INSTALLATION and OPERATION MANUAL
for the

A S C

A U T O M A T I C S E Q U E N C I N G C H A R G E R
Photovoltaic Charge Controller

S P E C I A L T Y C O N C E P T S , I N C .
8954 Mason Ave.
Chatsworth, CA 91311, USA

11 / 1997

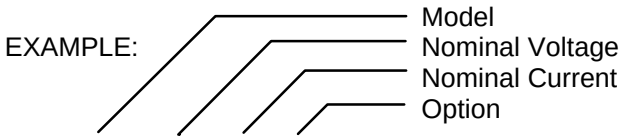
A S C - S p e c i f i c a t i o n s

PARAMETERS	UNITS	NOMINAL CURRENTS				
		1 amp	4 amp	8 amp	12 amp	16 amp
Short Circuit Current, Continuous	(Amps)	1.5	4	8	12	16
Short Circuit Current, Max (60 seconds)	(Amps)	1.9	5	10.5	15.5	21

PARAMETERS	UNITS	NOMINAL VOLTAGES		
		6 v	12 v	24 v
Load Current, Continuous (1)(2)	(Amps)	N/A	10	10
Load Current, Max (60 seconds) (1)(2)(3)	(Amps)	N/A	13	13
Array Voltage, Max Voc	(Volts)	26	26	46
Voltage @ Battery for Charging, Minimum	(Volts)	0	0	0
Voltage @ Battery for LVD, Minimum (1)	(Volts)	N/A	8.5	17
Quiescent Current	(Milliamps)	10	10	10
Current Consumption, Charging, Typ.	(Milliamps)	15	15	15
Current Consumption, Load Disconnected, Typ. (1)(4)	(Milliamps)	N/A	40	40
Voltage Drop, Array to Battery, Typ.	(Volts)	.30	.30	.30
Voltage Drop, Array to Battery, Max.	(Volts)	.55	.55	.55
Voltage Drop, Battery to Load, Typ. (1)	Volts@10 amps	.06	.06	.06
Charge Termination (5)	(Volts)	7.1 ± .1	14.3 ± .2	28.6 ± .4
Charge Resumption (5)	(Volts)	6.75 ± .2	13.5 ± .3	27.0 ± .6
Load Disconnect (LVD) (1)	(Volts)	N/A	11.5 ± .2	23.0 ± .4
Load Reconnect (1)	(Volts)	N/A	13.0 ± .3	26.0 ± .6
Operating Temp. Range	(°C)	-40 to 50	-40 to 50	-40 to 50
Storage Temp. Range	(°C)	-55 to 85	-55 to 85	-55 to 85
Temperature Comp. Coef. (from 25°C) (6)	(Volts/°C)	- .015	- .03	- .06

Notes:
(1) Low-voltage disconnect option
(2) Non-inductive.
(3) Carry only, Non-switching
(4) LVD relay energized, red L.E.D. on, typical value.
(5) Value adjustable with Adjust. Charge Termination Set-point option. Charge Termination / Resumption span fixed
(6) Temperature compensation option

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



ASC- 12 / 8 - A

MODEL	NOMINAL VOLTAGE	NOMINAL CURRENT	OPTIONS
ASC	6	1	A - Temperature Compensation
	12	4	E - Low-voltage Disconnect (LVD)/ Generator Start
	24	8	F - Adjustable Charge Termination Set-point
		12	
		16	

NOTES: 6 volt units available in 4 amp version only.
6 volt unit not available with option E
12 volt / 1 amp unit not available with options
24 volt units available in 8 and 16 amp versions
Options E and F cannot be ordered together

Specifications and product availability subject to change without notice.

A S C

G E N E R A L D E S C R I P T I O N

The ASC is a very compact, rugged, 100% solid-state battery charge controller for use in photovoltaic energy systems. It optimizes charging performance from the solar panels while providing over-charge protection to the system storage batteries, prolonging battery life and reducing maintenance requirements.

These units include a blocking diode to prevent any battery discharge through the solar panels at night, and a light to indicate when charging is occurring. Options include temperature compensation (Option A) and a low-voltage load disconnect (LVD) relay (Option E) that can be used to protect the batteries from deep discharge damage.

The ASC is a negative-ground switching shunt controller housed in an anodized aluminum chassis and encapsulated in a hard epoxy resin for water-resistant applications. The terminal block accepts 10 gauge wire (stranded), two 12 gauge wires or a spade connector, providing simple installation.

F E A T U R E S

CHARGE REGULATION

- 1-16 amp charge current, 12 volt
- 8 or 16 amp charge current, 24 volt
- 4 amp charge current, 6 volt
- Switching shunt, pulse charging
- Remote temperature compensation (option)
- Adjustable set-points (option)

LOW VOLTAGE LOAD DISCONNECT (LVD) (option)

- 10 amp LVD Relay
- Contacts for generator start or alarm

DESIGN FEATURES

- Encapsulated for protection
- 100% solid state charge controller
- Reverse leakage protection -blocking diode
- Lightning protection
- Input noise suppression
- Low power consumption
- Simple, rugged circuitry

MONITORING & MOUNTING

- “CHARGING” light
- LVD “ACTIVATED” light (with LVD option)
- Suitable for outdoor mounting

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

The ASC is an integral part of a solar electric power system that includes a photovoltaic (PV) solar array and a battery. The system should be installed according to the instructions provided by the equipment supplier.

SOLAR ARRAY PANELS: The ASC is compatible with all makes and models of PV panels, provided the open circuit voltage and short circuit current do not exceed the Array (Voc) Max. and the short circuit current (ISC), max., specification ratings for the ASC being used. *See Specifications section.*

HIGHER CHARGING CURRENTS: For larger arrays made up of many sub-arrays, or when adding to an existing system, an ASC can be wired in parallel to each sub-array, provided that the sub-arrays do not exceed the rating of the individual units. This method allows higher currents to be handled than allowed by a single ASC.

