

DCT SERIES
CASE SIZE 1
FILTERED BATTERY CHARGER
12V/12-50A
24V/6-50A
32V/6-35A
48V/6-35A
120V/6-12A
240V/6A

OPERATION & MAINTENANCE
MANUAL

| | |
|--------------------|-----------|
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IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important safety and operating instructions for Stored Energy Systems (SENS) model DCT.

Before using the battery charger, read all instructions and cautionary markings on the battery charger, battery and equipment connected to the battery system.

WARNING:

Please read these safety warnings and heed them. Failure to do so could result in either severe personal injury or equipment damage.

This equipment uses and generates potentially lethal voltages. The equipment should only be installed and maintained by trained persons. Do not attempt to install or operate this equipment unless you are certain you are adequately trained.

To reduce the risk of injury, charge only properly sized lead-acid or nickel cadmium batteries. Other types of batteries or under-sized batteries may burst causing personal injury and damage.

“**GROUNDING INSTRUCTIONS** – This battery charger should be connected to a grounded, metal permanent wiring system; or an equipment – grounding conductor should be run with circuit conductors and connected to equipment – grounding terminal or lead on battery charger. Connections to battery charger should comply with all local codes and ordinances”.

- Do not install or operate charger if it has been dropped or otherwise damaged. Return it to the factory for repair.
- Install the charger in accordance with all local codes.
- Do not expose charger to rain or snow.
- Do not disassemble charger; return to factory when service or repair is required. Incorrect assembly may result in a risk of electric shock or fire.
- To reduce risk of electric shock, de-energize and disconnect the AC input and the battery from the charger before attempting maintenance or cleaning.
- Use of an accessory not recommended or sold by SENS may result in a risk of fire, electric shock or personal injury.
- During normal operation, batteries may produce explosive hydrogen gas. *Never smoke, use an open flame, or create sparks near the battery or charger.*
- Remove jewelry, watches, rings, etc. before installing battery or charger.

Maintenance Instructions

User maintenance is limited to charger adjustment. All on-site servicing should be performed by qualified service personnel. If qualified personnel are not available, return the charger to the factory for repair, or contact the factory to arrange for field service.

When returning a unit to the factory for repair, ship it in the original factory packaging if possible. If the original carton is not available, pack in a carton with at least 2 inches of approved packaging material on all sides of the charger to help prevent shipping damage.

This manual covers installation, operation and troubleshooting of SENS model DCT filtered battery charger in case size 1.

1 Overview

1.1 READ THIS FIRST

Please follow the installation and use instructions. They are vital to the satisfactory operation of the charger. If you have any doubts about adjusting, maintaining or servicing the equipment, contact SENS service department.

Changing factory-set potentiometers *voids the warranty*. Contact the factory if you believe that the settings on your charger are incorrect. Before determining that the charger is not working correctly, check the following:

1. Is AC power available to the charger?
2. Are any circuit breakers tripped or fuses blown?
3. Is the charger connected to a battery of the correct voltage?
4. Was the charger damaged in transit or installation?
5. If you determine that the charger is not working because it is not putting out any current, check the battery's state of charge. If the battery is fully charged it is perfectly normal for the charger to indicate zero current flow.
6. The charger may have shut down due to excessive output voltage. To ensure that the high volt shutdown has been reset, turn off both the AC input breaker and DC output breaker for five minutes. This is more than sufficient time for the DC voltage to decay and reset the shutdown.
7. If the battery is being over- or undercharged, check whether the output voltage settings have been tampered with. The pots should be covered with either white adhesive paper dots or a hard colored varnish.

1.2 Description and Application

The DCT is a fully automatic battery charger and DC current source offering the following features:

- Constant voltage output
- Electronic current limiting
- Filtered output. Output ripple on battery rated in AH four times amp rating of charger for 12, 24, 48 volt units is 30 mV rms. 120 volt units: 150 mV rms; 240 volt units: 300 mV rms
- Temperature compensation to maximize battery performance and life
- Optional remote temperature compensation
- Circuit breakers for AC input and DC output

The chargers are designed to power equipment requiring a low ripple DC source and to simultaneously recharge and maintain lead-acid or nickel-cadmium batteries.

1.3 Upon Delivery

Inspect the charger for damage caused during transit, and report damage to the carrier immediately. Then contact SENS to determine how best to repair/replace the damaged unit.

2 Installation

2.1 Mechanical Installation

The charger can be mounted either on a wall or in a standard 19" relay rack. Locate the charger in a dry place as close to the battery and load as possible to minimize voltage drop.

WARNING: These chargers are *not* approved for operation in areas with explosive atmospheres!

Wall Mounting

Mount the system to a robust wall using 1/4" bolts with flat washers behind the mounting holes if necessary to level the charger on an uneven wall. The charger should be located as close to the battery and load as possible to reduce voltage drop in the charging leads. Refer to the mechanical drawings at the end of this document for case dimensions and mounting dimensions.

Relay Rack Mounting

The charger is shipped on its back with the mounting flanges in the wall-mount position. Place the charger in a vertical position, then unbolt and reverse the mounting flanges.

Protect the charger from construction grit, metal chips, paint or other debris. Clean away debris after installation and before turning on the charger.

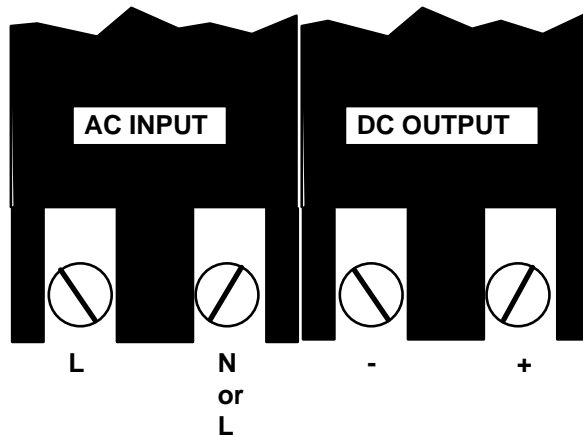
2.2 Electrical - Power Wiring

WARNING: Heat sinks and many other metallic components inside the charger are LIVE with either line or output voltage. These voltages can be lethal. Do not touch any exposed metal surfaces inside the enclosure while the charger is operating.

