually disconnected that day. If the light stays on all night every night, the timer may be defective.

BATTERY OVERCHARGING

CONTROLLER ALWAYS IN FULL CHARGE ("CHARGING" LIGHT ON)

See number 6 above: The battery may not be reaching the charge termination set-point.

See number 3 above: No voltage at the battery sense terminals tells the controller that the battery voltage is low and needs to be charged more. Install a connection from battery to "BATTERY SENSE" terminals to resolve.

See number 8 above: A damaged temperature sensor or wire will cause the controller to malfunction and requires immediate replacement.

CONTROLLER NOT IN CHARGE MODE ("CHARGING" LIGHT OFF)

Disconnect array, then reconnect. Listen for relay to click and for “CHARGING" light to come back on. If the light goes on but you hear no click, the relay or controller may be defective.

Check for other charging sources that are not properly regulated, causing the battery to overcharge.

LOAD DISCONNECT CIRCUIT (LVD) NOT OPERATING CORRECTLY

LOADS ALWAYS DISCONNECTED, LVD LIGHT ON, EVEN WHEN BATTERY VOLTAGE IS HIGH

See number 6 above: No voltage at the battery sense terminals tells the controller that the battery voltage is low and loads need to be disconnected. Install a connection from the battery to "VOLTAGE SENSE" terminals to resolve.

LOADS DISCONNECTED TOO SOON OR NOT RECONNECTING

See number 4 above: The battery may not be reaching the reconnect voltage set-point.

See numbers 11 and 13 above: A poor connection between the controller and the battery results in a voltage drop when heavy loads are turned on that disappears when the loads are turned off. The heavier the loads are, the larger the voltage drop will be. This voltage drop results in the controller seeing a lower voltage than what the battery voltage actually is.

LOADS NOT DISCONNECTING ON LOW VOLTAGE, LVD LIGHT OFF

Check the position of the "LVD" switch. If the switch is in the "NO LVD" position the load will not be disconnected.

LOADS ALWAYS DISCONNECTED, LVD LIGHT OFF, BATTERY VOLTAGE IS HIGH

Check the load circuit breaker on the front of the controller. If the breaker is tripped, the load will not operate.

MONITOR DISPLAY NOT READING CORRECTLY

DISPLAY BLANK, ALARMS DO NOT FUNCTION

Check the fuse on the backside of the front plate on the display circuit board. If it is blown, replace with a new 1 amp type agc fuse. If it continues to blow, this indicates that the SCS probably needs servicing.

Inspect the wire connections to and from the display circuit board on the back of the unit and confirm all connections are sound.

ALARMS DO NOT FUNCTION PROPERLY

Check alarm calibration. *See Voltage Alarms section*.

INCORRECT READINGS FOR AUX CURRENT

Check to be sure that the external shunt is wired in the negative leg of the system component.

Using a digital multimeter, measure the millivolt reading at the shunt and then at the terminal block of the display circuit board to which it is connected. Compare this value with the expected current reading and the displayed value.

RANDOM READINGS

Check the wire connections to the terminals on the display circuit board and make sure they are sound.

Electronic "noise" from inverters or other loads can sometimes influences the readings. Some types of loads (fluorescent lights, inverters) can generate electronic "noise" that sometimes interferes with the monitor reading, particularly when sense wires from remote shunts run close to wiring to the load. Check to see if strange behavior can be traced to the operation of a certain appliance.

CURRENT READINGS LESS THAN EXPECTED

Check to see that array modules and batteries are in the correct series-parallel configuration for proper system voltage and current.

Check for an alternative path to ground around the shunt. .

Check output from the solar panel(s), and that they are not partially shaded or dirty.

INCORRECT VOLTAGE READINGS

With an accurate digital volt meter, check voltage readings at the battery and at the monitor, to see if they agree. Voltage drops occur between the SCS and the battery occasionally during maximum charging. Drops often occur through old fuses, fuse holders or circuit breaker boxes and at loose or corroded connections.

T R O U B L E S H O O T I N G : B A T T E R I E S

Refer to this section to help diagnose potential problems based on battery observations.

CASE	BATTERY	SEE NOTE(S)
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 14.8 volts (12v system).
- **Controller Problem:** The SCS could be defective. Refer to the field test procedure.
- **Battery Type:** The batteries may be a type that require a lower full-charge voltage than what the SCS is set to. *Refer to SETTINGS / ADJUSTMENTS Section.*
- **Other Charging Sources**: Another charging source could be the cause. If the SCS "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, 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.
- **Bad Connection to the Solar Panel.**
- **SCS Controller Problem**. - Refer to the field test procedure
- **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. If the battery is cold much of the time, the battery's long-term performance and life may suffer.
- **System not sized correctly** - 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.

T R O U B L E S H O O T I N G : S O L A R P A N E L S

Refer to this section to help diagnose potential problems based on panel performance.

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

Panel Note 1 - The panels should generate a charge close to their rated load 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 SCS controller is much lower, consider the following potential problems.

- **Solar Panels Problem** - Panels may be dirty, not aligned or other problem. 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**. 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: Disconnect the array by switching the array circuit breaker off, and measure the solar array voltage between the array(+) and the array(-). In sunny conditions, this should be 18-24 volts (in a 12 volt system). A lower value could indicate problems with the solar panel.