BATTERIES: The ASC is designed to be used with standard lead-acid batteries. These include wet-cell batteries, sealed maintenance free batteries and gel cell batteries. Vented pocket plate nickel-cadmium batteries may also be used provided the number of battery cells in series is a multiple of 5 (for a 12 volt system, 10 cells). Consult with the battery manufacturer for specific recommended set-points.

LOADS: System loads such as lights, radios, DC/AC inverters, etc. must be rated for the proper DC input voltage. If the ASC is equipped with low-voltage disconnect (LVD) (Option-E), DC loads not exceeding 10 amps can be connected to the load control terminals of the ASC and they will automatically be disconnected in the event of low voltage. Refer to Figure 2 for correct installation. Higher current loads, or inductive loads such as pumps, motors or invertors should be connected directly to the battery and be properly fused.

OTHER CHARGING SOURCES: Do not use the ASC to regulate a power source other than a photovoltaic panel, such as a hydro or wind generator/alternator or an AC battery charger. To do so could result in damage to the ASC and/or the generating equipment because the ASC regulates charging by short circuiting the input. Connect other charging sources directly to the battery.

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

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

WARNINGS

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.

CAUTIONS:

CAUTION: DO NOT subject the controller to voltages greater than stated in the specifications. This is the open circuit voltage (Voc) of the array, or the sum of the Voc of all modules in series.

CAUTION: DO NOT exceed the maximum current rating of the ASC as stated in the specifications. This is the sum of the short circuit currents (Isc) of all the modules in parallel.

CAUTION: DO NOT reverse battery "PLUS" and "MINUS" connections to the ASC. Reverse polarity or accidental contact to the battery in reverse polarity will damage the unit.

CAUTION: DO NOT connect the array directly to the battery when the array is connected to the ASC at the same time. This will cause damage to the ASC when the battery voltage reaches the Charge Termination set-point.

CAUTION: DO NOT wire the ASC 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.

CAUTION: DO NOT exceed 8 inch pounds of torque on the terminal block screws during installation. The screws are corrosion resistant nickel plated brass, and are softer than standard steel screws.

INSTALLATION INSTRUCTIONS:

1. LOCATION: - The ASC may be mounted in almost any convenient location. The unit should be mounted as close as possible to the batteries to avoid errors in battery voltage reading. On units with temperature compensation (Option-A), the ASC should be mounted within 10 feet of the batteries to enable the 10 foot sensor cable to reach the battery. The ASC may be mounted on the rear of the solar panels or other surface using outdoor-type double-stick foam tape, or by using the mounting holes and screws.

2. PROTECTION REQUIREMENTS: - The circuitry of the ASC is encased within hard epoxy resin that offers substantial protection from the environment.

- **HEAT**: - The unit should not be mounted in direct sunlight or close to any heat generating source to avoid extreme temperature increases. The rear of the unit should not be blocked to allow air flow for adequate cooling.
- **CORROSION**: - The exposed terminal block is made of corrosion resistant nickel plated brass. This will endure most outdoor environments. If the ASC will be located in an excessively corrosive location, a coating of an oxide inhibitor should be applied to the terminals.
- **TEMPERATURE COMPENSATION CABLE (for units with Option-A):** - The temperature compensation cable and sensor need to be protected from damage (cuts, impacts, rodents). If the sensor or cable is damaged, the ASC will not operate. *(Refer to Options section: OPTION A - Temperature Compensation).*

3. COMPLETE THE INSTALLATION OF ARRAY, BATTERIES AND LOAD: - Follow the manufacturer's instructions for mounting and wiring the solar panel, batteries and the load. Install with the correct series-parallel configuration to insure proper system voltage and current

4. 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. Also, select a wire that offers the appropriate insulation for the condition of the location. *(Refer to the U.S. National Electrical Code for additional information)*

WIRE SIZE: - Wire should be sized of sufficient gauge to safely handle the rated current of the system and to limit voltage drop. An alternative to using larger wire is to use two wires for the runs and connections.

Approximate Wire Size: (for 10 foot total length: panels to batteries)

