

SuperTorque™ 8Z

Genset Starting System

Super High-Performance Battery + Integrated Charger System



Installation & Operation Manual

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This product is covered by one or more patents:
www.sens-usa.com/patents

Installation or service questions?

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1 IMPORTANT SAFETY INSTRUCTIONS FOR INSTALLER AND OPERATOR

- 1.1. **SAVE THESE INSTRUCTIONS** – This manual contains important safety and operating instructions for SuperTorque 8Z genset starting systems.
Conserver ces instructions. Ce manuel contient des instructions importantes concernant la sécurité et le fonctionnement.
- 1.2. Use of an attachment not recommended or sold by the manufacturer may result in a risk of fire, electric shock, or injury to persons.
- 1.3. **This genset starting system is intended for commercial and industrial use. ONLY TRAINED AND QUALIFIED PERSONNEL MAY INSTALL AND SERVICE THIS UNIT.**
- 1.4. Do not operate genset starting system if it has received a sharp blow, been dropped, been inverted, or otherwise damaged in any way; shut off power at the branch circuit protectors and have the unit serviced or replaced by qualified personnel.
- 1.5. To reduce risk of electric shock, disconnect the branch circuit feeding the genset starting system before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.
- 1.6. **WARNING – RISK OF FIRE, EXPLOSION OR BURNS**
 - 1.6.1. **WORKING IN THE VICINITY OF A NICKEL-ZINC BATTERY IS DANGEROUS. BATTERY INCLUDES ALKALINE ELECTROLYTES. STORAGE BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL BATTERY OPERATION. FOR THIS REASON, IT IS OF UTMOST IMPORTANCE THAT YOU READ THIS MANUAL AND FOLLOW THE INSTRUCTIONS EACH TIME YOU USE THE GENSET STARTING SYSTEM.**
 - 1.6.2. Do not disassemble battery, heat above 75°C, incinerate, puncture or impact.
Mise en garde : Risque d'incendie, d'explosion ou de brûlures. Ne pas démonter, chauffer à plus de 75°C (ou °F) ou incinérer.
 - 1.6.3. To reduce the risk of battery explosion, follow these instructions and those published by the battery manufacturer and the manufacturer of any equipment you intend to use in the vicinity of a battery. Review cautionary markings on these products and on the engine.
Pour réduire le risque d'explosion, lire ces instructions et celles qui figurent sur la batterie.
 - 1.6.4. Ensure battery spill control procedures exist in accordance with building, fire and installation codes.
- 1.7. **PERSONAL PRECAUTIONS**
 - 1.7.1. Someone should be within range of your voice or close enough to come to your aid when you work near a storage battery.
 - 1.7.2. Have plenty of fresh water and soap nearby in case battery electrolyte contacts skin, clothing, or eyes.
 - 1.7.3. Wear complete eye protection and clothing protection. Avoid touching eyes while working near a storage battery.
 - 1.7.4. If battery electrolyte contacts skin or clothing, wash immediately with soap and water. If electrolyte enters eye, immediately flood the eye with running cold water for at least 10 minutes and get medical attention immediately.
 - 1.7.5. **NEVER** smoke or allow a spark or flame in vicinity of battery or engine.
Ne jamais fumer près de la batterie ou du moteur et éviter toute étincelle ou flamme nue à proximité de ces derniers.
 - 1.7.6. Be extra cautious to reduce risk of dropping a metal tool onto the battery. It might spark or short circuit the battery or another electrical part that may cause explosion. Using insulated tools reduces

this risk but will not eliminate it.

- 1.7.7. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a storage battery. A storage battery can produce a short circuit current high enough to weld a ring or the like to metal, causing a severe burn.
- 1.7.8. **NEVER** charge a frozen battery.
Ne jamais charger une batterie gelée.
- 1.7.9. The charging circuit contains a DC output fuse for internal fault protection, but this will not protect the DC wiring from fault currents available from the battery. Consult national and local ordinances to determine if additional battery fault protection is necessary in your installation.
- 1.7.10. Calculate arc flash for each module per NFPA 70e, annex D, method D.5, using bolted fault current (IBF) 5400A (80Ah) / 6200A (90Ah), 1/2 bolted fault current 2700A/3100A, protective device clearing time (max arcing time) 2s, max system voltage 30.4V, working distance 45.5cm and no protective device.

1.8. Preparing Battery For Charge

- 1.8.1. Storage - recharge every 6 months or when open circuit battery voltage drops below 13.5VDC (12V nominal systems) or 27.0VDC (24V nominal systems).
- 1.8.2. Ensure area around battery is well ventilated and in accordance with local fire and installation codes while battery is being charged.
- 1.8.3. Ensure battery terminals are clean and properly tightened. Be careful to keep corrosion from coming in contact with eyes.
- 1.8.4. Do not operate genset starting system with damaged cables. Defective cables must be replaced before operation.
- 1.8.5. Verify that all cables are properly secured and connected.

1.9. Installation

- 1.9.1. Charging temperature: 0°C to 45°C
- 1.9.2. Do not tip, keep genset starting system level.
- 1.9.3. Do not set anything on top of genset starting system.
- 1.9.4. Unit shall be installed in accordance with Article 480 or 706 of NFPA 70 or Section 64 of CSA C22.1.
- 1.9.5. Unit shall not be connected in series. Paralleled units are limited to two when using the AC outlet connection.

1.10. Service

- 1.10.1. Do not open genset starting system, not field serviceable.

2 MODEL NUMBER BREAKOUT

| | | | | | | | | | | | | | | |
|----------|---|----------|---|----------|---|----------|---|----------|---|----------|---|----------|---|----------|
| 8Z | - | 24 | - | B | - | 15 | - | B | - | 1 | - | 1 | - | 00 |
| A | - | B | - | C | - | D | - | E | - | F | - | G | - | H |

| | Parameter | Code | Value |
|----------|-----------------------------|------|---|
| A | Product Family | 8Z | SuperTorque 8Z |
| B | DC Output Voltage | 12 | 12 VDC |
| | | 24 | 24 VDC |
| C | Battery Capacity | B | 80 Ah |
| | | 9 | 90 Ah |
| D | Charging Current | 15 | 15 Amps |
| E | Interface and Communication | A | Base model; includes status LEDs, two Form C relays, SENSbus, USB-C |
| | | B | Base model + LCD + keypad control + J1939 + RS-485 Modbus |
| | | C | Base model + LCD + keypad control + RS-485 and TCP/IP Modbus |
| F | Mounting | 1 | Standard, not for rigid mounting |
| | | 2 | With rigid mounting brackets |
| G | Terminals | 1 | Threaded inserts for ring lug connection (M8) |
| | | 2 | SAE battery terminal posts |
| H | Configuration | 00 | Standard Configuration |

3 PERFORMANCE SPECIFICATIONS

SuperTorque™ 8Z is a genset starting system including a high-performance NiZn battery, charging system, controls, communications, and user-interface in one package, specially targeted for long-life and high reliability.

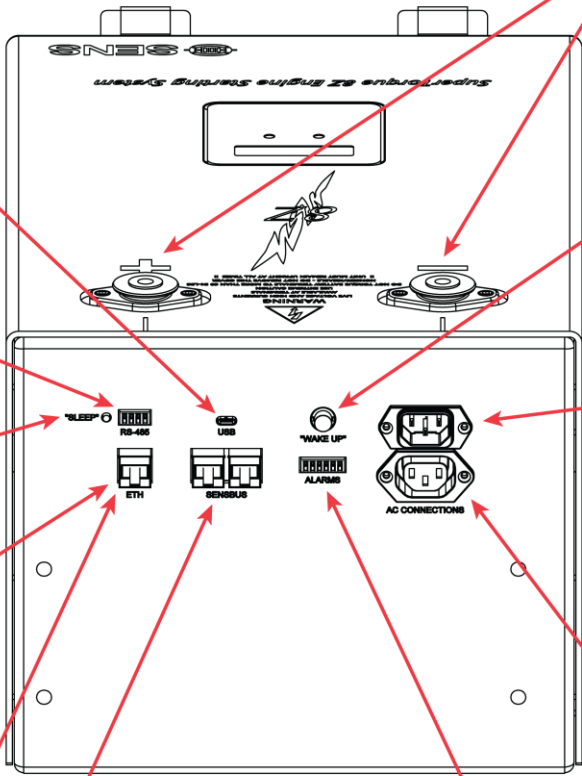
2 Standard Form C contact alarms are factory set and field reconfigurable, with indication via communication port, optional front panel LCD and assignable alarm relays. Keypad control and data communications including serial and Ethernet Modbus optional. Specifications are detailed in the table below, see following sections for installation and operation instructions.

| | | | |
|--|---|---|---------------|
| AC Input | VAC, Hz | 90-265 VAC single-phase, 47-63 Hz 24V: full charging current available above 170VAC input, 80% rated charging current 100-170VAC | |
| | Protection | Supplementary overcurrent protection fuse, transient protected to EN 61000-4-5 level 4 | |
| | Power factor & efficiency | PF >.95 typical; efficiency to 93%; meets CEC Title 20 Efficiency Regulations; standby AC draw < 3W | |
| DC Charging Output | Volts | 12V or 24V nominal with less than 30mV ripple | |
| | Recharge rate | 80-160Ah battery capacity, 15A charge current | |
| | Charging modes | NiZn-specific, multi-stage, non-adjustable | |
| | Current limit | Factory set at 100% of rating | |
| | Charging characteristic | Constant voltage, current limited; patented Dynamic Boost control | |
| | Line & load regulation | ±0.5% | |
| | Battery temp. compensation | Standard | |
| Engine Starting Performance | Typical cranking current | 2,700 amps at breakaway while maintaining battery terminal voltage above 12.0 volts (24V model). Rolling current is typically ~30% of breakaway (locked rotor) current. | |
| | Typical engine displacement per 8Z unit | 70 liter per one 24-volt 8Z battery system. Actual performance depends on number of starters and installation | |
| | Typical crank cycles | Depends on number of starters and their configuration. More than four cranks of 15 seconds typical. | |
| | Sequential discharges | Delayed recharge may occur after multiple sequential discharges. See recharge section for details. | |
| | Redundancy | Combine 8Z units in parallel for increased starting performance and redundancy. Integrates seamlessly with Best Battery Selectors for isolated redundancy. | |
| Status Display | LEDs | Two multi-color front panel status LEDs | |
| | Metering & status display | Optional, requires LCD. Battery voltage accurate to +1%; charger current to +1%; 20-character display of status & alarms. | |
| | Quiescent draw | Max quiescent draw with AC disconnected and unit not in "Sleep" mode: | |
| | | Model | 12/24V |
| Base model | | 164mA/82mA | |
| Base model + LCD + keypad + Modbus RS-485 | | 193mA/101mA | |
| Base model + LCD + keypad + Modbus RS-485 and TCP/IP | 237mA/123mA | | |

| | | |
|-------------------------------|--|--|
| Alarms | Alarms | Factory set, field reconfigurable. Alarm functions announced on the J-1939 and Modbus ports and on the optional LCD. Any one of 20+ alarms or any combination of alarms is assignable to either Form C contact. |
| | Alarms: Form C contacts | Two Form C contacts, each rated 30V, 2A resistive, assignable |
| Networking | J-1939 communications | Optional CAN 2.0 extended ID on RJ-45 port |
| | Modbus communications | Optional Modbus RS-485 or TCP/IP on RJ-45 port |
| | SENSbus | Proprietary bus for connection of paralleled units and SENS accessories |
| | USB | USB-C connectivity via SENS Setup Utility |
| Environmental | Operating temperature | -10°C to +55°C; charging 0°C to +45°C; storage -20°C to +60°C |
| | Humidity | 5% to 95%, non-condensing |
| | Altitude | Full specification 0 to 13,000 ft (0 to 4000 m) |
| | Ingress protection | NEMA2/IP22 |
| | Vibration & shock resistance | Vib: Swept Sine (EN60068-2-6): 4G, 18-500 Hz, 3 axes. Random: 20-500Hz, .01G2/Hz. Shock: EN 60068-2-27 (15G) |
| | Electrical transient | ANSI/IEEE C62.41 & EN 61000-4-12 on power terminals |
| Abuse Protection | Overvoltage shutdown | Selective; shutdown only operates if the overvoltage condition is caused by the internal charger itself |
| | Overtemperature protection | Gradual output power reduction if heatsink temperature becomes excessive; recovery is automatic. |
| Regulatory Compliance | North America | Internal batteries and charger are C-UL Listed/Recognized for US & Canada |
| | | NFPA-70 |
| | | FCC Part 15, Class B |
| | | Seismic: Rigid & non-isolated floor mount; max S_{DS} of 2.5G, z/h = 0, I_p = 1.5. IBC 2000-2021, Calif. BC 2007-2021 |
| | | American Bureau of Shipping: Type Approved |
| | European Union (CE), United Kingdom (UKCA) | EMC: 2014/30/EU, UK 2016 (EN 61000-6-2 & EN 61000-6-4) |
| | | LVD/Safety: 2014/35/EU, UK 2016 (EN 60335-1 & EN 60335-2-29) |
| | | RoHS: 2015/863, UK 2012 (EN 63000) |
| Battery Directive: 2006/66/EC | | |
| Construction | Housing/configuration | Rainproof aluminum enclosure with non-conductive top |
| | AC connections | AC Input Connection: IEC 320 C13 AC Outlet Connection: IEC 320 C14, 4A per unit AC Input Locking 8ft cord with NEMA 5-15R plug provided. Optional UL Listed field-terminable IEC 320 C13 connector for hard wiring. |
| | DC connections | Standard: M8 threaded inserts for positive and negative. Optional: SAE battery terminal posts. |
| | Alarms & comms connections | J-1939 and Modbus TCP/IP: RJ-45; Modbus RS-485 and Form C alarms: 28-16AWG terminal blocks |

4 SYSTEM OVERVIEW

4.1. Physical Overview



Connect **SENS SETUP UTILITY** using USB-C

Remove pluggable terminal block to connect **MODBUS RS-485** wires when optional display/comms PCA included (28-16AWG, tighten to 2lb-in, pin 1: +D1 (A), pin 2: -D0 (B), pin 3: COM, pin 4: Shield)
M/N: 8Z-XX-X-XX-B-X-X-XX
M/N: 8Z-XX-X-XX-C-X-X-XX

To prevent battery discharge when AC power is not connected, press "**SLEEP**" button to turn off display and communications

Connect **J1939** network cable to RJ-45 connector when optional display PCA included (pin 1: Data High, pin 2: Data Low pin 8: COM)
M/N: 8Z-XX-X-XX-B-X-X-XX

Connect **MODBUS TCP/IP** network cable to RJ-45 connector when optional comms PCA included
M/N: 8Z-XX-X-XX-C-X-X-XX

SENSBUS - connect load sharing units or remote accessories (**DO NOT** connect Ethernet, J1939, TCP/IP OR RS-485 here)

Remove pluggable terminal block to connect **ALARM RELAY** Form C contact wires (28-16AWG, tighten to 2lb-in, rated 30V AC/DC, 2A)
See unit label for factory alarm assignments, user configurable with SENS Setup Utility

Connect **DC 1/0AWG** minimum wires using ring lugs and M8 fasteners (13mm socket wrench, tighten to 60lb-in)

Optional - SAE battery terminal posts

CAUTION: voltage always present on battery terminals!

