

**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 (Solar) Charge Controller**

**The ASC is a highly reliable charge controller ideal for small to mid-sized photovoltaic systems. It will efficiently charge your batteries and provide years of protection from over-charging. Units with the low-voltage disconnect (LVD) option will provide additional protection from low-voltage. This protective care will prolong your battery life and reduce maintenance requirements.**

**S P E C I A L T Y C O N C E P T S , I N C .**

**8954 Mason Ave.**

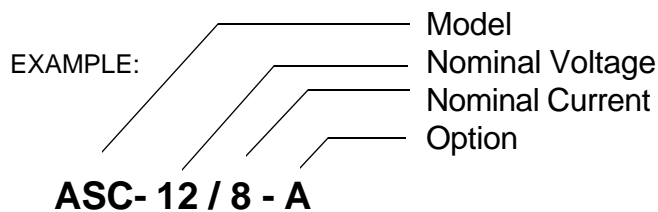
**Chatsworth, CA 91311, USA**

# ASC - Specifications

PARAMETERS	UNITS	NOMINAL VOLTAGES				
		6 v	12 v	24 v	36 v	48 v
Charge Current, Short Circuit, Continuous Charge Current, Short Circuit, Max.(60 sec)		Refer to Serial Number Tag (available in 1 – 20 amps) 1.30% of rated charge current				
Load Current, Continuous (1)(2)	(Amps)	N/A	10	10	N/A	N/A
Load Current, Max (60 seconds) (1)(2)(3)	(Amps)	N/A	13	13	N/A	N/A
Array Voltage, Max Voc	(Volts)	26	26	46	69	92
Voltage @ Battery for Charging, Minimum	(Volts)	0	0	0	0	0
Voltage @ Battery for LVD, Minimum (1)	(Volts)	N/A	8.5	17	N/A	N/A
Quiescent Current	(Milliamps)	10	10	10	10	10
Current Consumption, Charging, Typ.	(Milliamps)	15	15	15	15	15
Current Consumption, Load Disconnected, Typ. (1)(4)	(Milliamps)	N/A	40	40	N/A	N/A
Voltage Drop, Array to Battery, Typ.	(Volts)	.30	.30	.30	.60	.60
Voltage Drop, Array to Battery, Max.	(Volts)	.55	.55	.55	.70	.70
Voltage Drop, Battery to Load, Typ. (1) (Volts)	(Volts)	.06	.06	.06	N/A	N/A
Charge Termination (5)	(Volts)	7.1 ± .1	14.3 ± .2	28.6 ± .4	42.9 ± .6	57.2 ± .8
Charge Resumption (5)	(Volts)	6.75 ± .2	13.5 ± .3	27.0 ± .6	40.5 ± .6	54.0 ± 1.2
Load Disconnect (LVD) (1) (5)	(Volts)	N/A	11.5 ± .2	23.0 ± .4	N/A	N/A
Load Reconnect (1) (5)	(Volts)	N/A	13.0 ± .3	26.0 ± .6	N/A	N/A
Operating Temp. Range	(°C)	-40 to 50	-40 to 50	-40 to 50	-40 to 50	-40 to 50
Storage Temp. Range	(°C)	-55 to 85	-55 to 85	-55 to 85	-55 to 85	-55 to 85
Temperature Comp. Coef. (from 25°C) (6)	(Volts/°C)	-.015	-.03	-.06	-.09	-1.2

- Notes: (1) Low-voltage disconnect option. 10 amp load.  
 (2) Non-inductive.  
 (3) Carry only, Non-switching  
 (4) LVD relay energized, red L.E.D. on, typical value.  
 (5) Value adjustable with Adjust. Voltage Set-point option. Charge Termination / Resumption  
 (and Load Disconnect / Reconnect (Option E)) span is fixed  
 (6) Temperature compensation option

### PART NUMBERING KEY



### OPTIONS

- A - Temperature Compensation
- E - Low-voltage Disconnect (LVD)/  
Generator Start
- F - Adjustable Voltage Set-point(s)
- S - Special or Custom unit

# FEATURES

## IDEAL SOLAR CHARGING

- **Efficient** – Over 99% efficiency when charging
- **Full Charging** – Ensures that the batteries are always topped off
- **Battery Safe** – Charging method maximizes battery life
- **Reduced Maintenance** – from healthy charging and reliable operation
- **Temperature Compensation** – (Option)  
Remote sensor provides best charging for hot or cold locations

## OVER-CHARGE PROTECTION

- **High Voltage “Shut-off”** - shuts off only when battery is full
- **Robust Circuitry** – Control function 100% solid state.

## LOW-VOLTAGE PROTECTION (Option)

- **Automatic Load Shutoff** – Protects battery from deep discharge.
- **Generator Start or Alarm** – Includes N/O, N/C, COM voltage free contacts

## HIGH RELIABILITY

- **Simple, rugged electronics** – low component count and streamlined design ensure long term reliability
- **Maximum environmental protection** – Ideal for outdoor mounting
- **No Minimum Voltage Required** – Can charge a dead battery.
- **Lightning protection** – Survives most indirect strikes

## FEATURES

- **Reverse leakage protection** – Prevents power loss at night.
- **Terminal Block** – for sound and easy wire connections.
- **Status Light(s)** – “Charging” and LVD “Activated” (with LVD option)

## SYSTEM COMPATIBILITY

- **Minimum RF Noise** – Low switching frequency lessens electronic noise
- **Protection from External RF Noise** – Can operate with noisy invertors

# CERTIFICATIONS

Not all units are certified. Refer to logos on product (front or back) for certifications.