Remove the two 1/4-turn fasteners securing the charger's top front panel and open the front panel. Make AC and DC connections direct to the AC and DC circuit breakers in accordance with either diagram 2.2a or 2.2b below.

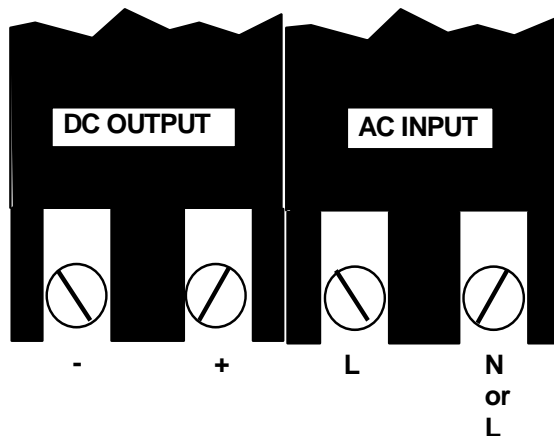
Caution: Small sense leads are connected to the output side of the DC breaker. These must remain connected to the output side of the breaker after installation of the DC cabling, or the charger will not function properly.

FIGURE 2.2a
Power Connections - 240 Volts AC Input or Lower



240 VAC OR LESS
MAKE INPUT & OUTPUT
CONNECTIONS DIRECT
TO CIRCUIT BREAKERS
AS SHOWN.

FIGURE 2.2b
Power Connections - 277, 380, 415 or 480 VAC



277, 380, 415 OR 480 VAC
MAKE INPUT & OUTPUT
CONNECTIONS DIRECT
TO CIRCUIT BREAKERS
AS SHOWN.

Connection should be made by a qualified installer in accordance with national and local electrical codes. The installer should determine the gauge of wire to be used based on the length of cable runs and the ampere requirements of the charger.

Refer to Table 2.2 for ratings of the charger's AC breaker. Chargers supplied with field-selectable input voltage are identified with an "A" as the first digit of the part number suffix. In these units

the AC breaker is sized for 115-volt operation. When the field setting is made for 115-volt operation, size the AC feed to provide a maximum of 20% less than the breaker ratings listed in Table 2.2. (The charger’s maximum power consumption is about 25% below the breaker rating). When set for 230-volt operation the current consumption will be 1/2 of the 115-volt figure.

Chargers with 480-volt input require half the current of 230 VAC units.

Use the charger’s rated DC amperes to determine DC cable gauge.

WARNING: The battery charger should be connected to a grounded permanent wiring system. A ground stud or terminal is provided for this purpose

TABLE 2.2
AC Input Circuit Breaker Ratings

| Charger output | | | | | | Breaker 115 V | Breaker 230 V |
|----------------|----|----|----|-----|----|------------------|------------------|
| V | A | V | A | V | A | amps | amps |
| 24 | 6 | | | | | 10 | same |
| 24 | 12 | 48 | 6 | | | 10 | same |
| 24 | 25 | 48 | 12 | | | 15 | same |
| 24 | 35 | | | | | 20 | same |
| 24 | 50 | 48 | 25 | | | 30 | same |
| | | 48 | 35 | | | 40 | same |
| | | 48 | 50 | | | 50 | same |
| | | | | 120 | 6 | 20 | same |
| | | | | 120 | 12 | 30 | same |

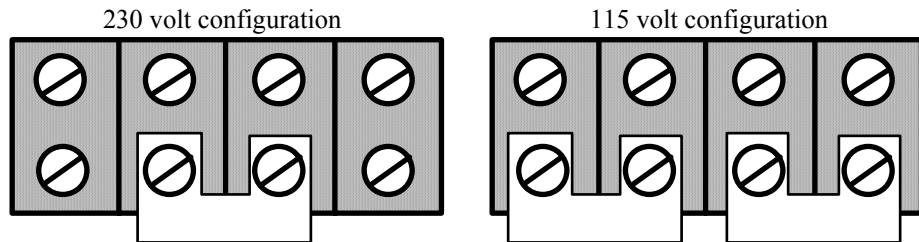
Caution: Do NOT connect the battery backwards; charger damage may result

The voltmeter will show battery voltage as soon as the DC connection is completed. Check the voltmeter as soon as the DC connection has been made. If the meter reads zero or is deflecting below zero, reverse the polarity of the battery connections.

2.3 115/230 Volt Strapping

Chargers equipped with field-selectable dual-voltage input are factory-set at 230 volts. If your input supply is 115 volts, change the voltage selection terminal block to the configuration shown below. The input voltage selection block is located inside the charger front door.

Figure 2.3
Input 115/230 Volt Strapping Configurations



230V Configuration:

If 115VAC is applied in this configuration the charger output voltage may sag, even though the “AC ON” and “Float” LEDs are on. “Low DC” and “Charge Fail” LEDs may be dimly lit. Please strap accordingly for the proper input voltage.

115V Configuration:

If 230VAC is applied the charger will enter into a High Voltage Shutdown (HVSD) condition, turning off the control board and the charger. No output voltage or current will be present. Please strap accordingly for the proper voltage.