# Solar Panels (50 watt)	Minimum Wire Gauge
1	# 14
2	# 12
3 - 6	# 10 (stranded wire)

FIGURE 1 ASC Controller

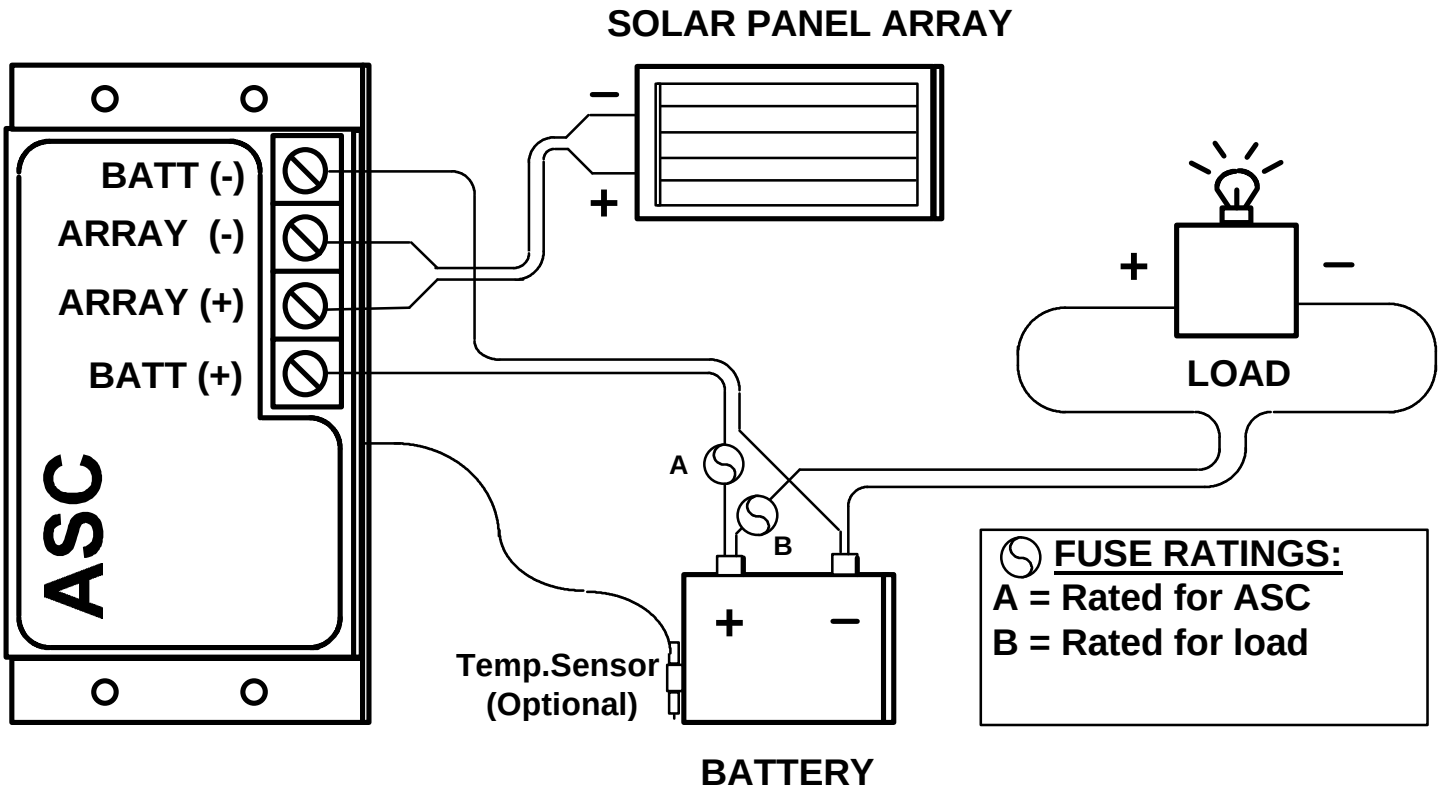
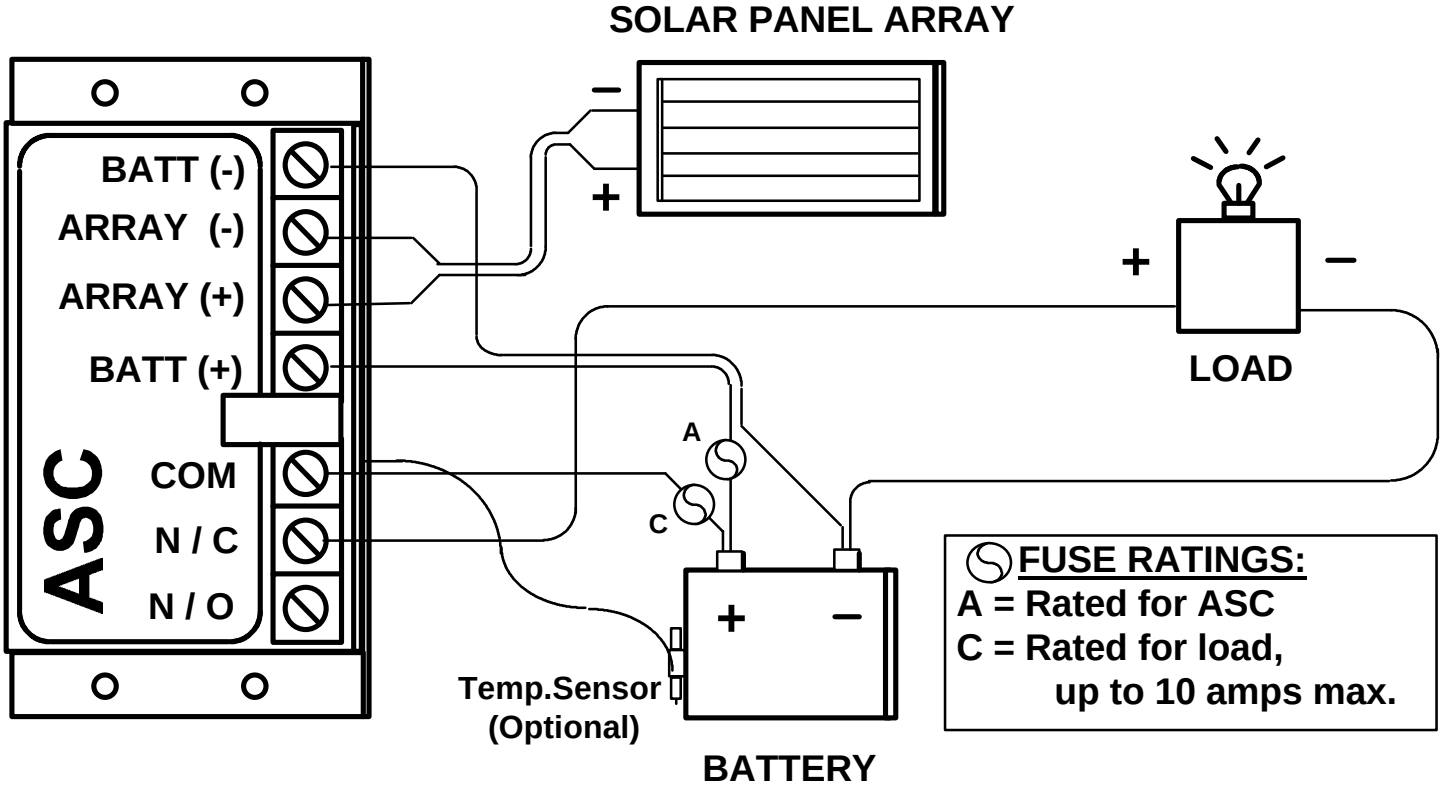


FIGURE 2 ASC Controller with Option-E (LVD)



INSTALLATION INSTRUCTIONS (continued) :

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

6. RUN SYSTEM WIRING: - After disconnecting the power sources, run the wires from the battery and solar panel to the location selected for the controller. The wires should reach the location of the ASC and be secured with a little extra for strain relief loops.