## Recognized by Underwriters Laboratories (UL)

Meets all requirements for UL 1741.



## Factory Mutual (FM) approved

For Class 1, Div 2, Groups A, B, C and D hazardous locations



## Canadian Standards Association (CSA) approved

- For Class 1, Div 2, Groups A, B, C and D hazardous locations
- Do not disconnect wiring while circuits are live unless area is known to be non-hazardous.
- Substitution of components may impair suitability for classification 2.

## RELATED SYSTEM EQUIPMENT

The ASC is an integral part of a solar electric power system that includes a photovoltaic (PV) solar array and a battery.

**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. Install all modules with the correct series-parallel configuration to insure proper system voltage and current. The ASC includes a blocking diode to eliminate leakage of the battery power into the solar panels at night. No additional protection is needed.

**FOR LARGER SYSTEMS:** Systems with large arrays and higher charging currents can divide up the array into 2 or more parallel sub-arrays. An ASC should be wired to each sub-array, provided that each sub-array does not exceed the rating of the individual ASC. This method allows higher currents, an ideal charging method and a degree of redundancy to increase overall system reliability.

**OTHER CHARGING SOURCES:** Systems with an additional source of charging (alternator, battery charger, wind power, etc.) can operate with a solar array and an ASC. All charging sources need to connect directly to the battery on independent lines and have their own form of over-charge protection.

**ASC FOR NON-SOLAR APPLICATIONS:** The ASC will only operate with solar panels (PV). Do not use with other power sources, such as a hydro or wind generators/alternators or AC battery chargers. These charging sources can damage the ASC and/or the generating equipment because the ASC regulates charging by short circuiting the input.

**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 (NiCad) 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. Install all batteries with the correct series-parallel configuration to insure proper system voltage and current

**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 ASC. These loads will disconnect automatically when the battery voltage is low. Higher current loads, or inductive loads such as pumps, motors or invertors should be connected directly to the battery and be properly fused.

# 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 EXCEED THE ASC'S VOLTAGE AND CURRENT RATINGS:**

- **Do not** exceed the maximum voltage rating of the ASC (see SPECIFICATIONS). Compare the ASC's rating of the open circuit voltage (Voc) to the array, or the sum of the Voc of all modules in series.
- **Do not** exceed the maximum current rating of the ASC (see SPECIFICATIONS). Compare the ASC's rating of the short circuit currents (Isc) to the array, or the sum of all the modules in parallel. Remember that cold temperatures increase the charging current from the modules. Refer to the temperature chart with the module specifications.

### **CAUTION: DO NOT DEVIATE FROM THE RECOMMENDED WIRING INSTRUCTIONS:**

- **Do not** reverse Battery(+) and Battery(-) connections to the ASC. Any reverse polarity from the battery can damage the unit.
- **Do not** reverse the Battery and Array connections to the ASC. A battery connected to the array terminals can damage the unit.
- **Do not** connect the array directly to the battery when the array is connected to the ASC at the same time. This will damage the ASC when the battery voltage reaches the Charge Termination set-point.
- **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. Other charging sources should have independent connections to the battery.
- **Do not** wire the ASC in such a way that it can be connected to a load without a battery connected. (Example: Do not connect the loads directly to the ASC BATT terminals. This will damage the ASC if the battery is disconnected.)

### **CAUTION: DO NOT OVER-TIGHTEN SCREWS:**

- **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 / MOUNTING:** - The ASC may be mounted in almost any indoor or outdoor location. The unit should be mounted as close as possible to the batteries to avoid errors in battery voltage reading. The ASC may be mounted on the rear of the solar panels using outdoor-type double-stick foam tape. On units with temperature compensation (Option-A), the ASC should be mounted within 10 feet (3m) of the batteries to enable the sensor cable to reach the battery.

**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. When the ASC is 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 optional sensor and cable 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*)

### **3. SELECT WIRE:**

**WIRE TYPE:** - When possible, use stranded wire rather than solid wire. Stranded wire is less likely to fail and cause loose connections over time. Consider using wires of different colors to indicate source or polarity. Also, select a wire that offers the appropriate insulation for the condition of the location. (*Refer to the U.S. National Electrical Code*)

**WIRE SIZE:** - Select wire of sufficient gauge to safely handle the rated current of the system and to limit voltage drop. The ASC terminals accept up to 10 gauge stranded bare wire (and 12 gauge solid wire). (When using 10 gauge stranded wire, divide the end wires into two equal sections and straddle the terminal screw). An alternative to using larger wire is to use two wires in parallel for each connection.