2.4 Alarm Connections

DCT chargers are supplied with one of three following alarms configurations:

**TABLE 2.4
Charger Part Number Suffix and Alarms Configuration**

Charger part number suffix

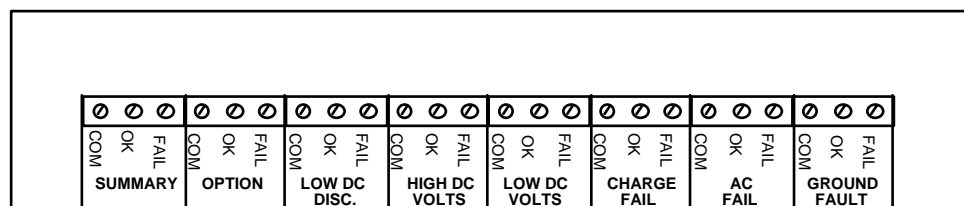
| | | |
|--|--|---|
| -A043, -3043 -4043, -4043 -7043, -8043 | -A643, -3643, -4643, -6643, -7643, -8643 | |
| Alarms “0” | Alarms “6” | Charger alarm system code Indication |
| none | Float or boost mode | LED |
| None | AC fail | LED & Form C contact |
| None | Charger fail | LED & Form C contact |
| None | Low battery voltage | LED & Form C contact |
| None | High battery voltage | LED & Form C contact |
| None | Ground fault + | LED |
| None | Ground fault - | LED |
| None | Ground fault + or - | Form C contact |
| none | Summary of above | Form C contact |

Connect to the charger’s Form C contacts according to Figure 2.4.

1. Make connections to the system's Form C alarm contacts as shown.
2. Run alarm wiring out of the charger separately from the AC supply wiring
3. Use 16 to 22-gauge wire.
4. NOTE: Do not exceed the relay maximum current rating of 1A @ 117 VAC or 2A @ 26 VDC.

The remote alarm connection board is located on the circuit breaker pan, adjacent to the control board. See Figure 2.4

**FIGURE 2.4
Remote Contact Terminal Block**



2.5 Temperature Compensation

DCT chargers include battery temperature compensation (TC). TC is required by all batteries for maximum performance and life. The TC feature automatically reduces the charger's output voltage at high temperatures and vice-versa.

The factory configuration is for charger local sensing of battery temperature (i.e. at the cooling air intake of the charger). The charger also includes as standard the provision for extension of a temperature sensor to a remote location. At installations where the battery is located in a different room, or is otherwise subject to ambient temperatures different from the charger it is necessary to sense temperature at the battery. If this is the case, then the optional SENS remote sensor should be obtained from the factory. When the optional remote sensor is attached correctly to the charger control board the charger automatically selects the remote sensor over the local sensor. If the remote sensor becomes damaged or disconnected temperature sensing automatically reverts to local.

The two leads of the optional RTS are connected to a port on the control board as follows: Connect the yellow lead of the sensor to J7 "YEL" and the violet lead to J7 "VIO". If the sensor is connected properly "RTS OFF" will not illuminate when the charger is in operation. If "RTS OFF" stays lit, check that RTS leads are not reversed, and check that the remote sensor is not damaged. Any excess length of the RTS leads should be cut off rather than coiled, to ensure the shortest possible length. The RTS leads should be routed separately and away from all other AC power, DC power and alarm wires and cable to prevent noise coupling that may cause abnormal operation of the charger.

NOTE: "RTS OFF" on the control board will remain lit whenever the remote temperature sensor is either not used, or if the remote sensor is disabled. This is normal when RTS is not used.

3 Operation

3.1 Start-up, Shut-down

Start with both input and output breakers OFF.

First, check that the connected battery voltage is correct (e.g. 120 volts for a 120 volt charger). It is OK if the battery voltage is different from the nominal value by a few percent. If the battery voltage is more than 10% different from the rated voltage of the charger, recheck your connections BEFORE turning on either breaker.

Close the AC input breaker. Check that the charger voltage comes up to approximately 15% above nominal. (Some voltage overshoot on initial startup is normal).

Next close the DC output breaker. The charger will immediately begin to supply current if required by the battery or load.

In chargers with alarms code "6", the front panel AC FAIL and CHARGE FAIL lights will extinguish, and should be replaced by the green AC ON light.

The charger will automatically supply power to the load and maintain the battery without further attention. If the charger does not start as described, or appears to have failed, check the following:

- Verify that AC mains power is available
- Verify that no external circuit breakers are tripped
- Verify that contractor-installed AC, DC and alarm connections are correct
- **Disconnect AC and DC power sources.** Open the charger. Verify that no components (e.g. main DC output fuse, if fitted) or harness connections are blown, loose or damaged

If all of the above appear to be in order, contact SENS at the toll-free service number on the front of this document for assistance in troubleshooting.

At power down or disconnection of charger from battery. The DC output breaker must not be operated from the closed to open position when AC power is present. Always open AC breaker before opening the DC output breaker.

3.2 FLOAT/BOOST MODES

Two modes of voltage control are provided in all DCT chargers as follows:

FLOAT

The float mode is the battery “maintenance” voltage. It is the normally fully charged voltage of the battery. This is the normal charging position for all batteries, and the recommended charging position at all times for Valve Regulated Lead Acid (VRLA) batteries.

BOOST

This voltage is slightly higher than the float setting. Boost slightly overcharges the battery in order to ensure that all the cells of a battery are fully charged to the same voltage. Continued operation in boost is *not* recommended because the high charging voltage will cause battery electrolyte to boil away quickly. This is a particular problem with VRLA batteries where there is no way to replenish lost electrolyte.

3.3 FLOAT/BOOST CONTROL

DCT chargers are equipped with one of the four following float/boost voltage control systems depending on the configuration ordered:

FLOAT/BOOST front panel rotary switch

The charger will operate indefinitely in the mode that is selected. The AUTO position may be shown on the front panel. If the AUTO position is locked out, the AUTOBOOST feature is not supplied.

AUTO/FLOAT/BOOST front panel rotary switch

When the selector switch is in the FLOAT or BOOST mode the charger will operate indefinitely in the mode that is selected.

The AUTO mode selects automatic equalization of the battery. The charger determines when the battery is in need of fast charging, and operates in the fast charge boost mode only until the battery is fully charged. The charger determines state of charge by measuring the amount of current drawn from the output terminals. When the selector switch is in the AUTO position the charger will start in the boost mode and stay there until current demanded drops below about 50% of the charger’s rated current. When current demand increases to about 70% of the charger’s rated output the charger will resume operation in the boost mode.