7. NOTE WIRE POLARITY: - Make sure to correctly mark the source and polarity of the wires using colored wires or tags. Incorrect polarity may damage the ASC.

8. ASC CONNECTION: - Wire the ASC according to Figure 1. The ASC terminals accept up to 10 gauge bare wire. (When using 10 gauge wire, use stranded wire and divide the ends wires into two equal sections and straddle the terminal screw). If using crimp connections, be sure to crimp and solder.

9. INSTALL TEMPERATURE COMPENSATION (OPTION-A): - If included. This cable can be momentarily unplugged as needed during installation. The cable's sensor needs to mount onto the batteries. *Refer to "OPTIONS" section.*

10. COMPLETE LVD CONNECTION (OPTION-E): - Refer to Figure 2 to complete the load connection for low-voltage load disconnect. *Refer to "OPTIONS" section.*

11. INSTALL FUSING AS NEEDED: - Add circuit protection where needed. A fuse and disconnect switch, rated for the nominal current of the ASC, should be installed on the Battery (+) run of the ASC. *See Figures 1 or 2.*

12. RECONNECT BATTERY AND ARRAY POWER: - No specific reconnect sequence needs to be followed.

13. OPERATION: - Operation of the ASC is now fully automatic. If the battery voltage is below the Full Charge Termination set-point (14.3 volts on 12 volt units)* and power is available from the array, the ASC should start up in the “CHARGING” mode.

TURN ON LOADS IMMEDIATELY AFTER INSTALLATION (LVD / Option E): On initial installation, the ASC with LVD (Option-E) will start out with the loads disconnected (relay energized). In a 12 volt system, the battery voltage has to rise to the reset voltage of about 13.0 volts* to start the loads. If the array is connected to the controller and is producing at least 17 volts* open circuit and the battery voltage is above 11.5 volts*, the loads can be turned on immediately by disconnecting and then reconnecting the battery positive. This LVD reset is indicated by the "ACTIVATED" light being off.

14. CHECK FOR VOLTAGE DROP (OPTIONAL): - Once the system is installed and operational, a check on the connections is recommended. A poor 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 poor connection to the battery will also distort the battery voltage reading and cause the charging to stop too soon. To check the connections, a voltage multi-meter is required and the ASC must be charging with maximum expected charge current (very sunny conditions).

Battery Connection: - First, note the voltage at the battery terminals. Select the positive and negative terminals that are used for the ASC connection. Then note the voltage at the ASC terminals for “BATT (+)” and “BATT (-)”. Ideally, the difference in voltage should be no more than ¼ volt*.

Array Connection: - Next, note the voltage at the panel wires. Select the positive and negative wires that are used for the ASC connection. Then note the voltage at the ASC terminals for “ARRAY (+)” and “ARRAY (-)”. Ideally, the difference should also be no more than ¼ volt*.

If the voltage drop is more, suspect crimp connections that have not been soldered, in-line fuses or fuse holders, or loose terminals. If no location of voltage drop is found, consider using larger wires (or double up the wires) for your run.

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

O P T I O N S

Options cannot be added to units after production.

OPTION A - Temperature Compensation:

DESCRIPTION: On units equipped with Option-A, a small sensor on a ten foot cable is plugged 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. *See Table 1 below.*

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) for weeks at a time. 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 cable is unplugged or cut or the sensor is damaged, the controller will no longer function.

INSTALLATION: Provision must be made to attach the plastic coated 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. The cable can be momentarily unplugged from the ASC as needed. Care should be taken to prevent the sensor from damage. When pulling the sensor and wire through conduit, do not pull on the sensor itself, but instead on the gray cable just behind the sensor. The sensor is made of glass and 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 and installed.

2. **ATTACH SENSOR:** Use the foam square (included) to attach and cover the sensor 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.

Table 1 : Voltage set-points by temperature.

Temperature compensation coefficient is: -.03 volts / °C from 25°C (for 12 volt)

-.06 volts / °C from 25°C (for 24 volt)

CONTROLLER VOLTAGE	TEMPERATURE °C (°F)						
	0 (32)	10 (50)	20 (68)	25 (77)	30 (86)	40 (104)	50 (122)

12 VOLT	15.05	14.75	14.45	14.30	14.15	13.85	13.55
24 VOLT	30.10	29.50	28.90	28.60	28.30	27.70	27.10

* Some units may feature this cable hardwired directly to the interior circuitry with no plug.

OPTION E - Low Voltage Disconnect (LVD):

Units with Option E, have an auxiliary relay that can be used to prevent deep-discharge damage to the batteries. The relay acts as an automatic switch and can be used to disconnect the load when the battery voltage gets low. The relay is activated and switches when battery voltage drops to the "low-voltage" threshold, and de-activates and switches back when the battery voltage rises to the "reconnect" threshold. The “ACTIVATION” light on the unit indicates the relay activation. This option provides the common ("COM"), the normally open ("N/O"), and the normally closed ("N/C") voltage free contacts of the relay. This option can also be used to automatically start a standby generator or send an alarm signal. The relay activates and deactivates at the set-points listed in the "SPECIFICATIONS" section (“Load Disconnect” and “Load Reconnect”).