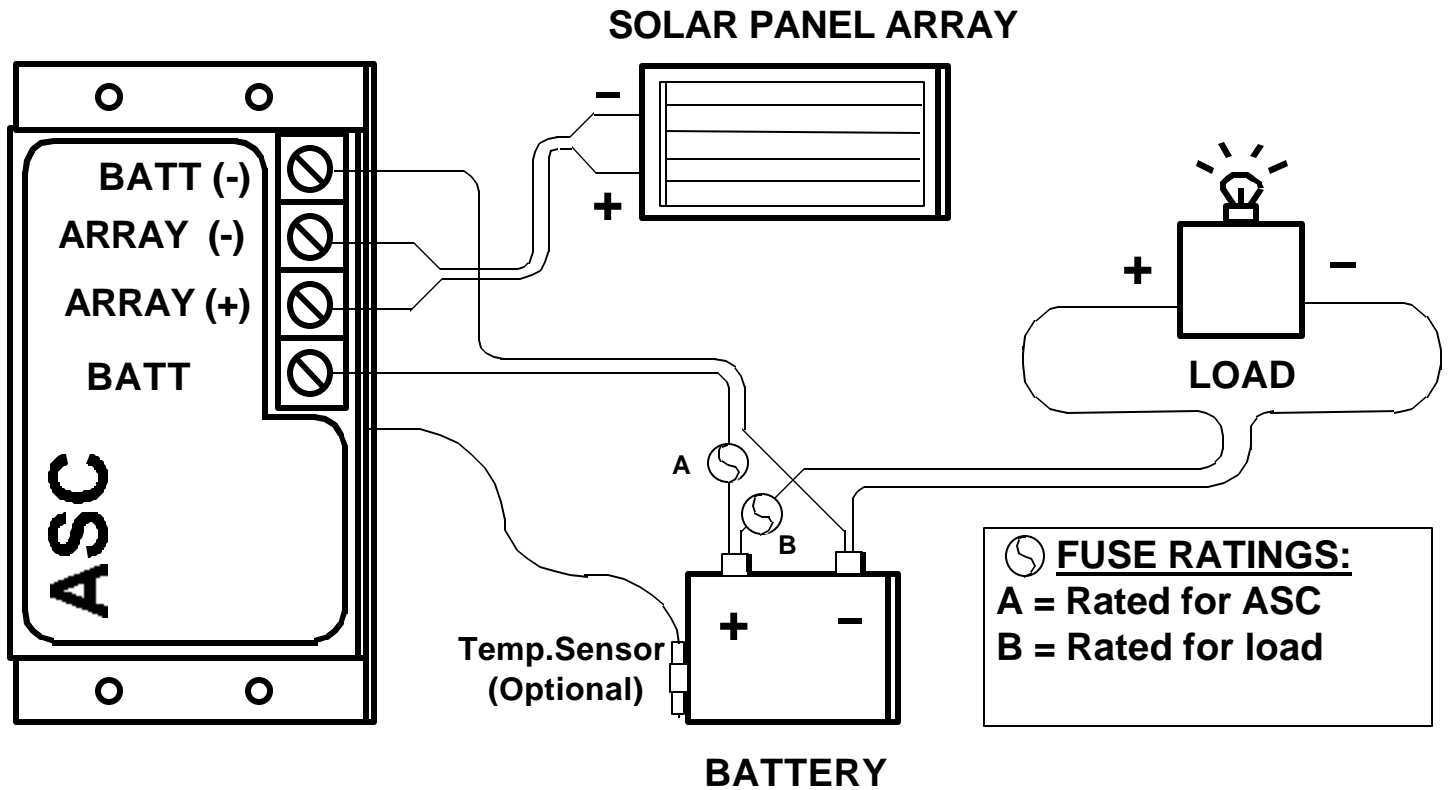
**Large Wires:** To connect large wire to the ASC, use crimp connectors or connect the larger wire to a short, thinner wire using a wire nut (solder these connections).