Please see the Appendix for a diagram of how the Autoboot system works. The AUTO setting eliminates the need to periodically equalize the cells of a battery as the charger does this automatically. *The AUTO position should not be selected when the continuous load on the charger is greater than about 50% of the charger’s maximum rated current.*

Manually initiated boost timer (either 0-24 hours or 0-72 hours)

When the timer is turned clockwise the charger will be in boost mode, where it will remain until the timer returns to 0 hours. At the end of the selected time the charger will return to float mode.

Manually initiated boost timer plus AUTO/FLOAT/BOOST rotary switch

Selection of the AUTO position allows the charger to operate in the AUTOBOOST mode (described above)

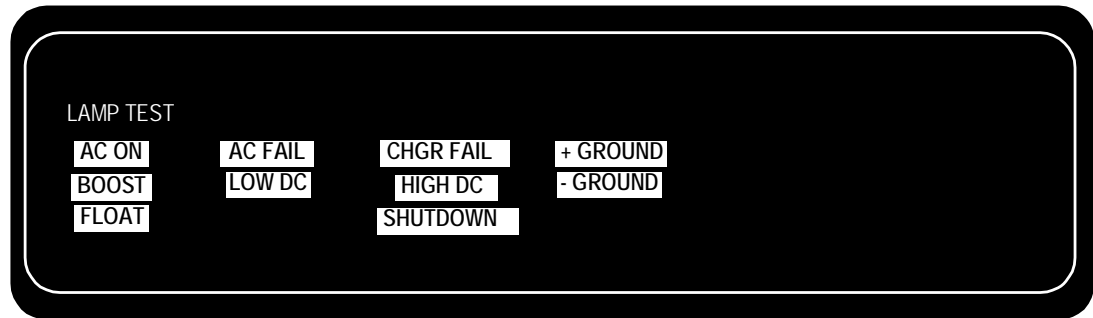
Selection of the FLOAT mode forces the charger to remain in the float mode *unless* the boost timer is activated by turning past zero. If the boost timer is activated, the charger will revert to float mode after the time selected on the timer expires.

Selection of the BOOST mode forces the charger into boost charge, where it will remain until BOOST is deselected manually.

3.4 Alarm Indications

NOTE: Chargers are equipped with a “dead-front” panel. Alarm LEDs are behind the dead front panel and will be visible when they illuminate due to an alarm condition, or when the TEST button is pressed. See Figure 3.4 for the location of LED indicators. Chargers with no alarms (alarms code “0”) have no LEDs or test button.

FIGURE 3.4
LED Indicators on Charger Front Panel



AC ON

Indicates that AC power is being supplied to the charger.

BOOST

The charger is operating in the BOOST mode.

FLOAT

The charger is operating in the FLOAT mode.

AC FAIL

Indicates that AC power is not available to the charger. Input AC is failed, or AC breaker is tripped.

CHGR FAIL

Indicates that the charger is failing to produce the output current required by the battery and load. When the battery and load demand no current the failure alarm will not activate.

In the event that the CHARGE FAIL and AC ON lights are illuminated simultaneously, then the charger has failed. The probable causes of an alarm, in descending order of likelihood are:

- a) A failure of AC power
- b) A tripped AC breaker
- c) The charger has malfunctioned

LOW DC

Indicates that DC voltage has dropped to approximately 8.5% below nominal battery voltage (e.g. 21 volts for a 24-volt system). Probable causes:

- a) The AC power has failed, and the battery has become discharged
- b) The charger has malfunctioned and the battery has become discharged
- c) The battery is defective

There is a time delay in the low voltage alarm which prevents the alarm from activating until approximately 30 seconds after the low voltage condition starts.

HIGH DC

Indicates that the charger's output has exceeded a pre-set threshold level (approximately 20% above nominal battery voltage - e.g. 29 volts for a 24-volt system). If this alarm stays activated for any period of time, the charger should be shut down and serviced. The charger may have malfunctioned, or the alarm card may be misadjusted. The alarm activates immediately upon high voltage condition, but stays activated for approximately 30 seconds after the condition disappears.

HIGH DC SHTDN

Indicates that the charger has been shut down by the high output voltage shutdown circuit. Probable causes of a high DC shutdown are as follows:

- a) The float or boost voltages have been increased above the pre-set shutdown voltage
- b) The high voltage shutdown set point has been changed from the factory setting
- c) The charger has malfunctioned, and is not regulating properly

There is a delay of approximately 5 seconds after the onset of the high voltage condition until the unit shuts down. When a high volt shutdown occurs, the red HVS LED on the control board will illuminate, along with the SHUTDOWN LED on the front panel.

If the high DC shutdown activates the charger will stay off until the battery voltage drops to approximately nominal, at which point the circuit will reset and the charger will start. Manual reset of the shutdown is accomplished as follows:

- 1) Turn off the AC input breaker. (Note that while the SHUTDOWN LED will extinguish, the charger is still locked out. This is because the shutdown LED is driven by the control board's power supply, which is derived from the AC supply, rather than from battery).
- 2) Turn off the DC output breaker.
- 3) Wait for about one minute for capacitor voltage to decay through the capacitor bleeder resistor
- 4) Turn on the DC output breaker
- 5) Turn on the AC input breaker. If the charger is still in high DC shutdown, repeat steps 1 through 3, waiting longer before turning DC and AC breakers back on.

The control board includes two sets of Form C contacts for high volt shutdown indication. Either one of these can be used for remote indication of high voltage shutdown.

GROUND

This is a ground fault alarm. If either the charger's positive or negative is connected to ground, even through a high resistance path, this alarm will activate. LEDs indicate either positive or negative grounding. The Form C contact only indicates that a fault has occurred.