Low-voltage Load Disconnect: - To use the relay as a load disconnect device, refer to Figure 2 for wiring instructions. *Refer to INSTALLATIONS: step #13 to start the loads immediately after the installation.*

Generator-Start: - To use the relay as a generator-start function, refer to the generator manual for instructions on interfacing the relay with the generator's auto-start circuit.

Alarm Signal: - The relay can also be used to send an alarm signal, but it must be remembered that the signal is sent at a low-voltage condition and does not reset until the reconnect set-point, after some charging has occurred.

OPTION F - Adjustable charge termination set-point:

On units with Option-F, the charge set-points can be adjusted. The termination and reconnect set-points will be adjusted simultaneously, with the span value remaining fixed.

Field adjustment is possible using a digital multi-meter (DMM) and an active solar array (Voc at least 17 volts).

1) Connect the array to the ASC with the battery disconnected, and measure and record the output voltage on the battery terminals of the ASC (BATT (+) and BATT (-)). This value should be 1% - 2% lower than the termination voltage.
2) Calculate the desired change in the terminal set-point, add that value to the measured output and adjust the potentiometer so the output voltage is the new value.

EXAMPLE:

The current set-point is 14.3 volts, the desired set-point is 13.9 volts (a decrease of .4 volts). With array connected and the battery disconnected, a reading of 14.0 volts (98% of 14.3 volts) is made on the battery terminals of the ASC before adjustment.

Adjust the potentiometer (adjustment screw) until the reading is .4 volts lower than the old reading. The new reading would be 13.6 volts (or 98% of 13.9 volts).

M O N I T O R I N G

“CHARGING” LIGHT: - The "CHARGING" light will be on when the battery is charging. When the battery is at a low state of charge, the light will be on continuously. 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 periods.

The “CHARGING” light will be on when there is voltage from the solar panel and the battery can use more charging. This could result in the "CHARGING" light being on faintly when the panels are in very low light conditions (i.e. night time with moonlight).

LOAD CONTROL / ALARM “ACTIVATED” LIGHT (Option-E): - Generally, this light indicates that the battery voltage is low and the loads have been turned off. (The ASC with this option can also be used to start a standby generator or send some other type of signal). This light will turn on if the battery voltage drops to 11.5 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.

O P E R A T I O N

The operation of the ASC is 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 ASC allows maximum available array current to flow into the battery through a blocking diode, lighting the "CHARGING" light. As the battery charges, the voltage will rise slowly until it reaches about 14.3 volts*. At this point, the "CHARGING" light goes out and battery charging stops. When charging stops the battery voltage will fall, and when the battery voltage drops to about 13.5 volts*, the ASC 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. As the battery charges up, current will pass into the battery for a while 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.

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

”QUICK” TROUBLESHOOTING

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

1) Re-check system wiring to insure proper installation and polarity .

2) Check all system fuses and circuit breakers. Before replacing a blown fuse, locate and correct the cause.

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

4) Review the controller specifications, operation and set-points, particularly the charge termination and reconnect voltage set-points. Units with temperature compensation will have higher set-points in cold weather and lower set-points in hot weather. If possible, check set-points while the controller is in operation, monitoring the battery voltage with a multi-meter.

5) If the unit has temperature compensation (Option-A), check to be sure that the cable is plugged-in and inspect the temperature sensor and sensor wire. Check for a broken sensor or a cut or frayed sensor wire.

6) Review controller specifications, array output, load ratings and system sizing to insure that ratings are not exceeded.

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

7) Check all system fuses and circuit breakers. Before replacing a blown fuse, locate and correct the cause.

8) Confirm that all connections are sound. In particular, check crimp connections that have been crimped but not soldered as these connections tend to deteriorate over time.

9) If you have an accurate volt meter, check for a voltage drop between the controller and the battery when maximum charging is occurring. Drops often occur through old fuses, fuse holders or circuit breaker boxes and at loose or corroded connections.

10) High voltage from nearby lightning strikes or unregulated charging sources can damage the controller, in spite of the built-in lightning protection.

11) If the unit has temperature compensation (Option-A), inspect the temperature sensor and sensor wire. Check for a broken sensor or a cut or frayed sensor wire.

12) Check output from the array, and that the array is not partially shaded or dirty.

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

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. You may be asked to perform a test using a voltage multi-meter to assist with the diagnosis.

- **ASC Charge Controller**: - If a possible problem is suspected based on the observations of the ASC controller, refer to the chart titled ***ASC PROBLEMS CHART*** and the "Case Note" for each condition on the following pages.
- **Battery**: - If you feel your batteries are not being adequately charged or are consistently being over-charged, refer to the section ***BATTERY PROBLEMS***.
- **Solar Panels**: - If you feel that the solar panels are not performing adequately, refer to the section ***SOLAR PANEL PROBLEMS***.

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

NORMAL CONDITIONS:

1. **NORMAL OPERATION: CHARGING / NOT CHARGING** - Depending on your system, the ASC may go for long periods of constant charging or long periods with no charging. The ASC is designed to prevent over-charging of the battery. It does this by stopping the charging at about 14.3 volts*. It will then turn the solar panel off. Charging will resume when the battery voltage drops to about 13.5 volts*. If the battery is fully charged, additional charging may not be needed. If the charge current is not strong enough to over-charge the battery, the controller may not turn the panel charging off.

2. **BATTERY WATER LOSS** - Vented batteries will need some water from time to time in the natural course of events. Minor water loss is not a problem, just top the level up when needed. Excessive water loss (a quart or more in a period of a month) may indicate a more serious problem.

3. **BATTERY GASSING** - In vented batteries, some gassing is good. Gassing stirs up the battery acid and allows the battery to fully charge. A little bubbling in the batteries is not necessarily a problem. See **BATTERY WATER LOSS** above.