**Wire Size: *Minimum wire gauge (AWG)*** - (based on ASC at maximum current)

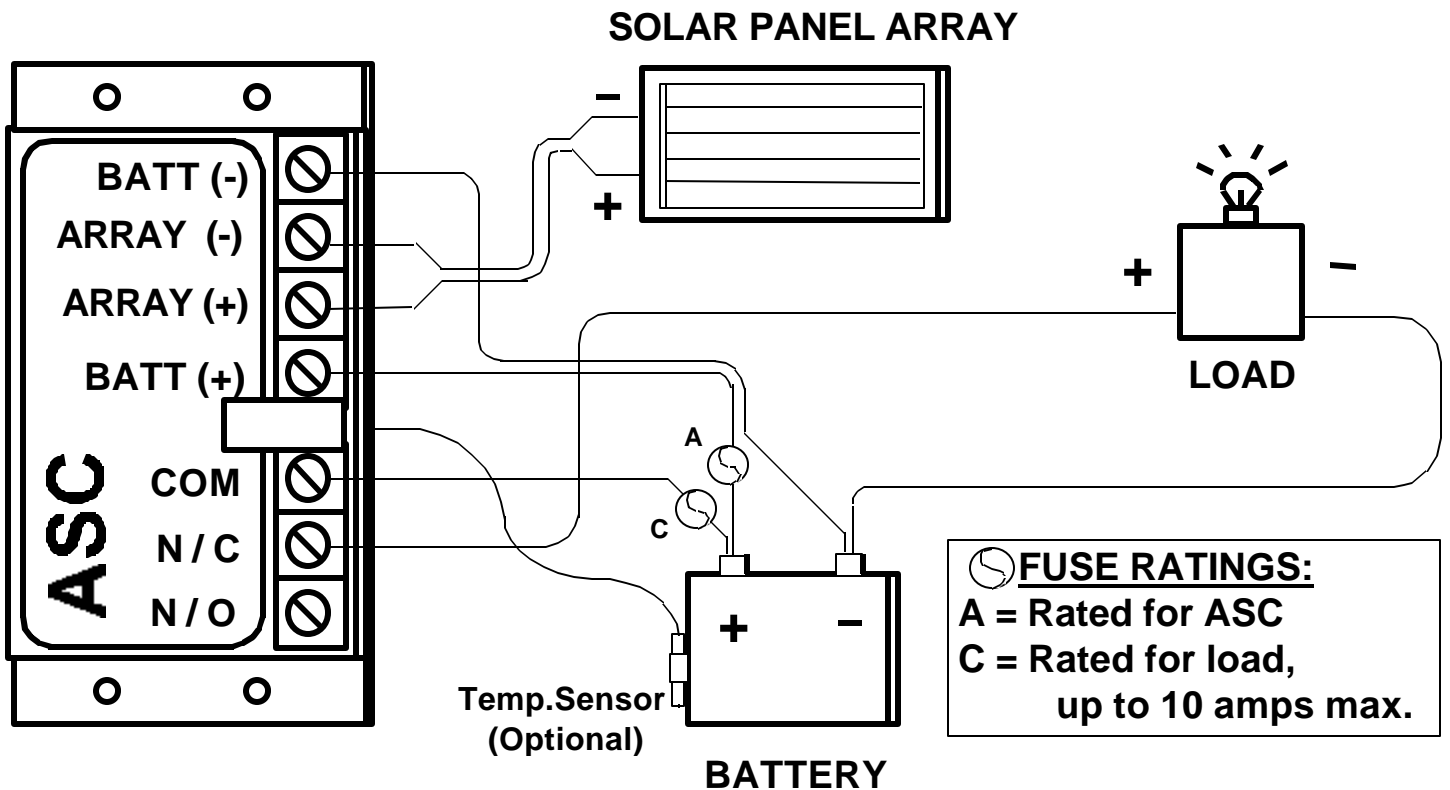
<b>Model (V/C)</b>	<b>Battery Connection</b>				<b>Solar Array Connection</b>			
	Distance round trip (feet / meter)				Distance round trip (feet / meter)			
	10'/3m	20'/6m	30'/9m	40'/12m	10'/3m	20'/6m	30'/9m	40'/12m
ASC-6/4	14	10	10	8*	14	14	12	10
ASC-12/1	14	14	14	14	14	14	14	14
ASC-12/4	14	14	12	10	14	14	14	14
ASC-12/8	14	10	10	8*	14	14	12	10
ASC-12/12	12	10	8*	6*	14	12	10	10
ASC-12/16	10	8*	6*	4*	14	10	10	8*
ASC-24/8	14	14	12	10	14	14	14	14
ASC-24/16	14	10	10	8*	14	14	12	10

\* Wire gauge larger than unit can accept directly. See WIRE SIZE / Large Wires above.

**FIGURE 1 ASC Controller**



**FIGURE 2 ASC Controller with Option-E (LVD)**



## **INSTALLATION INSTRUCTIONS (continued) :**

- 4. 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
  
- 5. REMOVE POWER FROM BATTERY / PANELS (if needed):** - Prior to running the wires to the ASC, be sure that power is disconnected from the batteries and panels
  
- 6. RUN SYSTEM WIRING:** - Run the wires from the battery and solar panel to the ASC 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 note 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. Do not use a jumper across the Array(-) and Batt(-) terminals. If using crimp connections, be sure to crimp and solder.
  
- 9. INSTALL TEMPERATURE COMPENSATION (OPTION-A):** - If included. The cable's sensor needs to mount onto the side of 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. Be sure to run a separate wire from the battery (+) terminal to the ASC's COM terminal. Do not use a jumper from the ASC's BATT(+) terminal to the COM position. *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. CONNECT BATTERY AND ARRAY POWER**



**13. OPERATION:** - Operation of the ASC is now fully automatic. If the battery voltage is below the Full Charge Termination set-point (about 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 probably 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 at the connection. 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, immediately check the voltage at the ASC terminals for "BATT (+)" and "BATT (-)". The difference in voltage **should not** be more than ¼volt\*.

**Array Connection:** - Next, note the voltage at the panel wires. Select the positive and negative wires that are used for the ASC connection. Then immediately check the voltage at the ASC terminals for "ARRAY (+)" and "ARRAY (-)". The difference should also be no more than ½volt\*.

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.