Some applications require that ground be referenced to either the positive or negative output. In this case, the activated ground fault alarm will be a nuisance. The alarm can be safely disabled by placing the ground fault jumper located on the alarm board (mounted on the charger's front door) in the "disabled" position. When pins 1 and 2 of J5 are connected together the ground fault alarm is disabled; when pins 2 and 3 are connected the ground fault alarm is enabled.

4

Adjustments

4.1 Output Voltage Adjustment

WARNING: Working inside the charger exposes you to dangerous AC and DC voltages. Exercise extreme caution to not touch circuit breakers, filter capacitors, heat sinks or any other exposed metal surfaces

NOTE: Do not tamper with factory adjustments unless you are absolutely sure adjustment is necessary. SENS control circuits are equipped with temperature-compensation circuitry designed to optimize battery performance and life. This circuitry changes the unit's output voltage continuously depending on the ambient temperature. Conditions under which you should make adjustments are as follows:

- a) To correct a previous unauthorized adjustment
- b) To adjust the charger for a different type of battery (e.g. from lead-acid to nickel-cadmium)
- c) If your battery is consistently being over-charged or under-charged

NOTE: Unless authorized by SENS, any charger adjustment, including output voltage adjustment, voids the warranty.

Procedure

1. Use a precision external voltmeter connected directly to the charger output terminals.
2. Set the charger's front panel FLOAT/BOOST control to FLOAT.
3. Open the charger's front panel and locate the control card. It contains two potentiometers labeled "FLOAT" (R14) and "BOOST" (R15), both located near the center of the board.
4. Adjust the FLOAT pot until the desired voltage is achieved.

Adjustment of the BOOST voltage is similar to adjustment of FLOAT, except that you adjust the BOOST pot instead of the FLOAT pot. Be sure that the charger front panel mode switch is in BOOST when you make adjustments.

Please note that the BOOST adjustment controls the level above FLOAT voltage, not the absolute voltage. Therefore, whenever the FLOAT the voltage is changed, the BOOST voltage also changes.

4.2 Factory-Set Output and Alarm Voltages

The factory settings are indicated on the test data sheet that is supplied with each charger. The type of battery for which the charger was factory-set is also shown on the test data sheet.

NOTE: Output voltages are temperature compensated (vary with temperature). The factory settings below are at 20 degrees C. The compensation is -0.18% per degree C. The alarm voltage settings are NOT temperature compensated.

Chargers set for sealed maintenance-free lead-acid battery

| | 12 volt | 24 volt | 32 volt | 48 volt | 120 volt | 240 volt |
|------------------|---------|---------|---------|---------|----------|----------|
| Float voltage | 13.62 | 27.24 | 36.32 | 54.48 | 136.20 | 272.40 |
| Boost voltage | 13.80 | 27.60 | 36.80 | 55.20 | 138.00 | 276.00 |
| Low DC alarm | 11.00 | 22.00 | 29.33 | 44.00 | 110.00 | 220.00 |
| High DC alarm | 14.61 | 29.22 | 38.96 | 58.44 | 146.10 | 292.21 |
| High DC shutdown | 15.19 | 30.39 | 40.52 | 60.78 | 151.95 | 303.89 |

Chargers set for flooded lead-acid battery

| | 12 volt | 24 volt | 32 volt | 48 volt | 120 volt | 240 volt |
|------------------|---------|---------|---------|---------|----------|----------|
| Float voltage | 13.32 | 26.64 | 35.52 | 53.28 | 133.20 | 266.40 |
| Boost voltage | 14.00 | 28.00 | 37.28 | 55.92 | 139.80 | 279.60 |
| Low DC alarm | 11.00 | 22.00 | 29.33 | 44.00 | 110.00 | 220.00 |
| High DC alarm | 14.82 | 29.64 | 39.47 | 59.20 | 148.01 | 296.02 |
| High DC shutdown | 15.41 | 30.83 | 41.05 | 61.57 | 153.93 | 307.86 |

Chargers set for nickel cadmium battery. Multiply volts per cell times # of cells for actual voltage

| | Per Cell |
|-----------------|----------|
| Float voltage | 1.43 |
| Boost voltage | 1.52 |
| Low DC alarm | 1.19 |
| High DC alarm | 1.61 |
| High DC shtdown | 1.67 |

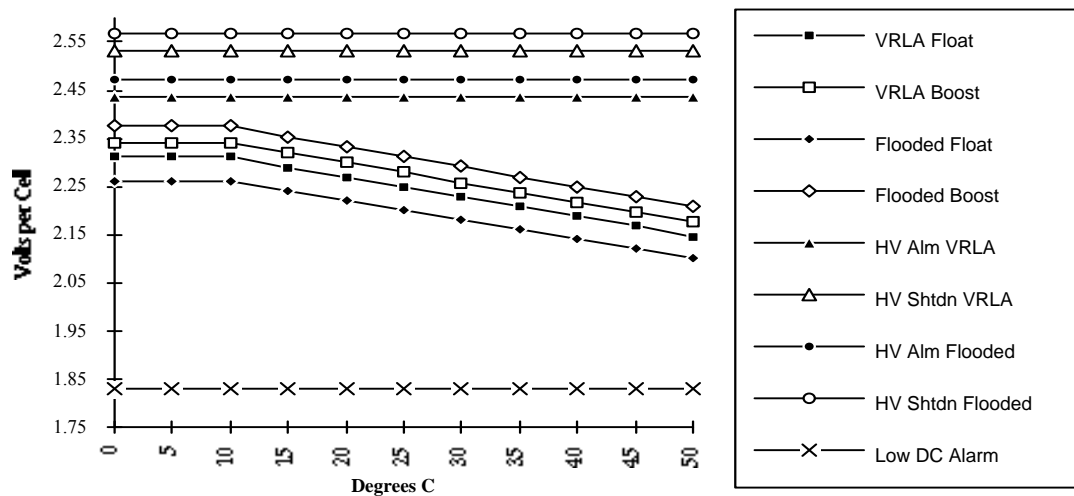
Chart 4.2 shows the relationship between charger output voltage, alarms and high voltage shutdown. Note that the output voltage is temperature compensated down to ten degrees C, below which the compensation ends.