4. **TEMPERATURE** - Temperature can affect the performance of batteries. They will tend to over-charge easier when hot, and will not have as much capacity when cold. On units with the temperature compensation option (Option-A), the charge set-point will be higher in cold weather and lower in hot weather. The variation is about .5 volts* for every 30° from 75° F. *See OPTIONS section, Table 1: VOLTAGE SET-POINTS BY TEMPERATURE.*

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

HELP NOTES: (continued)

PROBLEM CONDITIONS :

5. SYSTEM IS NOT SIZED CORRECTLY - The system batteries will tend to be under-charged if the solar 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 on the panel. At the time of installation, a solar array can have an incorrect series-parallel configuration for the proper system voltage and current. A panel can also become less productive or defective over time. **TEST**: Disconnect the ARRAY(+) connection on the ASC, and measure the voltage at the array using the positive and negative wires. In sunny conditions, this should be 18-24 volts*. A lower value could indicate a problem with the solar panel array.

7. PROBLEMS WITH BATTERIES - At the time of installation, a battery bank can have an incorrect series-parallel configuration for the proper system voltage and current. A battery can also go bad and unable to maintain a charge. If the battery is going bad, a little charging or discharging will cause a large change in the battery voltage.

8. BAD CONNECTION: PANEL - The panel connection to the controller may be weak or completely out. This may include problems with the connections at the ASC (ARRAY (+) and ARRAY (-) terminals), both panel connections ("+" or "-") or fuses and unsoldered crimp connectors in these lines. Also, wire that is too small for the length of the run may cause a voltage drop. **TEST**: *Refer to INSTALLATION INSTRUCTIONS, step #14:* ***CHECK FOR VOLTAGE DROP****.*

9. BAD CONNECTION: BATTERIES - The ASC needs to read an accurate battery voltage to regulate the charging correctly. The battery connection to the controller may be weak or completely out. Connection problems can be found with the connections at the ASC (BATT (+) and BATT (-) terminals), both battery terminals ("+" or "-") or fuses and unsoldered crimp connectors in these lines. Also, wire that is too small for the length of the run may cause a voltage drop. **TEST**: *Refer to INSTALLATION INSTRUCTIONS, step #14:* ***CHECK FOR VOLTAGE DROP****.*

10. CONTROLLER MISWIRED - This may include reversing the polarity from the panels or batteries, or switching the array and battery connections. For units with temperature compensation (Option A), the sensor may not be plugged-in completely.

11. INCORRECT CALIBRATION (with F-Option only) - The ASC may be functional but the calibration of the charge termination set-point may be off. *See OPTIONS section.* Specific adjustments to the calibration can be performed at the factory.

12. CONTROLLER DEFECTIVE - The ASC may no longer be functional. It could have been exposed to high voltage (such as a lightning strike nearby), too much current from the panels, reverse polarity from the batteries, or the temperature compensation cable could be damaged (for units with Option-A). *Refer to ASC FIELD TEST PROCEDURE*

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

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

Problems with charging

CASE	BATTERY VOLTAGE (use multi-meter at battery terminals) Voltages listed are for 12 volt systems*	CHARGE LIGHT	LOAD DISCONNECTED LIGHT ("ACTIVATED") (for Option-E)	OTHER	ASC CASE NOTES (next page)
1 →	Low voltage (9.0 - 13.2 volts*)	ON		Day time	See **Case Note 1** (next page)
2 →	Low voltage (9.0 - 13.2 volts*)	OFF		Day time	See **Case Note 2**
3 →	Moderate voltage (13.2 - 14.0 volts*)	Turns OFF (too soon)		Day time	See **Case Note 3**
4 →	High voltage (14.4 - 15.0 volts*)	ON			See **Case Note 4**
5 →	High voltage (14.4 - 15.0 volts*)	OFF			See **Case Note 5**
6 →		ON - at night			See **Case Note 6**
7 →		Light going on and off rapidly			See **Case Note 7**
8 →				ASC buzzing	See **Case Note 8**
9 →				ASC hot	See **Case Note 9**

Problems with low-voltage load disconnect (Option-E)

CASE	BATTERY VOLTAGE (use multi-meter at battery terminals) Voltages listed are for 12 volt systems*	CHARGE LIGHT	LOAD DISCONNECTED LIGHT ("ACTIVATED") (for Option-E)	OTHER	ASC CASE NOTES (next page)
10 →	Very low voltage (11.5 volts* or lower)		OFF	Loads stay on	See **Case Note 10**
11 →	Low to Moderate voltage (11.5 - 14.3 volts*)		ON	Loads off	See **Case Note 11**
12 →	Low voltage (11.5 - 13.2 volts*)		OFF	Loads off	See **Case Note 12**

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

ASC PROBLEM DESCRIPTIONS ***(from the ASC PROBLEM CHART)***

ASC Case Note 1 - A continuous low-voltage condition with good charging during the day would indicate that the controller is functional but one of the following problems exists:

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

ASC Case Note 2 - A low-voltage condition with no charging during the day would indicate one of the following:

- The system has no panel input. *See* ***BAD CONNECTION: PANEL*** *(Help Note #8)*
- The ASC is out of calibration and is set too low (for units with Option-F only). *See* ***INCORRECT CALIBRATION*** *(Help Note #11)*
- The ASC temperature compensation cable may not be plugged-in. (For units with Temperature Compensation option (Option A)).
- The ASC may be defective. *See* ***CONTROLLER DEFECTIVE*** *(Help Note #12)*

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

- The ASC may have a bad battery connection. Somewhere in the battery connection there could be a voltage drop that would cause the controller to sense a higher battery voltage than what actually exists. *See* ***BAD CONNECTION: BATTERY*** *(Help Note #9)*
- The ASC is out of calibration and is set too low (for units with F-Option only). *See* ***INCORRECT CALIBRATION*** *(Help Note #11)*
- Temperature Compensation (Option-A) can change the controller set-points. *See* ***TEMPERATURE*** *(Help Note #4)*
- The ASC may be defective. *See* ***CONTROLLER DEFECTIVE*** *(Help Note #12)*

TEST: - Try to monitor the voltage at the ASC "BATT (+)" and "BATT (-)" terminals when the controller actually stops charging (CHARGING light goes OFF). If the voltage at the ASC terminals is about 14.3 volts* then assume a voltage drop along the battery connection is causing the problem.