**Example:** You record these readings:

Battery terminals:	13.65 volts
ASC battery connection:	13.95 volts → <i>“.30 volt difference too large. Decrease voltage drop”</i>
ASC panel connection:	14.10 volts
Panel(s):	14.30 volts → <i>“Connection OK”</i>

\* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage. For 24 volt systems, multiply by 2. For 36 volts, multiply by 3. For 48 volts, multiply by 4.

# OPTIONS

Options cannot be added to units after production.

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

**DESCRIPTION:** On units equipped with Option-A, a small sensor on a 10 foot (3m) cable is connected to the controller to adjust the charging thresholds according to battery temperature. The rate of compensation is  $-5\text{mv}/^{\circ}\text{C}$  per battery cell in series from  $25^{\circ}\text{C}$ . 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  $50^{\circ}\text{F}$  ( $10^{\circ}\text{C}$ ) or above  $90^{\circ}\text{F}$  ( $32^{\circ}\text{C}$ ) 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. NiCad batteries often have different temperature compensation requirements.

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

**INSTALLATION:** The sensor at the end of the cable needs to attach to the side of the battery. This must be done properly to ensure 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:

- RUN SENSOR TO BATTERIES :** Run the sensor to the batteries. To protect the cable from cuts, rodents or other damage, consider running the cable through conduit or a PVC pipe. During installation, 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.
- 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. Temperature compensation of charging voltage is now automatic.

**Table 1 : Voltage set-points by temperature.**

Temperature compensation coefficient is:  $-.03$  volts /  $^{\circ}\text{C}$  from  $25^{\circ}\text{C}$  (for 12 volt)  
 $-.06$  volts /  $^{\circ}\text{C}$  from  $25^{\circ}\text{C}$  (for 24 volt)

CONTROLLER <u>VOLTAGE</u>	TEMPERATURE $^{\circ}\text{C}$ ( $^{\circ}\text{F}$ )						
	<u><math>0^{\circ}</math> (<math>32^{\circ}</math>)</u>	<u><math>10^{\circ}</math> (<math>50^{\circ}</math>)</u>	<u><math>20^{\circ}</math> (<math>68^{\circ}</math>)</u>	<u><math>25^{\circ}</math> (<math>77^{\circ}</math>)</u>	<u><math>30^{\circ}</math> (<math>86^{\circ}</math>)</u>	<u><math>40^{\circ}</math> (<math>104^{\circ}</math>)</u>	<u><math>50^{\circ}</math> (<math>122^{\circ}</math>)</u>
12 VOLT	15.05v	14.75v	14.45v	14.30v	14.15v	13.85v	13.55v
24 VOLT	30.10v	29.50v	28.90v	28.60v	28.30v	27.70v	27.10v

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

Units with Option-E can prevent deep-discharge damage to the batteries. These units feature a relay that can disconnect the load when the battery voltage is low. The "ACTIVATION" light will light to indicate the relay activation (loads disconnected).

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 "Load Disconnect" and deactivates "Load Reconnect" at the set-points listed in the "SPECIFICATIONS" section.

**Low-voltage Load Disconnect:** - To use the relay as a load disconnect device, use the N/C and COM terminals and refer to Figure 2 and the installation 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, generally you use the N/O and COM terminals and 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 charging set-point can be adjusted. The termination and reconnect set-points will be adjusted simultaneously (the span is fixed). The adjustment pot is located on the back of the unit and appears as a small slotted dial. The adjustment pot can be turned with a small screw driver. Be careful not to force the dial beyond its end-stops.

**ADJUSTMENT INSTRUCTIONS:** - Field adjustment is possible using a digital voltmeter and an active solar array (voc at least 17 volts).

- 1) Place a solar panel in full sun and connect it to the ASC (battery disconnected). Measure and record the output voltage on the battery terminals of the ASC (BATT (+) and BATT (-)). This value should be within 1% - 2% of the factory-set termination voltage of 14.3v\*.
- 2) Calculate the desired change in the charge termination set-point, add that value to the measured output and adjust the pot so the output voltage is the new value.  
***Do not adjust the voltage set-point below 13.5V\* or above 16.0V\*.***

**EXAMPLE:** - The current set-point voltage is 14.3V, the desired set-point is 13.9V (a decrease of .4V). With array connected and the battery disconnected, a reading of 14.0V (98% of 14.3V) is made on the battery terminals of the ASC before adjustment. Turn the adjustment pot until the reading is .4V lower than the old reading. The new reading would be 13.6V (or 98% of 13.9V).

\* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage. For 24 volt systems, multiply by 2. For 36 volts, multiply by 3. For 48 volts, multiply by 4.

## MONITORING

**“CHARGING” LIGHT:** - The "CHARGING" light will be on when the battery is charging. When charging, virtually all the power available from the solar array will pass through to the battery.

The “CHARGING” light will be on when there is voltage from the solar array and the battery can use more charging. This could result in the "CHARGING" light being on (bright or faint) 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.

## OPERATION

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.

**CHARGING METHOD: Low Frequency Pulse Width Modulation :** - The ASC provides pulses of charging current at varying durations to maintain the batteries at a full state of charge and insure the long-term health on the batteries. The “on” and “off” cycle time is wide enough to eliminate electronic noise and short enough to insure the batteries are always topped off. This method allows the batteries to reach a higher voltage with the “on” cycle and protect the batteries from gassing in the “off” cycle. This will provide the benefits of the higher voltage (reduced sulfation and stirred up electrolyte) and prevent excessive gassing and excessive water loss.