Press "**WAKE UP**" button to turn display and communications on when AC power is not connected

WARNING: this will cause battery discharge, connect ac power as soon as possible

Connect **AC INPUT** (100-240VAC, 50/60Hz) using 18-14AWG IEC 320 power cord ≤20A UL Listed Branch Circuit protection required, use UL recognized wire rated ≥90C

Optional - wire AC to screw terminal adapter provided with field termination kit (18-14AWG, tighten to 3.5lb-in)

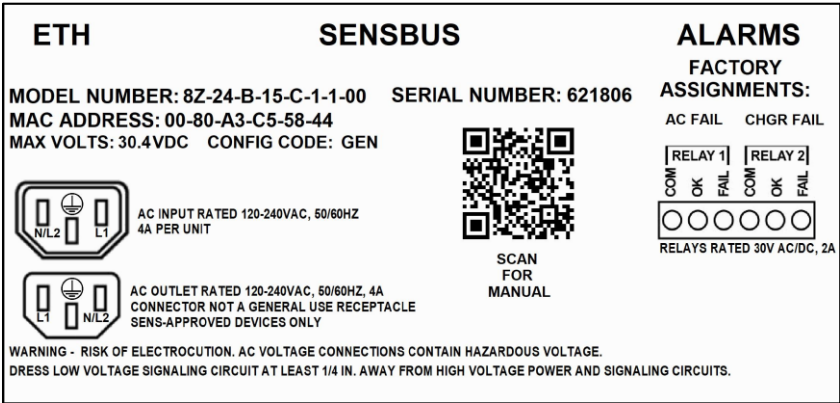
Connect **AC OUTLET** (4A per unit) to load sharing units or SENS-approved external devices

4.2. Functional Overview

4.2.1. Configuration

Each SuperTorque 8Z comes factory configured from the factory and requires no output adjustments. Configuration details are given on the configuration label. These values are assigned according to the profile configuration selected during the customer order. Adjustments to communications settings and other configurable settings can be made using the front panel keypad (optional) or the SENS Setup Utility software. Connect a computer with the SENS Setup Utility to the unit via USB-C.

Example Configuration Label



4.2.2. Standard Items

- 4.2.2.1. 2 Form C alarm relay contacts
- 4.2.2.2. USB-C
- 4.2.2.3. SENSbus communications

4.2.3. Factory Optional Items

- 4.2.3.1. Front panel LCD
- 4.2.3.2. Keypad control
- 4.2.3.3. Modbus (TCP/IP and RS-485) communications

5 MOUNTING INSTRUCTIONS

INSTALLATION OF THE UNIT MUST COMPLY WITH LOCAL ELECTRICAL CODES AND OTHER APPLICABLE INSTALLATION CODES AND BE MADE ACCORDING TO THE INSTALLATION INSTRUCTIONS AND ALL APPLICABLE SAFETY REGULATIONS.

Printed circuit boards contain static sensitive components. Damage can occur even when static levels are too low to produce a noticeable discharge shock. To avoid static discharge damage, handle the unit by the chassis only.

5.1. Mounting

See diagrams at back of manual for dimensions and mounting information.

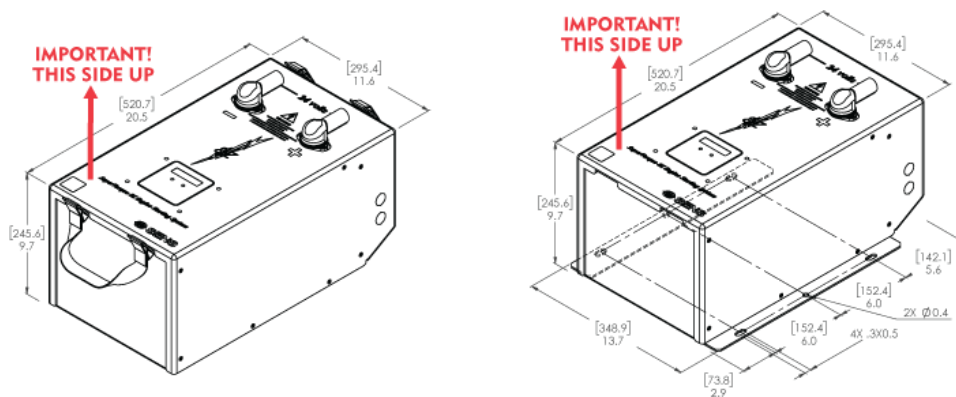
5.1.1. Unit rated IP44, NEMA 3R.

5.1.2. Operate unit at -10°C to +55°C (14°F to +131°F). Do not operate outside of 0°C to 50°C (32°F to 122°F) for more than 10% of operating life.

5.1.3. Mounting surface must safely support the weight of the unit and the fixed wiring. Unit weighs 89.0 lb (40.4 kg). Lift the unit using a lifting device or two or more people.

5.1.4. Place on battery shelf or in battery box. Optional rigid floor mounting brackets available; install using 3/8-inch fasteners (provided by installer).

5.1.5. Mount with battery terminals facing up. Do not permanently tip unit.



5.1.6. Allow sufficient room for routing the fixed wiring to the unit. AC, alarm and communications field connections may enter the unit side using 1/2-inch conduit knockouts. See diagrams at back of manual for further information.

6 SETUP AND WIRING

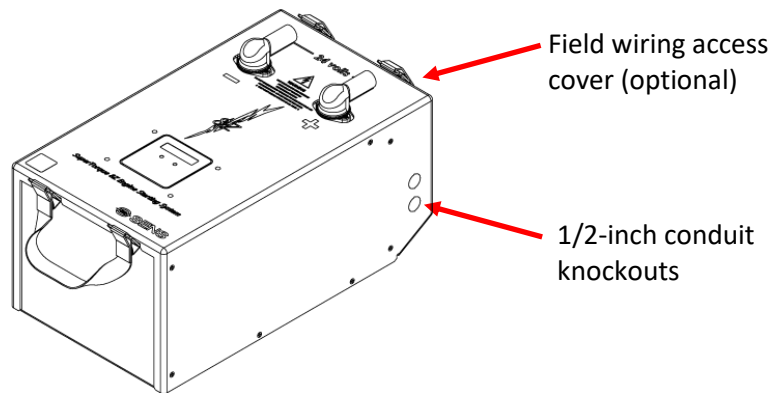
IMPORTANT! Charge for 8 hours minimum prior to placing into service. Do not leave AC disconnected. To avoid battery damage, do not drain battery below 11.2VDC (12V nominal systems) or 22.4VDC (24V nominal systems). Storage - recharge every 6 months or when open circuit battery voltage drops below 13.5VDC (12V nominal systems) or 27.0VDC (24V nominal systems).

The unit is configured at the factory and requires no adjustments before operating. Refer to the label on the field wiring end of the unit for alarm relay assignments. Communications settings are configured using the front panel keypad (optional) or the SENS Setup Utility.

6.1. Wire Ratings

All wiring must comply with applicable codes and local ordinances. All power conductors should be rated for use at 90°C or higher and 600V or higher. Alarm relay conductors and communications data cable should be rated for use at 75°C or higher. The field wiring area is accessed by removing the field wiring access cover (optional). Use conduit entry holes to route wires as needed.

CAUTION:
VOLTAGE ALWAYS PRESENT ON BATTERY TERMINALS!



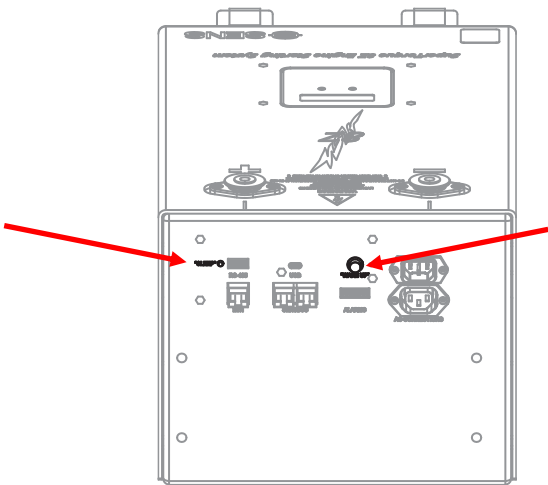
6.2. Grounding Instructions

Unit must be grounded via grounded AC input connection to reduce risk of electric shock. The unit must be connected to a grounded, metal, permanent wiring system, or an equipment-grounding conductor (earthing conductor) must be run with the circuit conductors.

6.3. Sleep and Wake Up Buttons

To prevent battery discharge when AC power is not connected, press “SLEEP” button to turn off display and communications (unit shipped from factory in SLEEP mode). Press “WAKE UP” button to turn display and communications on when AC power is not connected. The internal battery is always connected to the DC output terminals and will always be available to start an engine when the display and communications are powered off.

WARNING:
PRESSING “WAKE UP” BUTTON WITHOUT AC CONNECTED WILL CAUSE BATTERY DISCHARGE, CONNECT AC POWER AS SOON AS POSSIBLE!

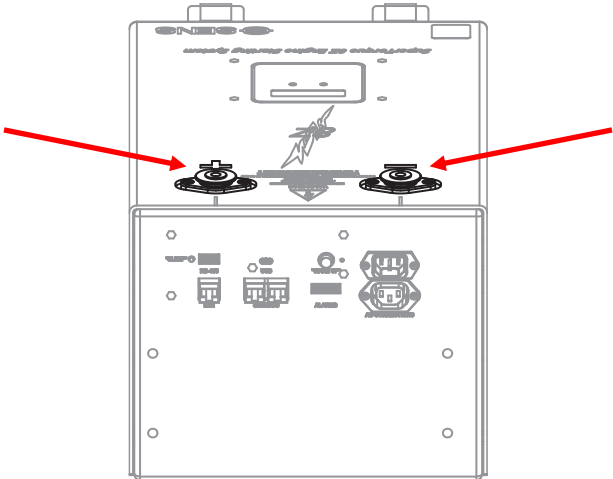


6.4. DC Connection

Connect 1/0AWG minimum DC output conductors to the DC output terminals on the unit using ring lugs and M8 fasteners. Always observe proper polarity of the DC output leads. Tighten connections to 60lb-in using a 13mm socket wrench. Do not rely on threads for electrical connection; ensure connection to terminal surface. Route DC wiring at least ¼ inch (6 mm) away from AC and alarm wiring. Optional – connect DC output conductors to SAE battery terminal posts on models including posts instead of standard terminals.

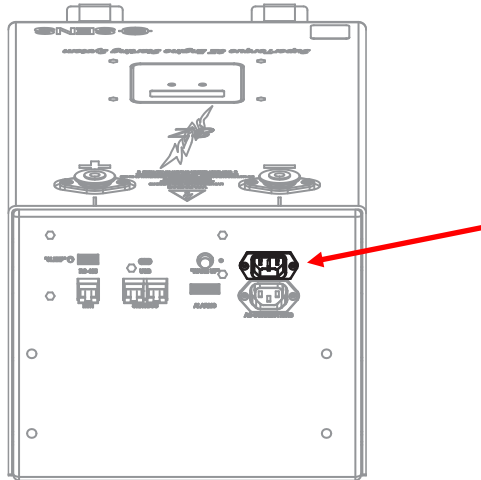
See engine manufacturer recommendation for DC output conductor gauge and length between the 8Z unit and the engine starter / DC bus.

WARNING:
BATTERY TERMINALS MUST BE COVERED
TO PROTECT AGAINST ELECTRICAL SHOCK!