ASC Case Note 4 - A high voltage condition with additional charging would indicate one of the following:

- The battery voltage may be just under the charge termination set-point and not need to shut off. *See* ***NORMAL OPERATION: CHARGING / NOT CHARGING*** *(Help Note #1)*
- The ASC is out of calibration and is set too high (for units with Option-F only). *See* ***INCORRECT CALIBRATION*** *(Help Note #11)*
- Temperature Compensation (Option-A) can change the controller set-points. *See* ***TEMPERATURE*** *(Help Note #4)*
- The ASC may be defective. *See* **CONTROLLER DEFECTIVE** *(Help Note #12)*

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

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

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

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

ASC Case Note 7 - The “CHARGING” light going on and off rapidly can indicate one of the following:

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

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

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

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

ASC Case Note 10 - A low-voltage condition where the loads do not turn off would indicate one of the following problems:

- The battery voltage may not have actually dipped down below the Load Disconnect set-point (about 11.5 volts*)
- A very low battery. The load-disconnect circuit stops working at about 8.0 volts*.

ASC Case Note 11 - If the loads are turned off when the battery voltage is above the Load Disconnect set-point consider one of the following:

- On initial installation, the ASC will start out with the relay energized (load disconnected mode). The battery voltage has to rise to the reset voltage of about 13.0 volts* to clear this condition. If the array is connected to the controller and is producing at least 17 volts* open circuit, the loads can be turned on by disconnecting and then reconnecting the ASC BATT (+) connection.
- The battery voltage may need to rise to the Load Reconnect set-point of about 13.0 volts*.
- A poor connection to the load exists or some other load problem.
- A poor connection in the battery connection may exist that results in a voltage drop during periods of load usage (larger drop for higher current) that disappears when loads are turned off. This voltage drop results in the controller seeing a lower voltage than what the battery voltage actually is. *See **BAD CONNECTION: BATTERY** (Help Note #9)*

ASC Case Note 12 - If the loads are turned off and the "ACTIVATED" light is off the ASC would seem to be wired incorrectly. Use the normally closed (N/C) contacts of the relay for load control. *Refer to wiring diagram: Figure 2.*

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

SOLAR PANEL PROBLEMS: - 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 current close to their max power current as presented in their specifications. To reach this level assumes that all conditions are ideal. If the panel performance as measured at the panel inputs on the ASC controller is much lower, consider the following potential problems.

- **Solar Panel Problem** - Panels may be dirty, not aligned or other problem. Panel may have shadows crossing it. The panels could be configured incorrectly or be defective. *See **Problem with the Solar Panels** (Help Note #6)*

- **Bad Panel or Battery Connection** - *See Help Notes #8 and #9.* Check for a voltage drop in the connections. *See **INSTALLATION INSTRUCTIONS**: step #**14. CHECK FOR VOLTAGE DROP.***

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

CASE	BATTERY	SEE NOTE(S)
1 →	Battery voltage low or does not hold a charge	See **Battery Note 1**
2 →	Battery seems to be over-charging	See **Battery Note 2**

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

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

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

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

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

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

TEST 1: *Temperature sensor (Units with Temperature Compensation - Option A)*

If the ASC is equipped with a removable temperature sensor, perform this test first.

1) Unplug the sensor from the ASC.
2) Measure the resistance between the two pins of the sensor connector (cable side). The resistance should be between 1K Ω (ohm) and 3K Ω.
3) If the sensor is good, reinstall it. If sensor is bad, it must be replaced with a good one. **THE ASC WILL NOT FUNCTION WITH A MISSING OR DAMAGED SENSOR.**

TEST 2: *Alternate A* (If no power supply is available)

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

Requirements: digital multi-meter (dmm)

1) Remove all connections from the ASC
2) Set multi-meter to the 200Ω resistance scale
3) Take measurements from ASC terminals. Contact positive lead of the meter to ARRAY(+) and negative lead of meter to ARRAY(-). Reading should be open (>200Ω). A short (<10Ω) indicates unit is defective.

TEST 2: *Alternate B* (Power supply required)

Complete Operation Test. This tests the FET's (not shorted or open) and verify the set-points.

Requirements: digital multi-meter and a current limited, variable voltage power supply. Set current limit to 1/2 amp (500 ma) and set voltage to 14 volts*.

Caution: Be careful of polarity. Incorrect connection can damage the ASC.

1) Connect multi-meter to the ARRAY(+) and ARRAY(-) terminals on the ASC.
2) Connect power supply to ASC BATT(+) and BATT(-)
3) Set multi-meter to the 200Ω resistance scale
4) Slowly vary the power supply voltage up and down (**do not** exceed 16 volts). Using the multimeter, watch for the change in resistance that results from the ASC attempting to short and open the array. (The "CHARGING'' light will not work during this procedure).
5) Note the power supply voltage when the thresholds occur. These voltages should compare to the voltage set-points listed In the specifications (Charge Termination: 14.3 volts* and Charge Resumption: 13.5 volts*). For units with Option-A (Temp. Comp.) the set-points will vary depending on the battery temperature. *(See Options section)*
6) Test the "CHARGING" LED by setting the power supply to 12 volts* and connecting it to the ASC ARRAY(+) and ARRAY (-) terminals. "CHARGING" light should go on.
7) For units with Option-E (LVD Relay), connect the multi-meter to N/C and COM positions on the ASC and repeat steps 2 through 5, observing where the relay switches and comparing the set-points. *(See Specification "Load Disconnect" and "Load Reconnect").*

TEST 3

This procedure tests the condition of the blocking diode.