**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, multiply by 2. For 36 volts, multiply by 3. For 48 volts, multiply by 4.

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

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

- 1) Re-check system wiring to assure 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 an accurate volt-meter.
- 5) 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.
- 6) Review controller specifications, array output, load ratings and system sizing to ensure 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) With 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 other 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.

# TROUBLE SHOOTING

The following section can assist in troubleshooting a solar system. Review the section below titled "**HELP NOTES**" that lists some common problems with a solar system.

- **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 "ASC 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. **"ALWAYS CHARGING" or "NEVER CHARGING"** - Depending on your system, it may be normal for the ASC to go for long periods with constant charging or long periods with no charging. The function of the ASC is to prevent over-charging of the battery. Therefore, it will charge continuously when the battery voltage is low and stop all charging as long as the battery voltage is high.
2. **BATTERY WATER LOSS** - It is normal for vented batteries to need some water from time to time. 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. Temperature can also affect the performance of the solar panels. The charging current can be substantially higher in cold conditions. When sizing the system, consider the current at cold conditions. Most panel specifications include a temperature chart. On units with temperature compensation (Option-A), the charge set-point will be higher in cold weather and lower in hot weather. 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, multiply by 2. For 36 volts, multiply by 3. For 48 volts, multiply by 4.

## **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. Some systems contain small hidden loads that can slowly draw down the battery.
- 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 the angle of the panel (as in winter months), 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 ASC from the panel, and measure the voltage at panel(+) and panel(-). In sunny conditions, this should be 18-24 volts\*. A lower value could indicate a problem with the panel. To check the panel's current output, contact a local solar dealer.
- 7. PROBLEMS WITH BATTERIES** - At the time of installation, a battery bank can have an incorrect series-parallel configuration for the proper system voltage and current. A battery can also go bad and unable to maintain a charge. If the battery is going bad, a little charging or discharging will cause a large change in the battery voltage. A battery short somewhere can also reduce the battery voltage.
- 8. BAD CONNECTION: PANEL** - The solar panel connection to the controller may be weak or completely out. Problems can be found at the ASC connection (ARRAY(+) & 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 problem. *Refer to INSTALLATION INSTRUCTIONS, step #14: CHECK FOR VOLTAGE DROP.*
- 9. BAD CONNECTION: BATTERIES** - The battery connection to the controller may be weak or completely out. The ASC needs to read an accurate battery voltage to regulate the charging correctly. Therefore, you need to minimize the voltage drop from the battery. Problems can be found with the ASC connection (BATT(+) and BATT(-) terminals), both battery terminals ("+" or "-") or fuses and unsoldered crimp connectors in these lines. Also, wire that is too small may cause a voltage drop. *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. This may also include a deviation from the wiring instructions, such as bypassing connections by using jumpers or by connecting to battery (-) at some place other than the battery itself.
- 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. A defective unit can overcharge the battery or stop all charging. A faulty unit can not *drain* a battery. It may have been exposed to high voltage or current, reverse polarity from the batteries, or the temperature cable could be damaged (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, multiply by 2. For 36 volts, multiply by 3. For 48 volts, multiply by 4.

**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. Use an accurate volt-meter and measure the voltage directly at the battery terminals.

**Problems with charging**

<u>CASE</u>	<u>BATTERY VOLTAGE</u> <u>(at battery terminals)</u> <u>(12v)</u>	<u>CHARGE</u> <u>LIGHT</u>	<u>OTHER</u>	<u>ASC NOTES</u> <u>(next page)</u>
1 →	Low voltage (9.0 - 13.2 volts*)	ON	Day time	See <b>ASC Note 1</b> (next page)
2 →	Low voltage (9.0 - 13.2 volts*)	OFF	Day time	See <b>ASC Note 2</b>
3 →	Moderate voltage (13.2 - 14.0 volts*)	Turns OFF (too soon)	Day time	See <b>ASC Note 3</b>
4 →	High voltage (14.4 - 15.0 volts*)	ON		See <b>ASC Note 4</b>
5 →	High voltage (14.4 - 15.0 volts*)	OFF		See <b>ASC Note 5</b>
6 →		ON - at night		See <b>ASC Note 6</b>
7 →		Light going on and off rapidly		See <b>ASC Note 7</b>
8 →			ASC buzzing	See <b>ASC Note 8</b>
9 →			ASC hot	See <b>ASC Note 9</b>

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

<u>CASE</u>	<u>BATTERY VOLTAGE</u> <u>(at battery terminals)</u> <u>(12v)</u>	<u>CHARGE</u> <u>LIGHT</u>	<u>LVD LIGHT</u> <u>"ACTIVATED"</u> <u>(for Option-E)</u>	<u>OTHER</u>	<u>ASC NOTES</u> <u>(next page)</u>
10 →	Very low voltage (11.5 volts* or lower)		OFF	Loads stay on	See <b>ASC Note 10</b>
11 →	Low to Moderate voltage (11.5 - 14.3 volts*)		ON	Loads off	See <b>ASC Note 11</b>
12 →	Low voltage (11.5 - 13.2 volts*)		OFF	Loads off	See <b>ASC Note 12</b>

\* Voltages above are for 12 volt systems. For 6 volt systems, use half the listed voltage. For 24 volt systems, multiply by 2. For 36 volts, multiply by 3. For 48 volts, multiply by 4.