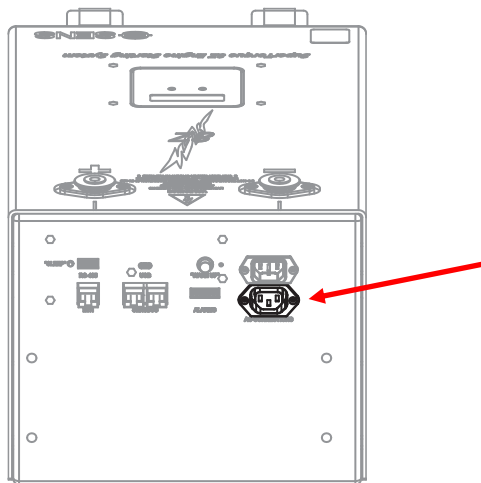
6.5. AC Connection

AC input voltage rated 100-240VAC, 50/60Hz. Connect 18-14AWG IEC 320 C13 locking power cord to the AC input connector on the unit. Use UL recognized wire rated $\geq 90^{\circ}\text{C}$. UL Listed Branch Circuit protection $\leq 20\text{A}$ required. Optional - wire AC input to locking screw terminal adapter provided with field termination kit (18-14AWG, tighten to 3.5lb-in). Route AC wiring at least $\frac{1}{4}$ inch (6 mm) away from DC and alarm wiring.



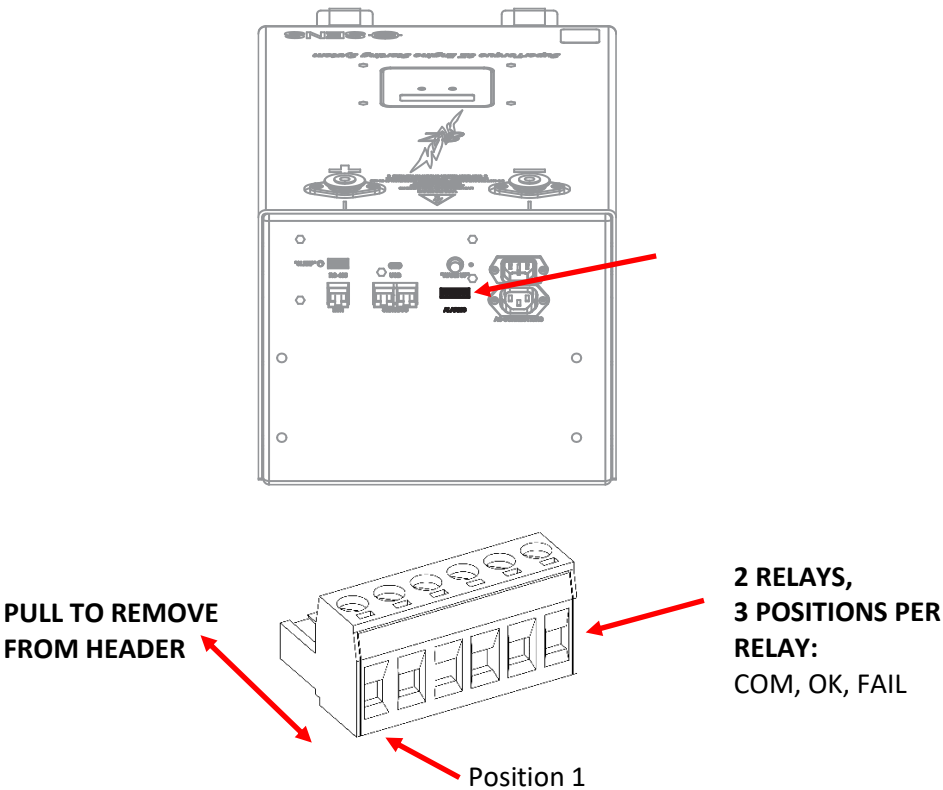
6.6. AC Outlet

The AC outlet IEC 320 C14 connection provides/passes-through the input voltage connected at the AC input connection. Rated 4A per unit. Use for load sharing units or connecting SENS-approved external devices.



6.7. Alarm Connections

See label on the field wiring end of the unit for original factory alarm relay assignments. Alarm relay assignments are custom configurable using the SENS Setup Utility. Alarm circuits are rated 2A at 30V AC or DC. Connect alarm wiring to the respective terminals on the pluggable terminal block on the unit. To make wiring easier, the terminal block unplugs from its header. Pull terminal block straight out from header to remove. Connect wires to terminal block by tightening screws at each position. After wires are connected, plug terminal block securely back into header. Wire from FAIL or OK to COM depending on whether the alarm should be present on an open or closed circuit. Connect alarm terminals only to low voltage, limited energy ("Class 2") circuits. The terminals accept 28-16 AWG (0.08-1.5 mm²) conductors. Tighten connections to 2.0 Lb-In (0.22 Nm) using a small slotted driver. Route alarm wiring at least $\frac{1}{4}$ inch (6 mm) away from DC and AC wiring.



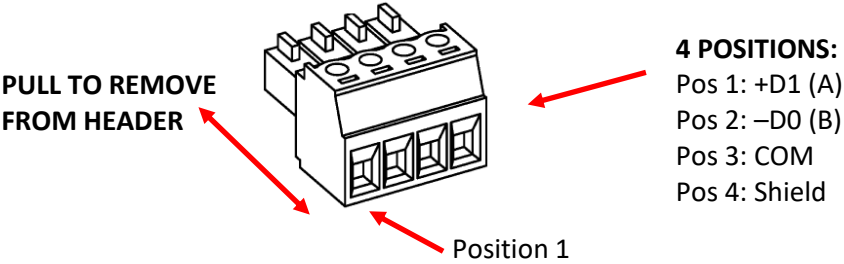
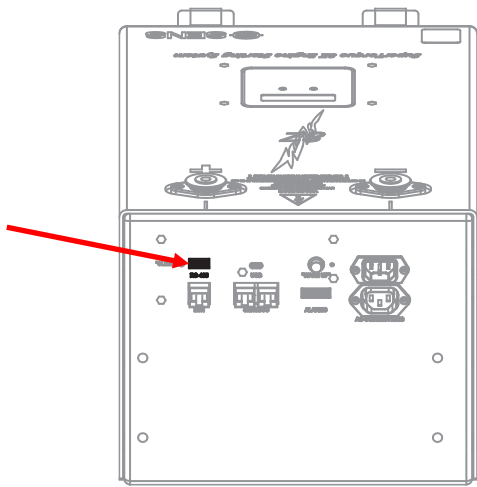
Alarm Relay Connections

Wire from COM to OK for alarm present on open circuit or from COM to FAIL for present on closed circuit.

| | RELAY 1 Non-latching Coil | RELAY 2 Non-latching Coil |
|---|-------------------------------------|-------------------------------------|
| Relay Contacts | AC Fail | Charger Fail |
| Common | COM (Pos 1) | COM (Pos 4) |
| Open on alarm | OK (Pos 2) | OK (Pos 5) |
| Close on alarm Defaults to FAIL with no AC and DC power (normally closed) | FAIL (Pos 3) | FAIL (Pos 6) |

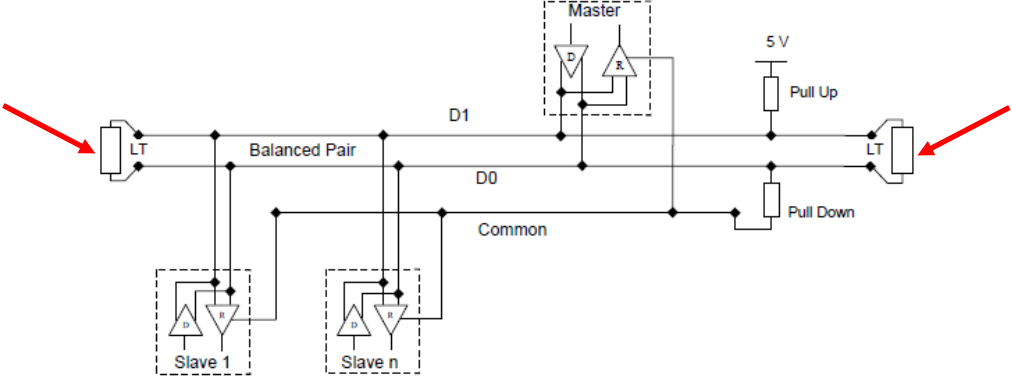
6.8. RS-485 Connection

Every unit includes RS-485 connections via a 4-pin pluggable terminal block. This interface is intended for monitoring and communicating with the unit using Modbus. Connect wiring to the respective terminals on the pluggable terminal block on the unit. To make wiring easier, the terminal block unplugs from its header. Pull terminal block straight out from header to remove. Connect wires to terminal block by tightening screws at each position. After wires are connected, plug terminal block securely back into header. Wire connector position 1 for Modbus +D1 (A), position 2 for Modbus -D0 (B), position 3 for COM and position 4 for Shield. The terminals accept 28-16 AWG (0.08-1.5 mm²) conductors. Tighten connections to 2.0 Lb-In (0.22 Nm) using a small slotted driver. Route alarm wiring at least ¼ inch (6 mm) away from DC wiring, AC wiring and low voltage wiring. See section 12 for further information on Modbus operation and registers.



6.8.1. Termination

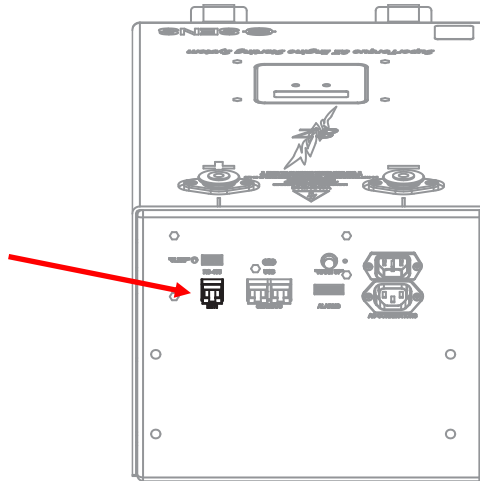
For proper operation, a 120-ohm terminator is required at the ends of the RS-485 bus. If multiple devices are on the bus, only the devices on the ends of the network bus need termination resistors. Termination may be provided as part of the network cabling or 120-ohm termination plugs for the RJ-45 communications connector on the unit are available to order separately (SENS p/n 803707). SENS units are server devices. Pull-up and pull-down resistors are optional per Modbus specifications. Below figure shows an example of how to terminate the network.



LT = Line Termination 120-ohm resistor

6.9. Ethernet or SAE J1939

The unit is equipped with an RJ45 port for Ethernet Modbus TCP/IP or J1939 communications, depending on model. See label below connector for indication of Ethernet or J1939 configuration.



6.9.1. Ethernet—Optional

Connect Cat5 or better ethernet cable. This provides a 10/100 ethernet connection. Ethernet communication includes ethernet connectivity to the unit for monitoring via Modbus TCP/IP.

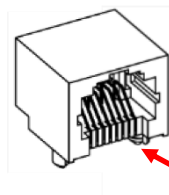
6.9.1.1. Configure TCP/IP Address

Configure TCP/IP settings using the SENS Setup Utility or the keypad (see section [9.6.3](#)). Set the IP address as desired. It may take up to 10 seconds for the network setting changes to apply. A TCP/IP address of 0.0.0.0 implies DHCP (Dynamic) addressing. Adjust the Gateway and Subnet Mask values as required. The displayed Hardware Address is the MAC address corresponding to the Ethernet interface. This value is not adjustable. See section [12](#) for further information on Modbus TCP/IP operation and registers.

6.9.2. SAE J1939 (CANbus)—Optional

The J1939 interface provides a highly reliable, low-cost method of delivering to the genset controller all information that NFPA 110 requires a charging system to deliver. To be operational, the genset controller must support the unit J1939 connection. See section [11](#) for further information on J1939 operation and registers.

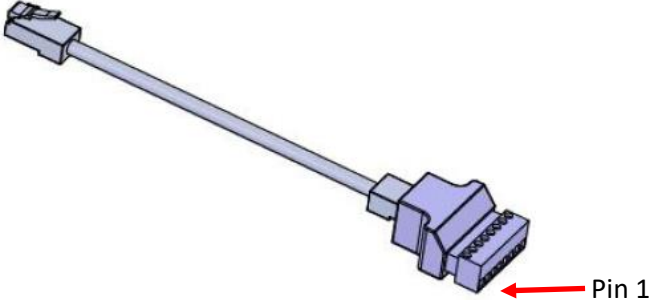
J1939 communications are disabled by default and until the BCH address is configured (see section 6.9.2.1). Connect J1939 communications using a twisted pair cable. Wire connector pin 1 for J1939 Data High, pin 2 for J1939 Data Low and pin 3 for Common. Communications are non-isolated and referenced to negative battery terminal. An adapter from RJ45 to an 8-position terminal block may be connected to the RJ45 connector and is available to order separately (SENS p/n 208026).



PINOUT:

Pin 1: J1939 Data High
 Pin 2: J1939 Data Low
 Pin 8: Common (referenced to battery negative)

RJ45 to Terminal Block Adapter — Ordered Separately

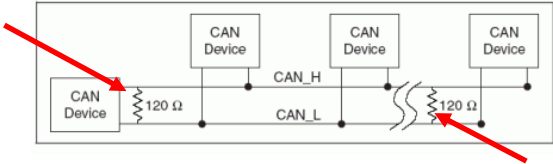


6.9.2.1. J1939 Address (BCH)

Configure the J1939 address using the SENS Setup Utility or optional front panel keypad (J9139 communications are disabled until this address is configured). J1939 supports two units per network cable. Set to address 1 for main unit or address 2 for auxiliary unit. The unit is set to address 1 by default.