Requirements: digital multi-meter (dmm)

1) Remove all connections from the ASC
2) Set multi-meter to the diode test scale (indicated by a  symbol).
3) Take measurements from ASC terminals. Contact positive lead of the meter to ARRAY(+) and negative lead of the meter to BATT(+). Reading should be less than 0.7. Above 0.7 would indicate a defective unit.

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

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

TEST 1: *Temperature sensor (Units with Temperature Compensation - Option A)*

If the ASC is equipped with a removable temperature sensor, perform this test first.

1) Unplug the sensor from the ASC.
2) Measure the resistance between the two pins of the sensor connector (cable side). The resistance should be between 1K Ω (ohm) and 3K Ω.
3) If the sensor is good, reinstall it. If sensor is bad, it must be replaced with a good one. **THE ASC WILL NOT FUNCTION WITH A MISSING OR DAMAGED SENSOR.**

TEST 2: *Alternate A* (If no active solar array is available)

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

Requirements: digital multi-meter (dmm)

1) Remove all connections from the ASC
2) Set multi-meter to the 200Ω resistance scale
3) Take measurements from ASC terminals. Contact positive lead of the meter to ARRAY(+) and negative lead of meter to ARRAY(-). Reading should be open (>200Ω). A short (<10Ω) indicates unit is defective.

TEST 2: *Alternate B* (Active solar array required)

This tests the basic operation of the ASC by testing the FET's (not shorted or open).

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

1) Connect the array plus and minus wires to the appropriate terminals on the ASC (no battery connection).
2) Measure voltage at BATT(+) and BATT(-) terminals on the ASC. The reading should be between 14.0 and 15.0 volts*. If this reading is very high, 16-20 volts*, or very low, 2-5 volts*, the unit is defective.

TEST 3

This procedure tests the condition of the blocking diode.

Requirements: digital multi-meter (dmm)

1) Remove all connections from the ASC
2) Set multi-meter to the diode test function. (indicated by a →|– symbol)
3) Take measurements from ASC terminals. Contact positive lead of the meter to ARRAY(+) and negative lead of the meter to BATT(+). Reading should be less than 0.7. Above 0.7 would indicate a defective unit.

* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage, for 24 volt systems, double the listed voltage.

LIMITED FIVE YEAR WARRANTY
SPECIALTY CONCEPTS, INC.

1. **Specialty Concepts, Inc. warrants all its products for a period of five (5) years from the date of shipment from its factory. This warranty is valid against defects in materials and workmanship for the five (5) year warranty period. It is not valid against defects resulting from, but not limited to:**

   A. Misuse and/or abuse, neglect or accident.
   B. Exceeding the unit's design limits.
   C. Improper installation, including, but not limited to, improper environmental protection and improper hook-up.
   D. Acts of God, including lightning, floods, earthquakes, fire and high winds.
   E. Damage in handling, including damage encountered during shipment.

2. **This warranty shall be considered void if the warranted product is in anyway opened or altered. The warranty will be void if any eyelets, rivets, or other fasteners used to seal the unit are removed or altered, or if the unit's serial number is in any way removed, altered, replaced, defaced or rendered illegible.**

3. **The five (5) year term of this warranty does not apply to equipment where another manufacturers' warranty is available. An example of such equipment may be, but is not limited to, an electronic enclosure. The time limit for this warranty may be for less than the Specialty Concepts limited warranty. Specialty Concepts will assist the claimant in attempts to seek warranty claims for such equipment, where appropriate.**

4. **Specialty Concepts cannot assume responsibility for any damages to any system components used in conjunction with Specialty Concepts products nor for claims for personal injury or property damage resulting from the use of Specialty Concepts' products or the improper operation thereof or consequential damages arising from the products or use of the products.**

5. **Specialty Concepts cannot guaranty compatibility of its products with other components used in conjunction with Specialty Concepts products, including, but not limited to, solar modules, batteries, and system interconnects, and such loads as inverters, transmitters, and other loads which produce "noise" or electromagnetic interference, in excess of the levels to which Specialty Concepts products are compatible.**

6. **Warranty repair and/or evaluation will be provided only at Chatsworth, California facility of Specialty Concepts. Units for such repair and/or evaluation must be returned freight prepaid to Specialty Concepts with a written description of any apparent defects. Specialty Concepts will not be required at any time to visit the installation site wherein Specialty Concepts' products are subject to warranty repair and/or evaluation.**

7. **Only Specialty Concepts is authorized to repair any of its products, and they reserve the right to repair or replace any unit returned for warranty repair. The party returning a unit for repair is responsible for proper packaging and for shipping and insurance charges, as well as any other charges encountered, in shipping to and from Specialty Concepts.**

8. **This warranty supersedes all other warranties and may only be modified by statement in writing, signed by Specialty Concepts.**

Warranty terms effective as of April 1, 1993

SPECIALTY CONCEPTS, INC.

8954 MASON AVE., CHATSWORTH, CA 91311 U S A

SPECIALTY CONCEPTS, INC.
REPAIR INFORMATION FORM

All Specialty Concepts, Inc. products carry a 5 year limited warranty. ASC's can not be repaired but will be replaced for all warranty failures.

Directions for returning units needing in warranty servicing.

1. Fill in this form completely
2. Box up unit with Repair Form and copy off sales receipt (if available).
3. Send by UPS or Certified Parcel Post to :

   Specialty Concepts, Inc.
   Attn: Repair Dept.
   8954 Mason Ave.
   Chatsworth, CA 91311 USA

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Contact Person's Name and Company : _____

Return Address : _____

(UPS Deliverable, Avoid PO Boxes) : _____

Daytime Phone : _____

Product Model / Serial Number : _____

Please attach a separate page describing the failure.