F I E L D T E S T P R O C E D U R E : S C S

Test equipment required: digital multimeter, jumper wires
Conditions: Sunny or bright overcast if possible

Precautions: This procedure assumes that the system panels are installed and operational, or at least capable of producing at least 15 volts for a 12 volt system (proportionately higher for higher nominal system voltages). When connecting and disconnecting the batteries and array as instructed in this procedure, be sure that the circuit breakers are in the "OFF" or down position, otherwise arcing will occur. On bright days, it may be advisable to partially cover the array to reduce current produced.

WARNING: Most batteries produce hydrogen gas when charging, which is extremely explosive. Avoid making sparks in the vicinity of batteries, and provide adequate battery ventilation.

1) Inspect temperature compensation sensor and cable for damage. If damaged, the controller will no longer operate. *See TEMPERATURE COMPENSATION section.*

2) Remove the VOLTAGE SENSE (+) jumper (or disconnect VOLTAGE SENSE (+) wire if remote sensing is used).

3) Switch Battery, Array and Load circuit breakers off. Disconnect the BATTERY (+) wire, the LOAD (+) wire and the SOLAR ARRAY (+) wires from the controller. Secure each wire away from any possible contact with other wires, metal chassis, enclosures etc. Switch Battery and Array circuit breakers back on.

4) Measure the resistance between the SOLAR ARRAY (+) and BATTERY (+) terminals on the controller. It should read open (more than 10M Ω).

5) Switch Array circuit breaker off. Reconnect the solar array to the controller. Switch Array circuit breaker on.

6) Measure the voltage between the SOLAR ARRAY (+) and SOLAR ARRAY (-) terminals to ensure it is at least 15 volts (30 for 24 volt units, 45 for 36 volt units, 60 for 48 volt units)

7) If the controller is in charge mode, go to step 8. If it is not, briefly connect a jumper wire between the SOLAR ARRAY (+) and BATTERY (+) terminals on the controller. When the controller switches to charge mode, remove the jumper.

8) The controller should now be in charge mode. Measure the voltage between the BATTERY (+) and BATTERY (-) terminals on the controller. It should be about the same as the panel voltage from step 6.

9) Install a jumper between SOLAR ARRAY (+) and VOLTAGE SENSE (+). The controller should switch out of charge mode. Remove the jumper.

10) Switch the Battery and Load circuit breakers on. Measure the resistance between the LOAD (+) and BATTERY (+) terminals on the controller. It should read closed. Switch Battery and Load circuit breakers off.

11) Connect BATTERY (+) wire. The LOAD DISCONNECTED light should go on, and battery voltage should be measured at the load terminals. Switch the Battery and Load circuit breakers off.

12) If the controller fails any of these tests, it is defective. If all tests are passed the problem is most likely elsewhere in the system.

B E N C H T E S T P R O C E D U R E : S C S

This procedure provides a basic bench test to check the operation and calibration for the SCS. ***This procedure is designed specifically for experienced electronic technicians.***

Equipment required: Digital multimeter: 0-80 volt 500 ma power supply

The SCS printed circuit board is coated with a water resistant coating. Use a sharp pointed probe and enough pressure to pierce the coating when making measurements.

1) Inspect temperature compensation sensor and cable for damage. If damaged, the controller will no longer operate. *See TEMPERATURE COMPENSATION section.*
2) Make sure there is a jumper between VOLTAGE SENSE (+) and BATTERY (+) and one between VOLTAGE SENSE (-) and BATTERY (-).
3) Measure the resistance between the BATTERY (+) and SOLAR ARRAY (+) terminals. It should be open.
4) Check the diodes connected to pins 6 and 7 of the MC1723 IC.
5) Set the power supply to the nominal system voltage (12, 24, 36 or 48 volt), current limit to 500 ma.
6) Connect the power supply (-) to the controller BATTERY (-) terminal. Connect the power supply (+) to the controller BATTERY (+) terminal and to the controller SOLAR ARRAY (+) terminal.
7) Measure the voltage at pin 11 of the MC1723 IC. It should be about the power supply voltage. If it is not, suspect the unit defective and return for repair.
8) Measure the voltage at pin 6 of the MC1723 IC. It should be 7.7 +/- 0.2 volts. If it is not, unsolder and remove one end of the diode on pin 6 and re-measure. If the voltage is now correct, the controller should be sent in for repair. If the voltage is still wrong, the MC1723 is bad.
9) If the controller is in charge mode, go to step 9. If it is not, switch on and then off the ARRAY circuit breaker. The controller should go into charge mode.
10) Measure the voltage across the relay coil (smaller wires). It should be between 8.0 and 13.0 volts. If it is not, suspect the 100 ohm power resistor, Xstr TIP 100(or 102).
11) Verify the set-points by changing the power supply voltage up and down and observing the activation.
12) Change the CHARGE SET-POINT SELECT switch and power supply to verify other set-points. Repeat steps 10-11. Refer to the specifications for set-point values.

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.

8954 MASON AVE., CHATSWORTH, CA 91311 USA PH: (818) 998-5238, FAX: (818) 998-5253