6.9.2.2. Termination

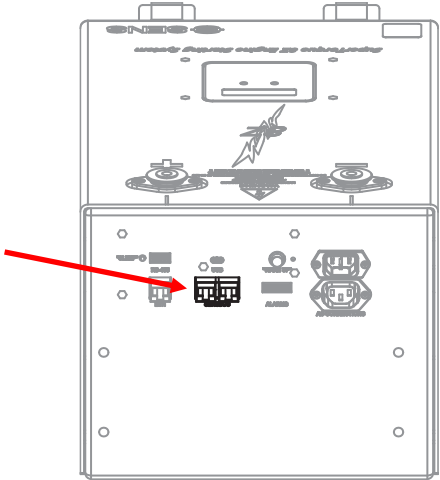
For proper J1939 operation, a 120-ohm terminator is required at the ends of the J1939 bus. If multiple devices are on the bus, only the devices on the ends of the network bus need termination resistors. The unit is not equipped with terminators. Termination may be provided as part of the network cabling or 120-ohm termination plugs for the RJ45 communications connector on the unit are available to order separately (SENS p/n 803707). Use a splitter as needed in the RJ45 port on the unit to connect both the network cable and terminator. Below figure shows an example of how to terminate the network.



6.10. SENSbus Connection

The unit is equipped with two SENSbus RJ45 ports. This connection is used to interconnect SENS specific devices.

WARNING:
DO NOT PLUG ETHERNET INTO THIS CONNECTION



6.10.1. Parallel/Load Share Connection—*Optional*

Multiple 8Z units may be connected in parallel to provide redundancy and increased capacity. Connect a network cable from one unit to another using the SENSbus RJ45 port on each unit to automatically initiate load sharing. For proper load share operation, a 120-ohm terminator is required at both ends of the SENSbus connection. Connect DC outputs from each unit in parallel to engine starter or DC bus. Connect AC input jumper from one unit to another using AC input and AC outlet connectors. Paralleling kits are available to order separately (SENS p/n 209665-20 for end-to-end mounting, p/n 209665-21 for side-by-side mounting).

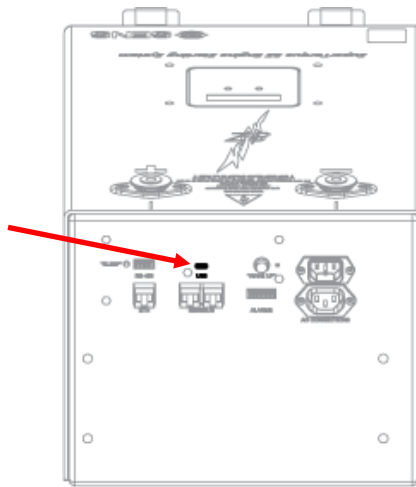
6.10.2. Remote Alarm/Communications Panel Accessory Connection—*Optional*

The optional remote alarm/communications panel accessory provides the ability to adjust and communicate with multiple units using one external device. The remote panel accessory may be configured with different alarm relay assignments than the alarm relays native to the unit.

Connect a straight-thru splitter to the RJ45 SENSbus port on the remote panel. Place a 120-ohm terminator in one of the positions on the remote panel splitter to ensure a terminator is located at both ends of the communications bus. Connect the remote panel to the 8Z unit using a network cable from the SENSbus RJ45 port on the unit to the remote panel splitter. Ensure a terminator remains in another SENSbus RJ45 port on the 8Z unit.

6.11. USB Connection

The unit is equipped with a USB-C connector for monitoring and configuration via the SENS Setup Utility.



6.12. Verify Connections

- 6.12.1. Verify that all connections are secure and in the proper locations. Tighten all unused screws on terminal blocks to secure them against vibration.
- 6.12.2. Ensure all wires are routed in a way that the field cover or other objects will not pinch or damage them.

7 START-UP PROCEDURE

7.1. Connect DC Output

Connect DC wires from 8Z unit to engine starter / DC bus (see section [6.4](#)). The unit is configured at the factory and requires no adjustments before operating.

7.2. Apply AC Power

Connect AC power to 8Z unit to start charging internal battery (see section [6.5](#)). Charge for 8 hours minimum prior to placing into service.

Depending on the battery state of charge, the unit may go into current limit upon initial AC connection. In this case, the output voltage will be reduced as the internal charger operates in constant current mode. As the battery is charged, the charging current demand will taper to a value below the current limit setpoint and the internal charger will revert to constant voltage output. Operation will continue in boost mode for a variable time ranging from a few minutes to several hours depending on state of charge of the batteries.

WARNING:

DO NOT LEAVE AC DISCONNECTED.

TO AVOID BATTERY DAMAGE, DO NOT DRAIN BATTERY BELOW

10.5VDC (12V NOMINAL SYSTEMS) OR 21.0VDC (24V NOMINAL SYSTEMS).

7.3. Connect Alarms and Communications

Connect alarm and communications wiring (see section [6.7](#)). Refer to the label on the field wiring end of the unit for alarm relay assignments. Review and adjust alarm relay assignments and communications settings using the front panel keypad (optional) or the SENS Setup Utility. See section [9.6](#) for additional details on keypad navigation.

8 ALARMS, LEDS AND DISPLAY

8.1. LED Indicators

The unit is equipped with two LEDs, one for AC status and one for DC status. See further alarm definitions in section [8.5](#). LEDs and the optional front panel LCD indicate active alarm(s).

| AC LED | DC LED | Meaning |
|--------------|-----------------------------|---|
| OFF | OFF | AC and DC not applied, unit failed or alarm/communications circuit board cannot communicate with unit |
| SOLID GREEN | SOLID GREEN | AC good, DC good, in Float Mode |
| SOLID GREEN | FLASHING GREEN | AC good, in Boost Mode |
| SOLID GREEN | FLASHING 2X GREEN | AC good, DC in current limit (constant current operation) |
| SOLID GREEN | FAST FLASHING GREEN | AC good, battery check in progress |
| SOLID GREEN | FAST FLASHING YELLOW | AC good, battery check failure |
| SOLID GREEN | SOLID RED | AC good, charger fail or overvoltage shutdown (charger disabled) |
| SOLID GREEN | SOLID YELLOW | AC good, high or low DC voltage (above/below alarm setpoint) |
| SOLID GREEN | FLASHING YELLOW | AC good, positive/negative ground fault present |
| SOLID GREEN | FLASHING GREEN/YELLOW | AC good, output limited by high temperature |
| SOLID GREEN | DOUBLE FLASH YELLOW | AC good, load share fail |
| SOLID GREEN | DOUBLE FLASH RED | AC good, load sharing DC negative connection open or load sharing charger address fault |
| SOLID YELLOW | SOLID GREEN | AC voltage/frequency out of range or AC phase missing, DC voltage good |
| SOLID RED | SOLID GREEN | AC fail or over max voltage, DC voltage good |
| SOLID RED | SOLID YELLOW | AC fail, high or low DC voltage (above/below alarm setpoint) |
| SOLID RED | SOLID RED | AC fail, charger fail or overvoltage shutdown (charger disabled) |
| SOLID RED | FLASHING YELLOW | AC fail, positive/negative ground fault present |
| | FLASH LONG-2X SHORT YELLOW | SENSbus Inactive |
| | ALTERNATING FLASHING YELLOW | Invalid Settings |
| | ALTERNATING FLASHING RED | Missing or invalid code (boot load required) |
| | ALTERNATING FLASHING GREEN | Unit starting up |

8.2. Individual Alarm Relay Contacts

The unit includes two alarm discrete Form C contacts. The Form C relay contacts change state when alarms are activated. Alarm relay assignments are custom configurable to any of the alarm functions listed in section [8.5](#). See label on the field wiring end of the unit for original factory alarm relay assignments. The relays can be configured to be latching or non-latching with adjustable delays using the SENS Setup Utility.

By default, the relay contacts change state 30 seconds after the onset of a fault. The relay delay is configurable using the front panel keypad (see section [9.6](#)) or the SENS Setup Utility. See section [8.5](#) for alarm definitions.

8.3. LCD Panel

A two line by twenty-character LCD is included optionally and provides precision digital AC and DC ammeters and voltmeters as well as information about input, output, charging status and alarms. The voltmeters are accurate to $\pm 1\%$ and the ammeters are accurate to $\pm 1\%$. The display is readable with or without ambient lighting and operates automatically, requiring no operator intervention.

The LCD is fully operational from -20°C to $+50^{\circ}\text{C}$. It may temporarily become unreadable below -20°C but should recover as temperature increases.

8.4. Latched Alarms

All alarm messages displayed on the front panel LCD are latching. Alarm relay configurations created using the SENS Setup Utility may be configured as latching if desired. Once an alarm condition no longer exists, the alarm message will no longer display in the main/home screen but will remain under the “Latched Alarms” menu. Clear latched alarms using the keypad under the “Latched Alarms” menu (see section [9.6.3](#)), using the SENS Setup Utility or by cycling power.

8.5. Alarm Definitions

See section [8.1](#) for a description of LED indicator activity. Unless noted otherwise, the following alarms are displayed on the LCD panel.

8.5.1. AC Line Failure

Indicates AC input voltage is not detected or is outside of the allowed 90-265VAC range. Activates solid red AC LED. When this alarm is assigned to a relay contact AC LINE FAIL will cause the assigned relay to change to the Failed state after the time delay.

8.5.2. High DC Voltage

Indicates DC output voltage is above the High DC Voltage factory alarm setpoint or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. Alarm setpoint is factory configured to 15.6VDC for 12V or 31.2VDC for 24V units. Activates solid yellow DC LED. When this alarm is assigned to a relay contact HIGH DC VOLTAGE will cause the assigned relay to change to the Failed state after the time delay.

8.5.3. Battery on Discharge

Indicates battery is beginning to discharge and DC output voltage is below Battery Discharge Voltage factory alarm setpoint or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. Alarm setpoint is factory configured to 13.4VDC for 12V or 26.8VDC for 24V units. The BATTERY DISCHARGING alarm is the first to trigger of three low output voltage alarms and is followed by LOW DC and then END OF DISCHARGE. Alarm setpoint must be set higher than LOW DC and END OF DISCHARGE alarms. Activates solid yellow DC LED. When this alarm is assigned to a relay contact BATTERY DISCHARGING will cause the assigned relay to change to the Failed state after the time delay.

8.5.4. Low DC Voltage

Indicates battery has discharged and DC output voltage is below Low DC Voltage factory alarm setpoint or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. Alarm setpoint is factory configured to 13.0VDC for 12V or 26.0VDC for 24V units. Alarm setpoint must be set lower than BATTERY DISCHARGING and higher than END OF DISCHARGE alarms. Activates solid yellow DC LED. When this alarm is assigned to a relay contact LOW DC VOLTAGE will cause the assigned relay to change to the Failed state after the time delay.

8.5.5. Battery End of Discharge

Indicates DC output voltage is below Battery End Discharge factory alarm setpoint or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. Alarm setpoint is factory configured to 10.0VDC for 12V or 20.0VDC for 24V units. Alarm setpoint must be set lower than LOW DC and BATTERY DISCHARGING alarms. Activates solid yellow DC LED. When this alarm

is assigned to a relay contact BATTERY END OF DISCHARGE will cause the assigned relay to change to the Failed state after the time delay.

8.5.6. Charger Failure

Indicates the internal charger has failed. Charger is not able to provide the current demanded by the battery and/or load or is providing more current than the control system is commanding. This alarm is typically caused by an internal component failure. This alarm does not occur during AC power failures. Activates solid red DC LED. When this alarm is assigned to a relay contact CHARGER FAIL will cause the assigned relay to change to the Failed state after the time delay.

8.5.7. Over Voltage Shutdown

Indicates the internal charger has executed a high voltage shutdown and DC output voltage is above Over Voltage Shutdown factory alarm setpoint or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. Alarm setpoint is factory configured to 16.0VDC for 12V or 32.0VDC for 24V units. The charger disables itself whenever excessive output voltage occurs while delivering current. The overvoltage shutdown system is protected against nuisance trips and will not execute if the high voltage condition is caused by an external source including a parallel connected charger of any type. Activates solid red DC LED. When this alarm is assigned to a relay contact OVERVOLTAGE SHUTDOWN will cause the assigned relay to change to the Failed state after the time delay.

8.5.8. Low Cranking Voltage

Indicates the battery voltage is likely to be inadequate to provide engine-cranking capability. Indicates that DC output voltage during a prior cranking event dropped below the Low Cranking Voltage setpoint. **This alarm is latching and must be manually reset using the front panel keypad (optional) or the SENS Setup Utility.** Low Cranking Voltage indication is disabled by default from the factory. When this alarm is assigned to a relay contact LOW CRANK will cause the assigned relay to change to the Failed state after the time delay.

8.5.9. Invalid Settings

Indicates settings are not valid. Output is disabled until the condition is corrected. The invalid setting is indicated on the optional LCD. Activates alternating flashing yellow AC and DC LEDs. When this alarm is assigned to a relay contact INVALID SETTINGS will cause the assigned relay to change to the Failed state after the time delay.

8.5.10. SENSbus Inactive

Indicates the unit is not communicating on SENSbus either when load sharing and/or remote accessories are connected. Activates flashing long then 2x short yellow AC and DC LEDs. When this alarm is assigned to a relay contact SENSBUS INACTIVE will cause the assigned relay to change to the Failed state after the time delay.