To determine the charger's voltage at temperatures other than 20 deg. C., multiply the number of degrees Celsius difference between your ambient and twenty degrees times .0018. Multiply that product times the factory voltage setting (e.g. 27.24) and add it to the factory setting.

Example 1: Float voltage at 10 degrees C of a 24 volt charger set for 27.24 volts at 20 degrees C:
 $20-10 (.0018) (27.24) + 27.24 = 27.73$ volts

Example 2: Float voltage at 50 degrees C of a 24 volt charger set for 27.24 volts at 20 degrees C:
 $20-50 (.0018) (27.24) + 27.24 = 25.77$ volts

CHART 4.2
Graph of Factory-Set Output, Alarm and Shutdown Voltages



4.3 Forced Load Sharing

Chargers can be set up for forced load sharing when used in parallel with units of the same current rating. Forced load sharing causes the chargers to share the load from light loading to full load except when either charger is in BOOST mode (whether activated manually or via the AUTOBOOST system) or if either charger is operating in current limit. Chargers will share the load within ± 10% of each other.

To set up, ensure that the DC output leads from each charger are identical in length and wire gauge. Install a Load Share Cable (supplied by SENS or assembled by user) between terminals on both control boards where labeled "PAR".

To assemble a Load Share Cable:

1. Cut desired length of signal wire (18 or 22 AWG).

2. Connect a 10K Ω , 2 Watts or more, resistor inline with signal wire. Connect resistor to wire using a Butt Connector or twist wires together and cover with Heat - shrink.

5 Trouble-shooting

5.1 Troubleshooting Table

If there is a problem and you suspect the charger is at fault, turn off the AC mains supply before proceeding. Ensure that the following are correct: AC input wiring, battery and/or load connections and PC card connectors. Ensure no foreign objects are in charger.

| Symptom | Possible Cause | Test | Corrective Action |
|---|--|--|--|
| No output / Fail alarm | Control board failure | Replace with known good board | Replace board |
| | DC fuse blown | Check fuse for continuity | Replace if open |
| | High DC Shutdown | Check HVS LED on control board | If lit, see "High Output Voltage" symptom below |
| | Power rectifier circuit failure | Test all power diodes with meter; test SCRs | Replace all shorted, open, or bad parts |
| | AC failure | Check input supply | Restore AC input supply |
| | Shutdown due to excessive output voltage | Check whether HVS LED on control board is lit | Shut off AC and DC breakers for at least 2 minutes, then restore |
| AC breaker trips repeatedly | Power diode, SCR, or freewheeling diode short | Check all power devices for shorts | Replace shorted device(s) |
| DC fuse blows or DC breaker trips repeatedly | Control board failure | Replace with known good board | Replace board, send bad board to SENS for repair |
| | Freewheeling diode short | Check diode for short | Replace diode |
| Low output volts/alarm | Control board failure | Replace with known good board | Replace board |
| | Misadjusted float voltage | Adjust pot to see if output voltage is affected | Adjust float pot to correct output voltage |
| | Overloaded charger | Turn off DC breaker, check voltage on INSIDE breaker terminals | Check load for problems, and check battery condition |
| | Bad filter capacitor | Disconnect capacitors one at a time and check for change in output voltage | Replace capacitor that corrected output voltage when removed |
| | Line voltage less than charger's operating range | Measure AC line voltage | Use larger gauge AC wires or contact utility company |
| High output volts / High DC alarm | Control board failure | Replace with known good board | Replace board |
| | Misadjusted Float Voltage pot on control board | Adjust pot and see if output voltage is affected | Adjust float pot to correct output voltage |
| High ripple voltage | Control board failure | Replace with known good board | Replace board |
| | Power diode / SCR failure | Test power diodes; perform SCR test on SCRs | Replace all open or bad parts |
| | AC line voltage too high | Check AC line voltage | Contact utility company |

| | | | |
|--|--|--|--|
| | Bad filter capacitor | Disconnect capacitors one at a time and check for change in output voltage | Replace capacitor that corrected output voltage when removed |
| Improperly functioning indicators | Alarm, display, or control board failure | Replace each board in turn with a known good board | Replace failed board(s) |

5.2 Component Diagnostic Tests

Test #1: With transformer leads disconnected, energize the transformer with the normal AC supply voltage. Measure entire secondary voltage. It should be 1.5 to 2 times the nominal battery voltage.

Test #2: With one or both leads disconnected from the inductor, measure the resistance across the inductor terminals. If the resistance is near a short circuit condition, the inductor is OK.

Test #3: Using a digital multimeter set to the diode testing function, measure the junction voltage across the diode. A reading of between 0.4 volt and 0.8 volt in the forward polarity direction and infinity in the reverse polarity direction indicates a good diode.

Test #4: Refer to Figure 5.2. Disconnect all the leads to the SCR and its heat sink. Connect a voltmeter across the 1KΩ resistor to measure the voltage drop. With the battery connected as shown, V_{drop} should read approximately 2.3V (V_{source}-0.7V). Remove the voltage source to the gate, but keep it connected to the 1KΩ resistor and cathode. V_{drop} should equal zero. Reconnect the gate and reverse the battery polarity. V_{drop} should read zero volts. Readings other than these indicate a defective SCR.

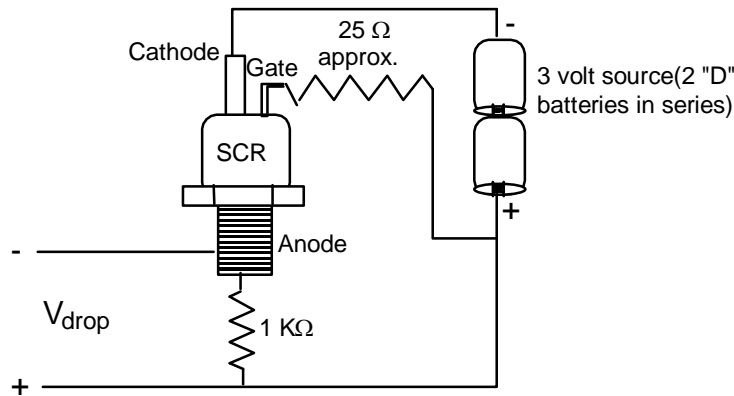
Test #5: Due to the modest cost of the control circuit, we recommend that the entire unit be replaced rather than attempting to repair it. If the trouble-shooting guide has not revealed any defective components (tests #1-4), the control circuit should be replaced as a unit.