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

**ASC 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 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 is defective. See **CONTROLLER DEFECTIVE** (Help Note #12)

**ASC Note 3** - A moderate voltage condition where the charging appears to stop too soon (below 14.0 volts\*) would indicate one of the following:

- The ASC has a bad battery connection. Somewhere in the battery connection there is a voltage drop that causes 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 charging set-points. On hot days the voltage set-point can be ½volt\* lower. See **TEMPERATURE** (Help Note #4)
- The ASC is defective. See **CONTROLLER DEFECTIVE** (Help Note #12)

**ASC 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 has not shut off yet. 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 charging set-points. On cold days the voltage set-point can be ½volt\* higher. See **TEMPERATURE** (Help Note #4)
- The ASC is defective. See **CONTROLLER DEFECTIVE** (Help Note #12)

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**ASC 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 Note 6** - The "CHARGING" light can be on (bright to dim) at night if the panels are under even very low levels of light (moonlight or street lights). The "CHARGING" light on brightly at night could also 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 is 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 Note 7** - The "CHARGING" light going on and off rapidly may indicate one of the following:

- A 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. See **OPERATION** Section
- A bad battery (one that is unable to maintain a charge). See **BATTERY PROBLEM** Section
- 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 a normal condition or indicate the battery bank is bad or too small.

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

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

**ASC Note 10** - A low-voltage condition where the loads are on indicates one of the following:

- The battery voltage has not yet dipped down below the Load Disconnect set-point (about 11.5 volts\*)
- The ASC has a bad battery connection. A poor connection could cause a voltage drop and result in the controller sensing a higher battery voltage than what actually exists. See **BAD CONNECTION: BATTERY** (Help Note #9)
- A very low battery. The load-disconnect circuit stops working at about 8.0 volts\*.

**ASC Note 11** - A condition where the loads are off when the battery voltage is above the Load Disconnect set-point would indicate one of the following:

- On initial installation, the ASC may start out with the relay energized (load disconnected). Refer to *Installation step # 13*.
- The battery voltage needs 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 battery connection exists that results in a voltage drop when the load is on, and disappears when load is off. This is generally a wiring problem which exists when the ASC's COM to battery(+) connection is bypassed by a jumper from the ASC's BATT(+) to COM terminals. If so, remove the jumper and run a separate wire from the COM position to the battery(+) terminal. See **CONTROLLER MISWIRED** (Help Note #10)

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

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

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

**Panel Note 1** - The solar panels should generate a charge current close to their max power current as listed in their specifications. To reach this level assumes that all conditions are ideal. If the panel performance is much lower, consider the following potential problems.

- **Solar Panel Problem** - Panels may be dirty, not aligned or other problem. 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.**
- **Temperature** - A hot panel will see a reduced charging current. See **TEMPERATURE:** (Help Note #4)

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

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

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

- **System not sized correctly** - 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. Look for small hidden loads that may be draining the battery. (See *Help Note #5*).
- **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. If the battery is cold much of the time, the battery's long-term performance and life may suffer. See **TEMPERATURE** (*Help Note #4*).
- **Solar Panels Problem** - Panel may be dirty, not aligned or other problem. An panel problem would **not** drain the battery of power. (See *Help Note #6*).
- **ASC Controller Problem** - A problem may exist with the charging input from the controller. This would stop the daily re-charging of the battery. A defective ASC would **not** drain the battery of power. See the **ASC PROBLEM** section.

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

- **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.)

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## ASC - BENCH TEST PROCEDURE

Determine if an ASC is operational. A power supply and an accurate multi-meter is required

### **STEP 1: Preparation**

- 1) **Power supply requirements:** current limited, variable voltage power supply.
- 2) Set current limit to ½ amp (500 ma) and set voltage to 20.0 volts\*.

### **STEP 2: Test FET's (power transistors)**

- 1) With all ASC connections removed, make these connections:  
Power supply(+) to ASC's "ARRAY(+)"  
Power supply(-) to ASC's "ARRAY(-)"
- 2) Measure voltage at BATT(+) and BATT(-) terminals on the ASC. The reading should be about 14.3 volts\*. This is approximately the charge termination set-point (within 1-2%).  
*(Units with Option-A (Temperature Compensation) and Option-F (Adjustable Set-points) may vary beyond this range. See Table 1 in Options section on how ambient temperature affects the set-points)*  
A very high reading (16-20 volts\*) would indicate an open FET, or very low reading (2-5 volts\*) would indicate a shorted FET. Open or shorted units are defective.