8.5.11. Thermal Fold Back

Indicates output power has been reduced to protect from over-heating. The unit will not be able to produce full output until the ambient temperature is lowered. When this alarm is assigned to a relay contact THERMAL FOLDBACK will cause the assigned relay to change to the Failed state after the time delay.

8.5.12. Current Limiting

Indicates the unit is operating at maximum allowable output, either the maximum current setting or maximum power output (whichever occurs first). Activates flashing green DC LED. When this alarm is assigned to a relay contact CURRENT LIMITING will cause the assigned relay to change to the Failed state after the time delay.

8.5.13. Ground Fault Positive

Indicates a short circuit or high impedance leakage current exists from the positive output to ground. Ground fault indication is disabled by default from the factory. Activates flashing yellow DC LED. When this alarm is assigned to a relay contact GROUND FAULT POSITIVE will cause the assigned relay to change to the Failed state after the time delay. Using the optional keypad, navigate to the “DC Meters” menu to view detected ground fault voltage and current.

8.5.14. Ground Fault Negative

Indicates a short circuit or high impedance leakage current exists from the negative output to ground. Ground fault indication is disabled by default from the factory. Activates flashing yellow DC LED. When this alarm is assigned to a relay contact GROUND FAULT NEGATIVE will cause the assigned relay to change to the Failed state after the time delay. Using the optional keypad, navigate to the “DC Meters” menu to view detected ground fault voltage and current.

8.5.15. Low Current

Indicates current from the charger is below the Low Current Alarm setpoint. The low current alarm is disabled by default from the factory. When this alarm is assigned to a relay contact LOW CURRENT will cause the assigned relay to change to the Failed state after the time delay.

8.5.16. Load Share Fail

Indicates that units connected for load sharing are not sharing the current load. Activates double flashing yellow DC LED. When this alarm is assigned to a relay contact LOAD SHARE FAIL will cause the assigned relay to change to the Failed state after the time delay.

8.5.17. AutoBoost Lockout Active

Indicates the Boost mode time limit has expired and unit has returned to Float mode. Boost mode is disabled until the time limit is reset. The Boost time limit is reset if unit power is cycled. The Boost time limit is set to 12 hours by default. When this alarm is assigned to a relay contact AUTOBOOST LOCKOUT ACTIVE will cause the assigned relay to change to the Failed state after the time delay.

8.5.18. DC Below Startup Voltage

Indicates battery voltage is below the factory Startup Voltage setpoint or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. When this alarm is assigned to a relay contact DC BELOW STARTUP VOLTAGE will cause the assigned relay to change to the Failed state after the time delay.

8.5.19. Thermal Fault

Indicates charger has faulted because it over heated and thermal fold-back has reached zero watts. Charger output has been disabled. Recycle AC and DC power for re-initiation. The issue is likely environmental. When this alarm is assigned to a relay contact THERMAL FAULT will cause the assigned relay to change to the Failed state after the time delay.

8.5.20. High Battery Temperature

Indicates battery temperature is above the High Battery Temperature setpoint. When this alarm is assigned to a relay contact HIGH BATTERY TEMPERATURE will cause the assigned relay to change to the Failed state after the time delay.

8.5.21. High Battery Temperature Shutdown

Indicates battery temperature is high enough that the charger has shut off as a safety concern. When this alarm is assigned to a relay contact HIGH BATTERY TEMPERATURE SHUTDOWN will cause the assigned relay to change to the Failed state after the time delay.

8.5.22. High Battery Room Temperature

Indicates battery room temperature is above the High Battery Room Temperature setpoint. When this alarm is assigned to a relay contact HIGH BATTERY ROOM TEMPERATURE will cause the assigned relay to change to the Failed state after the time delay.

8.5.23. Charger Low Temperature

Indicates charger is currently below its rated temperature. Output may be derated. When this alarm is assigned to a relay contact CHARGER LOW TEMPERATURE will cause the assigned relay to change to the Failed state after the time delay.

8.5.24. Battery Low Temperature

Indicates battery temperature is below the Low Battery Temperature setpoint. When this alarm is assigned to a relay contact BATTERY LOW TEMPERATURE will cause the assigned relay to change to the Failed state after the time delay.

8.5.25. AC Voltage Over Maximum

Indicates AC Voltage has gone above maximum allowed by the unit. This alarm has a delay of 3 seconds. Output has been disabled. Activates solid red AC LED. When this alarm is assigned to a relay contact AC VOLTAGE OVER MAXIMUM will cause the assigned relay to change to the Failed state after the time delay.

8.5.26. AC Voltage Low

Indicates AC Voltage has gone below AC Min Voltage alarm setpoint. Activates solid yellow AC LED. When this alarm is assigned to a relay contact AC VOLTAGE LOW will cause the assigned relay to change to the Failed state after the time delay.

8.5.27. AC Frequency Out of Range

Indicates AC Frequency is outside of the AC High Frequency and AC Low Frequency alarm setpoints. Activates solid yellow AC LED. When this alarm is assigned to a relay contact AC FREQUENCY OUT OF RANGE will cause the assigned relay to change to the Failed state after the time delay.

8.5.28. AC Voltage High

Indicates AC Voltage is above the AC Max Voltage alarm setpoint. Activates solid yellow AC LED. When this alarm is assigned to a relay contact AC VOLTAGE HIGH will cause the assigned relay to change to the Failed state after the time delay.

9 OPERATION

IMPORTANT! Adjustments of most settings are prohibited and protected by security code to ensure proper operation. Settings that are adjustable include communications (TCP/IP, MODBUS, J1939), alarm assignments, alarm delays, and AC alarm setpoints. Contact SENS Customer Service for more information regarding setting adjustments (800-742-2326 or www.sens-usa.com).

9.1. Charging Algorithms

The unit uses charging algorithms appropriate for Nickel-Zinc battery types, which includes Float mode and Dynamic Boost™ mode. See following sections for descriptions of each charging mode.

9.1.1. Recharging Batteries

After a battery has been discharged, the internal charger will enter Dynamic Boost mode. The charger's output voltage setpoint during Dynamic Boost mode increases to the boost voltage value (see section 9.3). If the battery is deeply discharged, DC voltage will remain below the boost voltage setpoint until the charger's output current drops below its rated maximum. Charging in boost mode continues until the Dynamic Boost control system ends boost mode or the boost time limit expires (boost time limit set to 12 hours by default). After operating in boost mode the charger switches to Float mode (see section 9.2). Note: After several high current discharges, battery temperature may exceed allowed charging temperature. Recharge will automatically initiate after battery temperature is lowered.

9.2. Float Mode

Float mode is used to maintain batteries in a charged state. When the unit is in Float mode the output voltage is maintained at the float voltage setting. Float voltage is factory configured to 14.2VDC for 12V or 28.4VDC for 24V units.

9.3. Dynamic Boost™ Mode

Dynamic Boost is an advanced method of boost charging that automatically computes during each recharge the optimal time for the charger to remain at the boost voltage, before transitioning back to the float charge mode. Dynamic Boost automatically adjusts for depths of discharge, varying load, battery age and other variables. Dynamic Boost mode safely maximizes recharge performance while cutting risks of both overcharging and undercharging associated with manual or automatic boost timers or earlier generation automatic boost control systems.

Dynamic Boost is automatically used by the unit. Boost voltage is factory configured to 15.2VDC for 12V or 30.4VDC for 24V units. Charging in boost mode continues until the Dynamic Boost control system ends boost mode or the boost time limit expires. The boost time limit is set to 12 hours by default.

9.4. Battery Check

Run a Battery Check test to determine if a battery can support a load. Battery Check will reduce charger output voltage to a configurable backstop level to permit the battery to support the load. Activate a Battery Check using the keypad or SENS Setup Utility. Using the keypad, navigate to the "Battery Check" menu to enable a Battery Check and configure battery check minimum voltage and duration. Upon completion of the test, the LCD will display whether the test passed or failed for ten seconds or until the "Enter" key is pressed. If the audible alarm is enabled, a single beep occurs when the battery check results are displayed. Schedule a Battery Check to run automatically by setting the Scheduled Battery Check interval in the "Battery Check" menu. An in-progress Battery Check activates a fast flashing green DC LED. Battery Check failure activates a fast flashing yellow DC LED. Alarm/communications circuit board BATTERY CHECK relay contacts change to Fail state after delay when alarm is assigned to relay contacts. Clear a failed Battery Check alarm using the keypad by scrolling to the "Alarms & Settings" menu then selecting the "Battery Check" option and pressing the UP arrow.

When units are connected to load share, initiating a battery check on one unit will automatically initiate a simultaneous battery check on connected unit(s).

IMPORTANT: A load less than 3% of the charger output maximum current rating may cause inaccurate battery check results. If the system load is typically lower than 3% disable the Scheduled Battery Check feature. Battery Check will not indicate whether a battery is healthy enough to start a generator or engage switchgear relays for chargers in typical genset or switch gear applications without a continuous current load.

9.5. Restore Factory Defaults

Restore factory defaults using the front panel keypad or the SENS Setup Utility. Values that will revert to original factory settings include:

- Battery type
- Cell count
- Float Voltage
- Boost Voltage
- Battery Discharge Voltage
- Low DC Voltage
- Battery End of Discharge Voltage
- High DC Voltage
- Battery Check Voltage
- Over Voltage Shutdown
- Temperature Compensation Slope
- Auto Boost Time Limit
- Periodic Scheduled Boost Interval
- Periodic Scheduled Boost Duration
- Low Current Alarm
- Battery Check Interval
- Battery Check Duration
- Commissioning Time
- Commissioning Charge Voltage
- Commissioning Current

9.6. Keypad Operation—Optional

The optional front panel keypad provides the ability to adjust unit settings.

9.6.1. Security Code Protection

Units are security code protected from the factory to ensure only authorized personnel may adjust settings. Adjustments of most settings are prohibited to ensure proper operation. Settings that are adjustable include communications (TCP/IP, MODBUS, J1939), Battery Check (start/stop, duration, interval), alarm delays, AC alarm setpoints and Low Current alarm setpoint. Contact SENS Customer Service for more information regarding setting adjustments (800-742-2326 or www.sens-usa.com).

9.6.2. Menu Navigation

Use the keypad to scroll through settings to view and adjust. The keypad provides X-Y navigation with main fields up and down and details within each field left and right. Press the up and down arrow keys to scroll through main menu options. Press the left and right arrow keys to scroll through data available within each menu. Value adjustments are made with the up and down arrow keys. Values are saved to nonvolatile memory. Press center Enter key to return to main fields. Press center Enter key twice to return to Home screen.



Menu Navigation

| | |
|--------|---|
| Step 1 | ↑ or ↓ for main fields |
| Step 2 | ← or → for details within each main field |
| Step 3 | ↑ or ↓ to adjust values |
| Step 4 | ↶ to return to main fields |
| Step 5 | ↶ to return to Home screen |

9.6.3. Menu Options

Input, output, temperature and alarm status are displayed on the front panel LCD by default. Press the UP or DOWN arrow to access additional menus as described below. Absolute maximum voltage limits apply to all output and alarm settings. A message is displayed indicating an adjustment is limited due to settings conflict.

IMPORTANT! Adjustments of most settings are prohibited to ensure proper operation (see section 9.6.1).

| Main Menus <i>(Press arrows to scroll through menu options)</i> | | Configurable/Viewable <i>(Press left/right arrows to scroll through menus, press up/down arrows to configure values)</i> | Parameter Descriptions |
|--|---|---|--|
| Main Menu  | Sub Menu  | | |
| Browse Status | | Scroll left/right to view basic meters and alarms | |
| Latched Status | | Clear All Latched Alarms | Clear status of all latched alarms |
| DC | Meters | DC Output (<i>voltage</i>) | DC output voltage and current |
| | | DC Output (<i>power</i>) | DC output watts and % of rated output being provided |
| | | Battery Temp. | Temperature at battery if a remote temperature sensor is connected |
| | | Ambient Temp. | Temperature inside charger |
| | | GF voltage | Ground Fault voltage detected by charger and indication of whether on positive or negative battery terminal |
| | | GF Current | Ground Fault current detected by charger and indication of whether on positive or negative battery terminal |
| | Basic Settings | Battery Select Type | Set to NiZn for 8Z units, not adjustable |
| | | Battery Select Number of Cells | Adjust number of series cells in battery string |
| | | Float Voltage | Adjust output Float voltage, must be greater than 60% of Boost setting |
| | | Boost Voltage | Adjust output Boost voltage from, must be same or greater than Float setting, must not be greater than 166% of Float setting |
| | | HELIX-EcoFloat | Disable for 8Z units |
| | | Current Limit | System current limit setting. Set to "No Limit Set" for full current capacity. Set a value in amps to limit available current. It is sometimes necessary to limit maximum charging current to the battery. |
| | | Temp. comp./°C | Adjust temperature compensation slope from 0 to -0.30%/°C |
| | Boost Settings | Boost Voltage | Adjust output Boost voltage from, must be same or greater than Float setting, must not be greater than 166% of Float setting |
| | | Auto Boost Delay | Adjust amount of time from 0 to 5 minutes to delay before entering Boost mode after power is cycled or battery type is changed. Delay affects all outputs for multiple output models. |
| | | Auto-Boost | Enable or disable Dynamic Boost mode |
| | | Auto Boost Limit | Adjust the maximum amount of time charger will be in Dynamic Boost mode from 1 to 255 hours. The Boost time limit is reset if charger power is cycled or an engine crank is detected. |