Test #6: Remove all wires from the current shunt. Place a milliohmmeter across the two terminals. The following formula should be used to determine the correct resistance:

Resistance in ohms should equal 0.5/Output current rating of the charger, except in 35 amp units when resistance should equal 0.1 ohms.

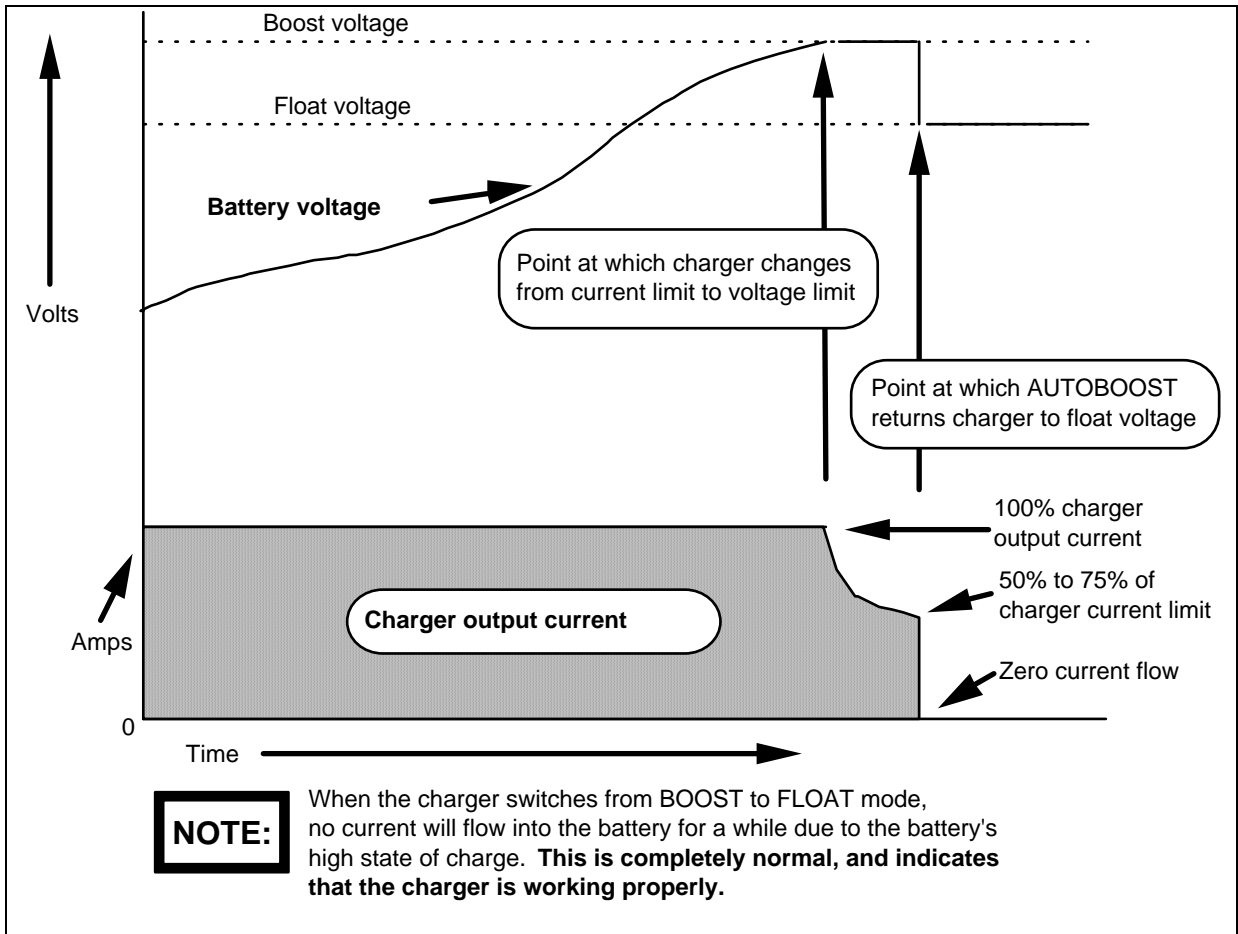
If the resistance is more than 20% too low, the current shunt should be replaced.


**FIGURE 5.2
SCR test setup**

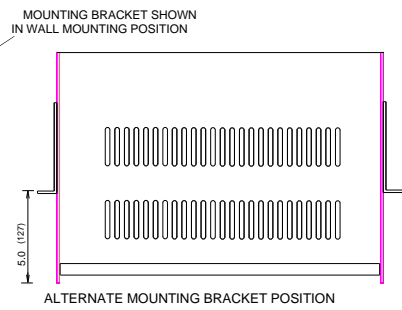
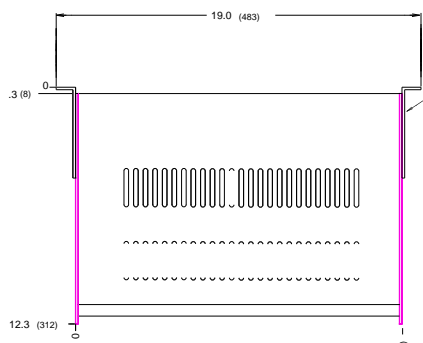