### **STEP 3: Test Blocking Diode**

- 1) With all ASC connections removed, make these connections:  
Power supply(+) to ASC's "ARRAY(+)"  
Power supply(-) to ASC's "BATT(+)"
- 2) Measure voltage as follows:  
Meter (+) to ASC's "ARRAY(+)"  
Meter (-) to ASC's "BATT(+)"  
The reading should be .3 to .6 volts. A very high reading (16-20 volts\*) would indicate an open diode, a very low reading (0 to .2 volts) would indicate a shorted diode. Open or shorted units are defective.

### **STEP 4: Test/Inspect Temperature Compensation Cable (units with Option-A only)-**

- 1) Inspect the cable and sensor tube for cuts or damage. If the sensor cable is cut and the sensor itself is OK, the 2 wires within the cable can be reconnected and soldered. There is no polarity with the 2 wires.
- 2) With all ASC connections removed, make these connections:  
Power supply(+) to ASC's "ARRAY(+)"  
Power supply(-) to ASC's "ARRAY(-)"
- 3) Measure voltage on the ASC at BATT(+) and BATT(-). The reading should be about 14.3 volts\*.
- 4) Expose the temperature sensor to a substantially higher or lower temperature for 30 seconds (Example: attach the sensor to the side of a cup of hot coffee or ice water). With colder temperatures, the voltage will rise (about ½ volt\* per 16°C (30° F)). Hotter temperatures will lower the voltage. Changes with temperature can be subtle. A unit that does not change with temperature could have a defective sensor.

### **STEP 5: Test Load Function (LVD) (units with option E only)**

- 1) With all ASC connections removed, make these connections:  
Power supply(+) to ASC's "BATT(+)"  
Power supply(-) to ASC's "BATT(-)"
- 2) Set Power Supply to 16.0 volts\*.
- 3) Set meter to read resistance. Connect to ASC's "COM" and "N/C". It should read zero ohms.
- 4) Slowly lower Power Supply to LVD set-point voltage (11.5 volts\*). At the set-point, the "ACTIVATED" light should come on. The meter should read infinite resistance.
- 5) Slowly raise Power Supply to Reconnect set-point voltage. (13.0 volts\*). At the set-point, "ACTIVATED" light should turn off. The meter should read zero resistance.

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

You can determine if an ASC is operational. An active solar panel is required. An accurate digital volt-meter is recommended although a simple analog volt-meter may also be sufficient.

## **STEP 1: Preparation** –

- 1) Put a solar panel in full sun. Remove any connections. Measure the open circuit voltage (voc) of the panel (meter(+) to panel(+); meter(-) to panel(-) ). It needs to be 17 volts\* or higher to perform the following tests.
- 2) Remove any connections from the ASC.

## **STEP 2: Test FET's (power transistors)** – *A unit with an shorted FET will not charge a battery. One with an open FET may overcharge the battery.*

- 1) With all ASC connections removed, connect the panel(+) to the ASC's "ARRAY(+)" ; panel(-) to the ASC's "ARRAY (-)" (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\*. (Units with Option-A (Temperature Compensation) and Option-F (Adjustable Set-points) may vary beyond this range).  
A very high reading (16-20 volts\*) would indicate an open FET, or very low reading (2-5 volts\*) would indicate a shorted FET. Units with open or short FET's are defective

## **STEP 3: Test Blocking Diode** – *A unit with a shorted diode may blow any in-line fuses and damage the power FET (see above). A unit with an open diode will not charge the battery.*

- 1) With all ASC connections removed, connect the panel(+) to the ASC's "ARRAY(+)" ; panel(-) to the ASC's "BATT(+)" (no battery connection).
- 2) Measure voltage at ASC. Meter(+) to ASC's ARRAY(+), meter(-) to ASC's BATT(+) terminals. The reading should be .3 to .6 volts. A very high reading (16-20 volts\*) would indicate an open diode, a very low reading (0 to .2 volts) would indicate a shorted diode. Units with open or shorted diodes are defective.

## **STEP 4: Test/Inspect Temperature Compensation Cable (units with Option-A only)- An ASC with a cut or damaged cable will not charge the battery.**

- 1) Inspect the cable and sensor tube for cuts or damage.
- 2) If the sensor cable is cut and the sensor itself is OK, the two wires within the cable can be reconnected and soldered. There is no polarity with the two wires. Protect this connection with electrical tape.

### ***If an accurate digital volt meter is available...***

- 3) With all ASC connections removed, connect the panel(+) to the ASC's "ARRAY(+)" ; panel(-) to the ASC's "ARRAY(-)" (no battery connection).
- 4) Measure voltage at BATT(+) and BATT(-) terminals on the ASC. The reading should be about 14.0 to 15.0 volts\*.
- 5) Expose the temperature sensor to a substantially higher or lower temperature for 30 seconds (Example: attach the sensor to the side of a cup of hot coffee or ice water). With colder temperatures, the voltage will rise (about ½volt\* per 16°C (30° F)). Hotter temperatures will lower the voltage. Changes with temperature can be subtle. A unit that does not see a change with temperature could have a defective sensor.

\* Voltages above are for 12-volt systems. For 6-volt systems, use half the listed voltage. For 24-volt systems, multiply by 2. For 36 volts, multiply by 3. For 48 volts, multiply by 4.

**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 of 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

=====

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.