| | | |
|---------------|-----------------------------|--|
| | Boost Duration | Adjust amount of time charger will be in scheduled periodic Boost mode from 1 to 255 hours. The Boost timer is reset if charger power is cycled |
| | Scheduled Boost | Adjust amount of time between periodic scheduled Boost events from 1 to 180 days. Set to OFF to disable. |
| | Run Timed Boost | Start or stop a manual Boost cycle. Will operate in Boost mode until the Boost Duration expires. |
| | Next Scheduled Boost | View time until next scheduled Boost |
| Battery Check | Battery Check | Start or stop a manual Battery Check. |
| | Clear Failure Battery Check | Press UP arrow to reset/clear Battery Check alarm on selected output |
| | Batt Check Time | Adjust amount of time to run Battery Check from 1 to 60 minutes |
| | Batt Check Vmin | Adjust minimum voltage allowed during Battery Check test, must be greater than End-of-Discharge voltage and less than 98% Float voltage |
| | Sched Batt Check | Adjust amount of time between scheduled Battery Check tests from 1 to 90 days |
| | Next Sched Batt Check | View time until next scheduled Battery Check test |
| Alarms | Relay Delay Time DC | Adjust amount of time to delay activation of alarm relays after a DC alarm event takes place from 5 to 60 seconds. Alarm/comms circuit board alarm relay contacts and alarms on communications ports are delayed; LED alarm indication is not delayed. |
| | Ground Fault Alarm | Enable/disable or adjust setpoint to trigger positive or negative Ground Fault alarm. |
| | Low Crank | Adjust setpoint to trigger Low Crank alarm from 6V to 98% of Float, must be at least 2% less than Float setting |
| | Clear Failure Low Crank | Press UP arrow to reset/clear Low Cranking alarm on selected output |
| | End Discharge | Adjust setpoint to trigger Battery End-of-Discharge alarm, must be less than Low DC setting |
| | Low DC Voltage | Adjust setpoint to trigger Low DC voltage alarm, must be greater than End Discharge setting and less than Battery Discharging setting |
| | Batt Discharging | Adjust setpoint to trigger Battery Discharging alarm, must be between Low DC setting and 98% of Float setting or Eco-Float setting when HELIX is active |
| | High DC Voltage | Adjust setpoint to trigger High DC voltage alarm, must be greater than Boost by 2% of Float setting, must be less than 40% higher than Boost setting |

| | | | | |
|--------|-------------------|-------------------------------------|---|---|
| | | Overvolt Fault | Adjust setpoint to trigger Over Voltage Shutdown alarm, must be greater than High DC setting | |
| | | Low Current | Adjust setpoint to trigger Low Current alarm from 0% to 50% of nominal current | |
| | | High Batt Temp | Adjust setpoint to trigger High Battery Temperature alarm | |
| | | Hi BatTmp Shtdwn | Adjust setpoint to trigger High Battery Temperature Shutdown alarm | |
| | | Low Batt Temp | Adjust setpoint to trigger Low Battery Temperature alarm | |
| | | Battery Room Temp | Adjust setpoint to trigger High Battery Room Temperature alarm | |
| | Startup Voltage | DC Start Volts | Adjust DC Startup Voltage. Set to zero to start into zero-volt battery automatically. | |
| | | Force Startup | Enables charger to attempt to charge a battery with a voltage below the DC Startup Voltage. Only enables startup on selected output. | |
| | Commission | Batt Commission (<i>voltage</i>) | Adjust battery commissioning output voltage must be greater than or equal to Float voltage | |
| | | Batt Commission (<i>current</i>) | Adjust battery commissioning output current from 5% to 100% of nominal current rating | |
| | | Batt Commission (<i>duration</i>) | Adjust battery commissioning hours from 1 to 120 hours | |
| | | Batt Commission (<i>enable</i>) | Start or stop commissioning cycle. Charger will deliver commissioning voltage and current until commissioning hours expire. | |
| | Advanced Settings | Restore Factory Default Settings DC | Press UP arrow to restore settings to factory configuration | |
| | | DC Output #A | Enable for 8Z units | |
| | | DC Output #B | Disable for 8Z units | |
| | | DC Output #C | Disable for 8Z units | |
| | AC | Meters | AC Input | AC input voltage and frequency |
| | | | AC Reference Meters | Press UP arrow to enable displaying AC meter values in the Browse Status menu area |
| | | Basic Settings | Number of Phases | Set to 1 for single-phase or 3 for three-phase input voltage |
| | | | Nominal Volts AC | Set nominal input voltage for charger model. Must match hardware jumper/terminal block on inside of charger when jumper exists. |
| Alarms | | Relay Delay Time AC | Adjust amount of time to delay activation of alarm relays after an AC alarm event takes place from 5 to 60 seconds. Alarm/comms circuit board alarm relay contacts and alarms on communications ports are delayed; LED alarm indication is not delayed. | |

| | | | |
|---------------|----------------------|---|--|
| | | Max Voltage | Adjust setpoint to trigger AC Voltage High alarm |
| | | Min Voltage | Adjust setpoint to trigger AC Voltage Low alarm |
| | | High Freq | Adjust setpoint to trigger AC Frequency Out of Range alarm |
| | | Low Freq | Adjust setpoint to trigger AC Frequency Out of Range alarm |
| | Advanced Settings | Restore Factory Default Settings AC | Press UP arrow to restore settings to factory configuration |
| | | AC Input #A | Enable for 8Z units |
| AC Input #B | | Disable for 8Z units | |
| User Access | UI Access Control | Select allowed user interface access. Adjustments of most settings are prohibited and security code protected to ensure proper operation. | |
| | Change Security Code | Units are security code protected from the factory to ensure only authorized personnel may adjust settings. Adjustments of most settings are prohibited to ensure proper operation. Contact SENS Customer Service for more information regarding setting adjustments (800-742-2326 or www.sens-usa.com). | |
| | Relock Access | Exit Service Mode and relock access | |
| Service Tools | Output | Force DC Startup All | Enables charger to attempt to charge a battery with a voltage below the DC Startup Voltage. Enables startup on all outputs. |
| | Alarms | Clear Failures All | Press UP arrow to reset/clear failures on all outputs |
| | | Clear Failure Low Crank | Press UP arrow to reset/clear Low Cranking alarm on all outputs |
| | | Clear Failure Battery Check | Press UP arrow to reset/clear Battery Check alarm on all outputs |
| | Alarm Test | Relay Test | Press UP arrow to set all alarm relays and DOWN arrow to clear all relays |
| | | Simulate Alarms | Simulate/set alarms for testing purposes. Set AC Fail, High DC, Low DC, Charger Fail and Over Voltage Shutdown alarms true. Alarm state times out after 5 minutes. |
| | Display | Display Type | Set to "Unit Display" to display single unit values or set to "System Display" to display system (for a system with multiple chargers) values on the unit LCD |
| | | LCD Brightness | Adjust LCD brightness from 0 – 100% |
| | | Display Test | Press UP arrow to set all LCD segments black and DOWN arrow to clear all LCD segments |
| | Advanced | Soft Reset All Devices | Press UP arrow to reset all devices in the unit/system |
| | | Repository Config | Set to Stable |

| | | | |
|---------------------|---------------------|---|--|
| | | Minimum System Number of Chargers | Not applicable to 8Z units |
| | | Minimum Unit Number of Chargers | Not applicable to 8Z units |
| Communica- tions | TCP/IP Settings | TCP-IP Address | Set TCP-IP Address |
| | | TCP-IP Gateway | Set TCP-IP Gateway |
| | | TCP-IP Subnet Mask | Set TCP-IP Subnet Mask |
| | | Hardware Mask | Reads Hardware Address (MAC address of the unit) |
| | SENSnet | SENSnet Mode | Enable or disable SENSnet Mode. When disabled the charger will not communicate via IP address. Enabled by default. |
| | Modbus RS485 | Modbus Configuration | Select RTU or set to OFF to disable Modbus communications. Only one RS-485 communications protocol is allowed at a time. |
| | | Modbus Configuration Address | Adjust Modbus server address from 1 to 255. Set to OFF to disable Modbus communications. |
| | | Modbus Configuration Parity Bit | Set Modbus parity to none, even or odd |
| | | Modbus Configuration Baud Rate | Adjust Modbus baud rate, 230.4 Kbps maximum |
| | | Modbus Configuration Write | Enable or disable write access via Modbus |
| | Modbus TCP | Modbus Configuration | Enable or disable Modbus TCP-IP |
| | | Modbus Configuration Address | Adjust Modbus server address from 1 to 255. Set to OFF to disable Modbus communications. |
| | | Modbus Configuration Write | Enable or disable write access via Modbus |
| | | Modbus Configuration Max Connections | Set number of clients allowed to connect at once |
| | J1939 | J1939 Configuration BCH1 Output | Assign charger output for J1939 battery charger address to 1 |
| | | J1939 Configuration BCH2 Output | Assign charger output for J1939 battery charger address 2 |
| | | J1939 Configuration Veh Sys Instance | Adjust J1939 Vehicle System Instance from 0 to 15 |
| | | J1939 Configuration Funct Instance | Adjust J1939 Function Instance from 0 to 31 |
| | | J1939 Configuration ECU Instance | Adjust J1939 ECU Instance from 0 to 7 |
| | | J1939 Configuration Extended Status | Enable or disable receiving extended J1939 data |
| | User CAN | User CAN Mode | Enable or disable User CAN Mode |
| Alarm Relays | Relay Delay Time AC | Adjust amount of time to delay activation of alarm relays after an AC alarm event takes place from 5 to 60 seconds. Alarm/comms circuit board alarm relay contacts and alarms on communications ports are delayed; LED alarm indication is not delayed. | |

| | | |
|------------------|---------------------|--|
| | Relay Delay Time DC | Adjust amount of time to delay activation of alarm relays after a DC alarm event takes place from 5 to 60 seconds. Alarm/comms circuit board alarm relay contacts and alarms on communications ports are delayed; LED alarm indication is not delayed. |
| | Relay Test | Press UP arrow to set all alarm relays and DOWN arrow to clear all relays |
| Unit Information | Serial No. | Charger serial number |
| | Display Revision | Software revision currently loaded on alarms/comms circuit board |
| | Copyright | SENS copyright year |
| | Charger Revision | Software revision currently loaded on charging devices |

9.7. Configuration and Monitoring with SENS Setup Utility

The SENS Setup Utility is used to monitor, configure, and troubleshoot SENS units. Download the SENS Setup Utility software at sens-usa.com/support/download-center/. Use the setup utility to update firmware on all devices and configure select settings including alarm relay assignments. Communication between a computer and the unit using the SENS Setup Utility requires connection via USB-C (see section [6.11](#)). See the SENS Setup Utility user manual for further details.

9.8. Temperature Compensation

The unit is temperature compensated to match the negative temperature coefficient of the internal battery. With temperature compensation active, the output voltage will increase slightly as temperature decreases, decrease as temperature increases, and is clamped at 0°C (32°F) and +40°C (122°F) to protect against extremely high or low output voltage.

9.9. Parallel/Load Share Operation

Multiple units may be connected in parallel to provide redundancy and increased capacity. Individually charge each 8Z unit for 8 hours minimum prior to connecting in parallel. Load sharing units are fault tolerant; one unit failure will not cause failures in paralleled units.

9.9.1. Load Sharing and Synchronization

Connection of a network cable between units using the SENSbus RJ45 connectors (see section [6.10](#)) automatically initiates load sharing and synchronization of all operating modes. Units will share the current load within $\pm 10\%$. For proper load share operation, a 120-ohm terminator is required at the ends of the bus. The LOAD SHARE FAIL alarm will occur any time a unit is unable to load share. If a unit in a multi-charger load sharing system fails or is disconnected the remaining units will still load share and ignore the faulted unit. Each load sharing unit will alarm independently using individually configured alarm setpoints.

9.10. Remote Alarm/Communications Panel Accessory

The optional remote alarm/communications panel accessory provides additional alarm relay contacts and the ability to adjust and communicate with multiple units using one external device. Connection of a network cable between the accessory and units using the SENSbus RJ45 connectors (see section [6.10](#)) automatically initiates communication. For proper operation, a 120-ohm terminator is required at the ends of the bus. Adjust configuration and view status using the remote panel keypad and display. See section [9.6](#) for keypad operation.

10 SERVICE AND MAINTENANCE

10.1. Recommended Annual Maintenance

Check all field wiring connections for electrical and mechanical integrity. Verify no corrosion or loose hardware is present.

10.2. Service

Do not open the 8Z unit, field repair is not recommended. Contact SENS Customer Service for more information (800-742-2326 or www.sens-usa.com).

11 J1939 COMMUNICATIONS

See data messages below for read-only information available using J1939. Each unit automatically broadcasts a data message once per second after it has joined the J1939 network. Unit operation parameters may not be configured using J1939 communications.

J1939 communications are disabled by default and until the BCH address is configured (see section [6.9.2](#)). In most cases, the remaining default J1939 settings are sufficient to automatically begin using J1939 communications after connecting the unit to the network. Use the SENS Setup Utility to adjust J1939 settings if required.