Appendix

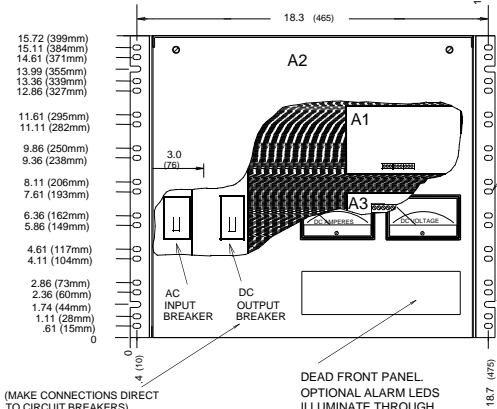
Diagram of Automatic Boost Operation



| | | | |
|---|--|---|-----------------------|
|  SENS STORED ENERGY SYSTEMS Longmont, CO | | description DC1 CONNECTION AND MOUNTING DIAGRAM | |
| prepared checked engineer date size scale | KAA WFK 3-20-95 DIA100330 none | drawing no. DIA100330 | rev B |
| sheet 1 of 1 | | | |
| revisions | | | |
| dcn# 101144 102585 | rtr A B | description ADD BREAKER NOTE REMOVE KNOCKOUTS | date 4-95 11-98 |
| | | | app WFK AM |

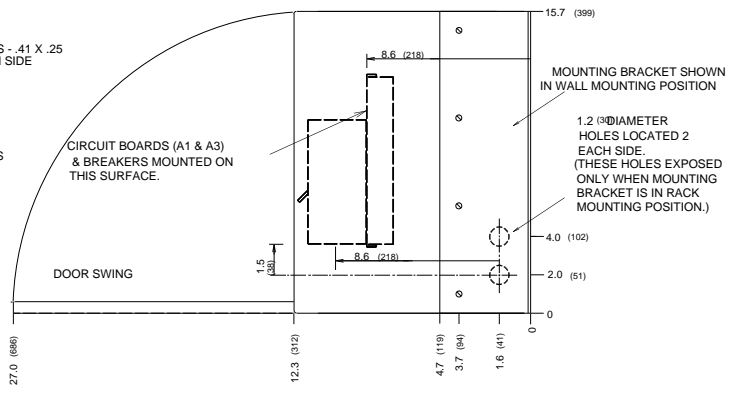


NOTE: ALL SYSTEMS SHIPPED WITH MOUNTING BRACKETS IN WALL MOUNTING POSITION.



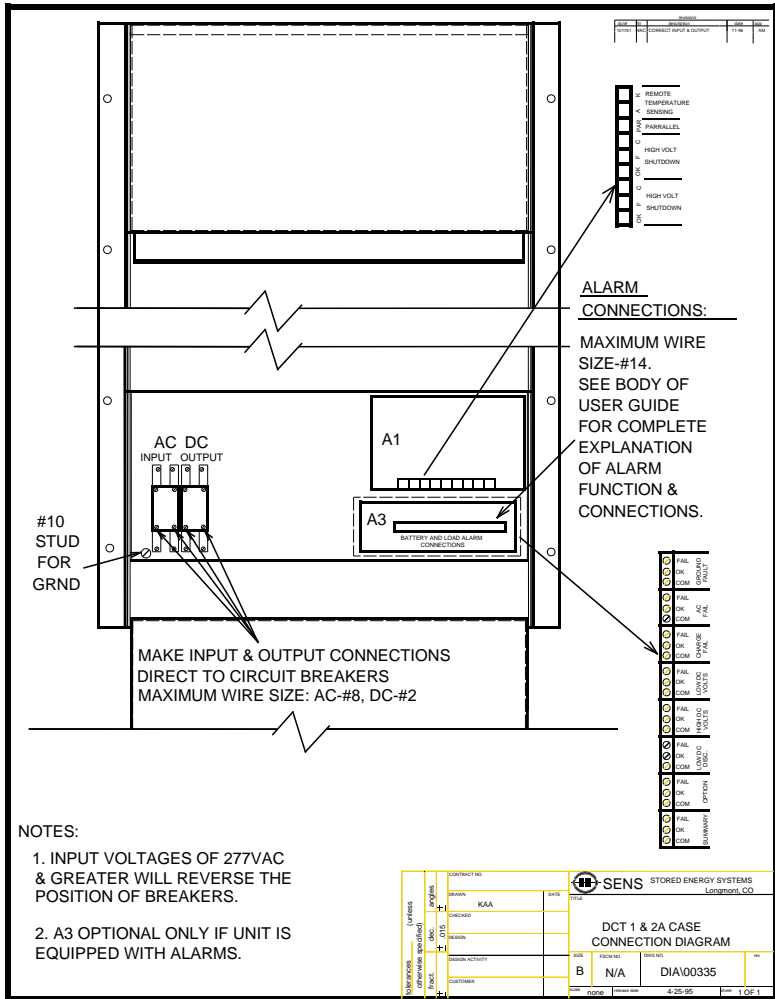
(MAKE CONNECTIONS DIRECT TO CIRCUIT BREAKERS)
 NOTE: 277VAC INPUT & GREATER WILL REVERSE THE POSITION OF BREAKERS.

DEAD FRONT PANEL. OPTIONAL ALARM LEDS ILLUMINATE THROUGH THIS PANEL.



CIRCUIT BOARDS (A1 & A3) & BREAKERS MOUNTED ON THIS SURFACE.

MOUNTING BRACKET SHOWN IN WALL MOUNTING POSITION
 1.2 (30.5) DIAMETER HOLES LOCATED 2 EACH SIDE. (THESE HOLES EXPOSED ONLY WHEN MOUNTING BRACKET IS IN RACK MOUNTING POSITION.)



| | |
|--|---------------------------------------|
| STORED ENERGY SYSTEMS Longmont, CO | |
| DCT 1 & 2A CASE CONNECTION DIAGRAM | |
| CONTRACT NO. KAA PROJECT NO. DRAWING NO. DATE | REV. B DATE N/A DRAWN DIA/00335 |
| 4-25-95 1 OF 1 | |