11.1. J1939 Data Messages

| J1939 Data | Bits | Details |
|-----------------------------|-------|--|
| Battery Charger State | 0-3 | 0 = OFF, 1 = boost charge, 2 = float charge, 13 = battery failure/too hot/cold to charge, 14 = charger failure, 15 = no status available |
| AC Power Line State | 4-5 | 0 = AC OFF, 1 = AC ON, 2 = sensing error, does not indicate power out of specification, 3 = no status available |
| Thermal Limit Alarm* | 6-7 | 0 = OK, 1 = Fail, 2 = sensor failure, 3 = no status available |
| Output Voltage | 8-23 | 0 to 3212.75V in 0.05V increments, 0xFFFF = data not available, 0xFEFF = hardware error |
| Output Current | 24-39 | -1600.00 to +1612.75A in 0.05A increments, 0xFFFF = data not available, 0xFEFF = hardware error |
| High DC Voltage Alarm* | 42-43 | 0 = OK, 1 = Fail, 2 = sensor failure, 3 = no status available |
| Low DC Voltage Alarm* | 44-45 | 0 = OK, 1 = Fail, 2 = sensor failure, 3 = no status available |
| Low Cranking Voltage Alarm* | 46-47 | 0 = OK, 1 = Fail, 2 = sensor failure, 3 = no status available |
| Invalid Settings Alarm* | 48-49 | 0 = OK, 1 = Fail, 2 = sensor failure, 3 = no status available |

*Optional, must enable SENS data extensions using SENS Setup Utility

12 MODBUS COMMUNICATIONS

Modbus is an application layer messaging protocol used for client/server communication and is implemented according to specifications provided by Modbus Organization (<http://www.modbus.org/specs.php>).

12.1. TCP/IP Modbus—*Optional*

Modbus communications over TCP/IP is optional and requires configuration using the SENS Setup Utility or the keypad (see section 9.6.3). Adjust IP address as desired. It may take up to 10 seconds for the network setting changes to apply. A TCP/IP address of 0.0.0.0 implies DHCP (Dynamic) addressing. Adjust the Gateway and Subnet Mask values as required. Configure Modbus server address and enable/disable Modbus write access as desired. The displayed Hardware Address is the MAC address corresponding to the Ethernet interface. This value is not adjustable. See section 6.9.1 for connection information.

TCP/IP Modbus Default Settings

| Setting | Value |
|-----------------------|-------------------|
| IP Address | 0.0.0.0 DHCP/AUTO |
| Subnet Mask | N/A |
| Gateway | N/A |
| Port Number | 502 |
| Modbus Server Address | 10 |

12.2. Modbus RS-485—*Optional*

Serial Modbus communications over RS-485 using RTU mode requires the optional keypad and display. Modbus communications settings may be configured using the keypad or SENS Setup Utility prior to executing communications. Configure Modbus server address, baud rate, parity and enable/disable Modbus write access as desired. See section 6.8 for connection and termination requirements.

Modbus RS-485 Default Settings

| Setting | Value |
|----------------|-------|
| Configuration | RTU |
| Baud Rate | 19200 |
| Data Bits | 8 |
| Parity | Even |
| Stop Bits | 1 |
| Server Address | 10 |

12.3. Modbus Holding Registers

The 8Z unit includes an extensive array of Modbus registers. These Modbus registers are organized using 32-bit big-endian. The registers are zero-indexed, meaning the first register is index zero as opposed to index 1. Some Modbus polling utilities may be one-indexed or default to little-endian and as such may need to be adjusted. To verify, poll register 9 as a 32-bit value and verify the first 6-digits match the serial number shown on the product label. If they don't match, adjust the offset (zero or one), change the endianness (sometimes referred to as swapping the registers) or both. Note that registers that do not have a scaling factor of one must be divided by the scaling factor to obtain the decimal/floating point representation.

The following are common registers that are applicable to most applications. Contact SENS for further information if necessary.

| Address High | | Address Low | | Name | Description | Units | Scale Factor |
|--------------|-------|-------------|-------|-----------------------------------|---|----------|--------------|
| Decimal | Hex | Decimal | Hex | | | | |
| 0 | 0x000 | 1 | 0x001 | Unit Serial | Serial Number of System the device was built into and shipped part of | Num | 1 |
| 2 | 0x002 | 3 | 0x003 | Program Revision | Version of the main program | Num | 1 |
| 4 | 0x004 | 5 | 0x005 | Bootloader Version | Version of bootloader | Num | 1 |
| 6 | 0x006 | 7 | 0x007 | Type | Device type | Enum | 1 |
| 8 | 0x008 | 9 | 0x009 | Serial | Serial Number of the Device | Num | 1 |
| 10 | 0x00A | 11 | 0x00B | Build Date | Year (16bit), month(8bit), day(8bit) | Num | 1 |
| 12 | 0x00C | 13 | 0x00D | Model Num 1_4 | Model number character | bit | 1 |
| 14 | 0x00E | 15 | 0x00F | Model Num 5_8 | Model number character | bit | 1 |
| 16 | 0x010 | 17 | 0x011 | Model Num 9_12 | Model number character | bit | 1 |
| 18 | 0x012 | 19 | 0x013 | Model Num 13_16 | Model number character | bit | 1 |
| 20 | 0x014 | 21 | 0x015 | Model Num 17_20 | Model number character | bit | 1 |
| 22 | 0x016 | 23 | 0x017 | Model Num 21_24 | Model number character | bit | 1 |
| 24 | 0x018 | 25 | 0x019 | Model Num 25_28 | Model number character | bit | 1 |
| 26 | 0x01A | 27 | 0x01B | Model Num 29_32 | Model number character | bit | 1 |
| 42 | 0x02A | 43 | 0x02B | Basic Charging Alarms | Charging Alarm status bits (see section 12.4) | Bitfield | 1 |
| 44 | 0x02C | 45 | 0x02D | Charging Status | Charging Status bits (see section 12.5) | Bitfield | 1 |
| 46 | 0x02E | 47 | 0x02F | Charging Alarms Extended | Charging Alarm Extended status bits (see section 12.6) | Bitfield | 1 |
| 48 | 0x030 | 49 | 0x031 | Charging AC Alarms | Charging AC Alarm status bits (see section 12.7) | Bitfield | 1 |
| 50 | 0x032 | 51 | 0x033 | Accessory Channel Alarms | Accessory Channel Alarm status bits (see section 12.8) | Bitfield | 1 |
| 52 | 0x034 | 53 | 0x035 | Accessory System Alarms | Accessory System Alarms status bits (see section 12.9) | Bitfield | 1 |
| 54 | 0x036 | 55 | 0x037 | Accessory Assigned Charger Alarms | Accessory Assigned Charger Alarms status bits (see section 12.10) | Bitfield | 1 |
| 62 | 0x03E | 63 | 0x03F | Uptime Counter Value | Charger uptime counter value | Sec | 1 |
| 212 | 0x0D4 | 213 | 0x0D5 | Unit Voltage | Voltage currently being supplied by the unit to the battery/loads | V | 32768 |
| 214 | 0x0D6 | 215 | 0x0D7 | Unit Current | Current currently being supplied by the unit to the battery/loads | A | 32768 |
| 216 | 0x0D8 | 217 | 0x0D9 | Unit Power | Power currently being supplied by the unit | W | 32768 |
| 218 | 0x0DA | 219 | 0x0DB | Unit Float Voltage | Float Voltage Setting of the unit | V/cell | 32768 |
| 220 | 0x0DC | 221 | 0x0DD | Unit Boost Voltage | Boost Voltage Setting of the unit | V/cell | 32768 |
| 222 | 0x0DE | 223 | 0x0DF | Unit Battery Temp | Battery temperature | °C | 32768 |
| 224 | 0x0E0 | 225 | 0x0E1 | Unit Internal temp | Internal temperature of the unit | °C | 32768 |
| 226 | 0x0E2 | 227 | 0x0E3 | Unit Boost Timer | Boost timer | Sec | 1 |
| 228 | 0x0E4 | 229 | 0x0E5 | Unit Periodic Boost Countdown | Interval between periodic boost events (0=disabled) | Sec | 1 |
| 230 | 0x0E6 | 231 | 0x0E7 | Unit Line Frequency | AC Line Frequency | Hz | 10 |

| | | | | | | | |
|-----|-------|-----|-------|---------------------------------|--------------------------------------|-----|-------|
| 232 | 0x0E8 | 233 | 0x0E9 | Unit Line Voltage 1 | AC Line 1 Voltage | V | 32768 |
| 234 | 0x0EA | 235 | 0x0EB | Unit Line Current 1 | AC Line 1 Current | A | 32768 |
| 236 | 0x0EC | 237 | 0x0ED | Unit Line Voltage 2 | AC Line 2 Voltage | V | 32768 |
| 238 | 0x0EE | 239 | 0x0EF | Unit Line Current 2 | AC Line 2 Current | A | 32768 |
| 240 | 0x0F0 | 241 | 0x0F1 | Unit Line Voltage 3 | AC Line 3 Voltage | V | 32768 |
| 242 | 0x0F2 | 243 | 0x0F3 | Unit Line Current 3 | AC Line 3 Current | A | 32768 |
| 244 | 0x0F4 | 245 | 0x0F5 | Unit Battery Check Time Elapsed | Timer for Battery Check elapsed time | Sec | 1 |
| 246 | 0x0F6 | 247 | 0x0F7 | Unit Battery Check Due | Time until next Battery Check | Sec | 1 |
| 248 | 0x0F8 | 249 | 0x0F9 | Unit Number of Chargers | Number of modules | Num | 1 |

12.4. Basic Charging Alarms Bit Definition

| Bit Address | | Name | Description |
|-------------|------|--------------------------|---|
| Decimal | Hex | | |
| 0 | 0x00 | AC Fail | AC input voltage is not detected by the module. |
| 1 | 0x01 | High DC | DC output voltage is above the High DC Voltage alarm setpoint. |
| 2 | 0x02 | Low DC | DC output voltage is below Low DC Voltage alarm setpoint. |
| 3 | 0x03 | Charger Fail | Module has failed. Module is not able to provide the current demanded by the battery and/or load or is providing more current than the unit's control system is commanding. |
| 4 | 0x04 | Over Voltage Shutdown | DC output voltage is above Over Voltage Shutdown setpoint and unit has executed a high voltage shutdown. This only occurs when the overvoltage is caused by the charger. |
| 5 | 0x05 | Reverse Polarity | Battery is connected backwards. Output is disabled until the condition is corrected. |
| 6 | 0x06 | Unused | Unused |
| 7 | 0x07 | Incompatible Battery | Unit is connected to an incompatible battery and is unable to bring up the output voltage after a set period of time. |
| 8 | 0x08 | Invalid Settings | Settings are not valid. Output is disabled until the condition is corrected. |
| 9 | 0x09 | Unused | Unused |
| 10 | 0x0A | Thermal Fold Back | Output power has been reduced to protect from over-heating. |
| 11 | 0x0B | Temperature Probe Fault | Disabled or failed remote temperature sensor. Temperature compensation is forced OFF when sensor is shorted. |
| 12 | 0x0C | Current Limiting | Charger is operating at maximum allowable output, either maximum current or maximum power, whichever occurs first. |
| 13 | 0x0D | Ground Fault Positive | Ground fault current to the positive output terminal is above the Ground Fault Trip sensitivity setpoint. |
| 14 | 0x0E | Low Current | Output Current is under the Low Current Alarm setpoint. |
| 15 | 0x0F | Load Share Fault | Modules or chargers connected for load sharing are not sharing the current load. |
| 16 | 0x10 | AutoBoost Lockout Active | Boost mode time limit has expired and charger has returned to Float mode. Boost mode is disabled until the time limit is reset. The Boost time limit is reset when power is cycled. |
| 17 | 0x11 | Unused | Unused |

| | | | |
|----|------|--------------------------|---|
| 18 | 0x12 | SENS Bus Inactive | Device is not communicating on SENSbus. |
| 19 | 0x13 | Battery On Discharge | Battery is beginning to discharge and DC output voltage is below Batt Discharge Voltage alarm setpoint. |
| 20 | 0x14 | Battery End Discharge | DC output voltage is below Batt End Discharge Voltage alarm setpoint. |
| 21 | 0x15 | Ground Fault Negative | Ground fault current to the negative output terminal is above the Ground Fault Trip sensitivity setpoint. |
| 22 | 0x16 | DC Negative open | Chargers connected in parallel that suffer a loss of high current negative connection may try to route power through the SENSbus cabling. This alarm shows that a charger has detected the issue and has shut itself off. Please check battery terminal connections |
| 23 | 0x17 | DC Below Startup Voltage | Battery voltage is below the Startup Voltage setpoint. Unit output voltage is disabled. Forced startup feature overrides. |
| 24 | 0x18 | Fan Fail | There is a problem with one or more of the module fans. |
| 27 | 0x1B | Battery Check | Battery has failed the most recent battery check. |

12.5. Charging Status Bit Definition

| Bit Address | | Name | Description |
|-------------|------|---------------------------|--|
| Decimal | Hex | | |
| 0 | 0x00 | Output Idle | Charging status - Output Idle |
| 1 | 0x01 | Follower Mode | Charging status - Follower Mode |
| 2 | 0x02 | Helix Float Charge | Charging status - Helix Float |
| 3 | 0x03 | Float Charge | Charging status - Float Charge |
| 4 | 0x04 | Helix Refresh Charge | Charging status - Helix Refresh Charge |
| 5 | 0x05 | Auto Boost Charge | Charging status - Auto Boost Charge |
| 6 | 0x06 | Periodic Boost Charge | Charging status - Periodic Boost Charge |
| 7 | 0x07 | Battery Check Active | Charging status - Battery Check Active |
| 8 | 0x08 | Commission Charge | Charging status - Commission Charge |
| 9 | 0x09 | High Charger Current | Output current is more than rated current. |
| 10 | 0x0A | Unused | Unused |
| 11 | 0x0B | Unused | Unused |
| 12 | 0x0C | Using Battery Temperature | Charger reading battery temperature and is compensating the voltage. |
| 13 | 0x0D | UltraCap Mode Active | Charger is set to charge an Ultra Capacitor. |
| 14 | 0x0E | Battery Check Passed | Battery Check test successfully passed |

12.6. Charging Alarms Extended Bit Definition

| Bit Address | | Name | Description |
|-------------|------|---------------|--|
| Decimal | Hex | | |
| 0 | 0x00 | Check Filter | Module has experienced a thermal roll back which can be caused by a clogged input air filter. |
| 1 | 0x01 | Thermal Fault | Module has faulted because it over-heated and thermal fold-back has reached zero watts. Module output has been disabled. |

| | | | |
|---|------|-----------------------------------|--|
| 2 | 0x02 | High Battery Temperature | Battery temperature is above the High Battery Temperature alarm setpoint. |
| 3 | 0x03 | High Battery Temperature Shutdown | Battery temperature is high enough that the unit has shut off for safety precautions. Only available when a remote battery temperature sensor is installed with the optional remote battery monitor. |
| 4 | 0x04 | High AC Ripple Detected on Output | Charger's output ripple is above High AC Ripple Detection alarm setpoint. |
| 5 | 0x05 | DC Output Open | Charger has detected that the output is not connected to anything. |
| 6 | 0x06 | Charger Low Temperature | Unit ambient temperature is below its rated ambient temperature, unit output may be derated. |
| 7 | 0x07 | Battery Low Temperature | Battery temperature is below Battery Low Temperature alarm setpoint. Only available when a remote battery temperature sensor is installed with the optional remote battery monitor. |

12.7. Charging AC Alarms Bit Definition

| Bit Address | | Name | Description |
|-------------|------|---------------------------|--|
| Decimal | Hex | | |
| 0 | 0x00 | Unused | Unused |
| 1 | 0x01 | AC Phase Missing | An AC phase is missing or out of range. Only available in a 3-phase capable device. |
| 2 | 0x02 | AC Voltage Over Maximum | AC Voltage has gone above max AC voltage allowed by the charger on any phase. NOTE: This alarm has a delay of 3 seconds. Output has been disabled. |
| 3 | 0x03 | AC Voltage Low | AC Voltage has gone below AC Min Voltage alarm setpoint. |
| 4 | 0x04 | AC Frequency Out Of Range | AC Frequency is outside of the AC High Frequency and AC Low Frequency alarm setpoints. |
| 5 | 0x05 | AC Voltage High | AC Voltage is above the AC Max Voltage alarm setpoint. |

12.8. Accessory Channel Alarms Bit Definition

| Bit Address | | Name | Description |
|-------------|------|-----------------------|---|
| Decimal | Hex | | |
| 0 | 0x00 | Invalid Settings | Setting for this channel are invalid and must be corrected before settings may be sent to the chargers on this channel. |
| 1 | 0x01 | Low Current Channel | Channel Current is below Low Current alarm setpoint. |
| 2 | 0x02 | Invalid System Config | System configuration settings are invalid. |

12.9. Accessory System Alarms Bit Definition

| Bit Address | | Name | Description |
|-------------|------|-----------------------|--|
| Decimal | Hex | | |
| 0 | 0x00 | Invalid System Config | Configuration of system is conflicted. Charger will continue to operate but may not be fully functional until the issue is resolved. |
| 1 | 0x01 | AC1 SPD | The AC supplementary surge protector has expired and needs replacement. |

| | | | |
|----|------|----------------------|--|
| 2 | 0x02 | AC1 Breaker | The AC breaker is OPEN or has tripped. Only available with Breaker Status option. |
| 3 | 0x03 | Unused | Unused |
| 4 | 0x04 | Unused | Unused |
| 5 | 0x05 | DC SPD | The DC supplementary surge protector has expired and needs replacement. |
| 6 | 0x06 | DC Breaker | The DC breaker is OPEN or has tripped. Only available with Breaker Status option. |
| 7 | 0x07 | Unused | Unused |
| 8 | 0x08 | Unused | Unused |
| 9 | 0x09 | Unused | Unused |
| 10 | 0x0A | Unused | Unused |
| 11 | 0x0B | System Display Board | This device is configured as a system display board. It will present information for the entire system, even if devices are not in its unit. |
| 12 | 0x0C | Unused | Unused |
| 13 | 0x0D | SENSbus Inactive | No other devices are found on SENSbus. |
| 14 | 0x0E | Unused | Unused |
| 15 | 0x0F | Unused | Unused |
| 16 | 0x10 | Unused | Unused |
| 17 | 0x11 | Unused | Unused |
| 18 | 0x12 | No Power Board Data | No module power boards are found on SENSbus. |

12.10. Accessory Assigned Channel Alarms Bit Definition

| Bit Address | | Name | Description |
|-------------|------|-------------------------|--|
| Decimal | Hex | | |
| 0 | 0x00 | Invalid Config | The configuration of one or more power modules in the unit is invalid. |
| 1 | 0x01 | Individual Module Fault | A power module in the unit has faulted. |

12.11. Writable Control Flags (Coils) - Single coil writes: 0xFF00 for ON, 0x0000 for OFF

| Address | | Description | Details |
|---------|-------|--------------------------------------|------------------------------------|
| Decimal | Hex | | |
| 16 | 0x010 | Start/stop manual boost | ON to start, OFF to stop |
| 17 | 0x011 | Reset periodic boost charge schedule | ON to reset schedule, OFF is no-op |
| 18 | 0x012 | Start/stop battery check | ON to start, OFF to stop |
| 19 | 0x013 | Reset periodic battery | ON to reset schedule, OFF is no-op |
| 20 | 0x014 | Clear battery check failure | ON to reset alarm, OFF is no-op |
| 21 | 0x015 | Not applicable | Not applicable |
| 22 | 0x016 | Force DC Startup | ON to start, OFF to stop |
| 23 | 0x017 | Reset Latched Alarms | ON to reset alarm, OFF is no-op |

13 TROUBLESHOOTING/ERROR CODES

13.1. Configuration Error Codes

Error codes are displayed on optional front panel LCD.

| Error | Scope | Description | Corrective Action |
|-------|------------------|---|--|
| 104 | Charger Module | Invalid output channel. Chargers must be set to use a valid output channel setting: use output A for single output units. | <ul style="list-style-type: none"> - If necessary, enable the channel using the keypad "DC Output #" selection in the "DC -> Advanced Settings" menu or the setup utility. - To select a different output channel, reassign the charger to match its actual output channel connection using the setup utility. |
| 201 | Channel | No chargers assigned to output channel. Every enabled output channel must have at least one charger assigned to it. When none is found, it is presumed that a charger has failed, has lost SENSbus data communication, or has an incorrect channel setting. | <ul style="list-style-type: none"> - Check for a charger that has failed (indicated by its LED status). - Check for disconnected or damaged SENSbus data cables. - If the output channel is not to be used, disable it by using the keypad "DC Output #" setting in the "DC -> Advanced Settings" menu or the setup utility. |
| 202 | Channel | Too few chargers operating. The combined output rating of all chargers operating on this channel is less than the channel's rated output. This can occur because a charger has failed, has an open AC input or DC output connection, has lost SENSbus data communication, is configured for the wrong output channel, etc. | <ul style="list-style-type: none"> - Use the "DC Output #" setting in the "DC -> Advanced Settings" menu or the setup utility to verify all chargers' output channel settings. Each charger must be set for the output channel corresponding to its electrical DC output connection. - Use the setup utility to verify the channel DC output current and power ratings. - Check for disconnected or damaged SENSbus data cables. - Check for miswired, disconnected, or damaged input and output connections. |
| 203 | Channel | Charger assigned to a disabled channel. All chargers must either be set for non-channelized operation (0, Default output) or to a valid output channel that is enabled in this unit or system. | <ul style="list-style-type: none"> - To use this channel, enable it using the keypad "DC Output #" selection in the "DC -> Advanced Settings" menu or the setup utility. Verify that the DC outputs of all chargers assigned to this channel are electrically connected to that output bus. |
| 305 | Unit (or System) | Rogue Module Found. This can apply to any type of system. It indicates that a charger module was found that has a Unit Serial Number that does not match any display found on the bus. This could happen when adding a module from another system. | Corrective action is to fix Unit Serial Numbers on all chargers/modules and Accessory boards. |

13.2. Troubleshooting

| AC LED | DC LED | Symptom | Possible Causes | Recommended Actions |
|-------------|----------------------|---|--|--|
| OFF | OFF | Both AC and DC LEDs are off and display is off on models with optional display | <ol style="list-style-type: none"> 1. Proper AC or DC voltages not applied 2. Frozen accessory display board or charger module 3. Failed accessory display board or charger module | <ol style="list-style-type: none"> 1. Using a voltmeter, check that AC input voltage and frequency are in the range 80VAC – 265VAC / 47Hz – 63Hz or that >8VDC is present at DC output terminals. Correct charger AC input as required. 2. If step 1 doesn't resolve issue, press the "Sleep" button and remove AC power for 1 minute, then reapply power. <p>If steps 1 and 2 don't resolve issue, charger module failure is the likely cause. Replace unit.</p> |
| SOLID GREEN | FLASH or SOLID GREEN | Unable to Communicate using J1939 on models <u>with accessory display board</u> | <ol style="list-style-type: none"> 1. Address is not configured or is configured for the wrong position 2. No communication bus termination installed 3. Communication cable is plugged into the wrong unit port 4. Wiring is incorrect 5. Unsupported or incorrect J1939 command 6. Incorrect address or address conflict | <ol style="list-style-type: none"> 1. Verify that Battery Charger (BCH) 1 or Battery Charger (BCH) 2 (depending on selected address) is configured using keypad or setup utility. 2. Verify that both ends of the J1939 bus is terminated. (Note that a terminator is not required if the unit is not at the end of the communication bus). 3. Verify that communication cable is connected to the port marked J1939. Correct cabling as required. 4. If communication cable is connected correctly, verify that cabling is correct and the J1939 Data High goes to pin 1 and that J1939 Data Low goes to pin 2. 5. If cable wiring is correct, verify that requested command is supported by SENS unit per J1939 table in manual. 6. Check for address conflicts on the network |
| SOLID GREEN | FLASH or SOLID GREEN | Basic J1939 communications work but SENS extended commands don't work | <ol style="list-style-type: none"> 1. SENS extended J1939 commands are not enabled | <ol style="list-style-type: none"> 1. Enable SENS extended J1939 commands using keypad or setup utility |
| SOLID GREEN | FLASH or SOLID GREEN | Unable to Communicate using MODBUS | <ol style="list-style-type: none"> 1. No communication bus termination installed 2. Communication cable is plugged into the wrong unit port 3. Wiring is incorrect 4. Incorrect MODBUS | <ol style="list-style-type: none"> 1. Verify that a terminator is installed as directed in the manual (note that a terminator is not required if the unit is not at the end of the communication bus). 2. If terminator is installed, verify that communication cable is connected to ports as directed in the manual, in the Modbus connections section. Correct cabling as required. |

| | | | | |
|-------------|-----------------------|---|---|---|
| | | | settings (baud rate, address) | <p>3. For serial applications, if cable is connected correctly, verify that Modbus +D1 (A) goes to connector position 1 and that Modbus –D0 (B) goes to position 2.</p> <p>4. If cable wiring is correct, verify that unit and application MODBUS settings are as required. Adjust settings using keypad or setup utility as required.</p> |
| SOLID GREEN | SOLID RED | AC good, charger fail or overvoltage shutdown | <p>1. Charger has experienced an unexpected fault</p> <p>2. Programmed settings are incorrect (OVSD set too low)</p> <p>3. Charger module failure</p> | <p>1. Press “Sleep” button and remove AC power for 1 minute, then reapply power.</p> <p>2. If fault remains, check overvoltage shutdown settings and again remove power for 1 minute, then reapply power.</p> <p>3. If steps 1 and 2 don’t resolve issue, a charger module failure is the likely cause. Replace unit.</p> |
| SOLID GREEN | SOLID YELLOW | AC good, high battery voltage | <p>1. Alarm setpoint incorrect for application</p> <p>2. DC voltage is high due to an external source</p> | <p>1. Check that unit settings and alarms are set appropriately.</p> <p>2. If settings and alarms are correct, check and correct high output/load voltage due to any other connected equipment.</p> |
| SOLID GREEN | SOLID YELLOW | AC good, low battery voltage | <p>1. Alarm setpoint incorrect for application</p> <p>2. Battery discharged or defective</p> | <p>1. Check that unit settings and alarms are set appropriately.</p> <p>2. Verify battery is being charged. Measure that output voltage is correct at battery terminals and/or output current is present. If settings and alarms are correct and battery voltage is not improving, likely cause is failed internal battery. Replace unit.</p> |
| SOLID GREEN | FLASHING GREEN/YELLOW | AC good, output power limited | <p>1. Charger power is reduced to protect unit due to high temperatures</p> | <p>1. Reduce operating environment temperature. Unit will automatically increase power as temperature is lowered.</p> |
| SOLID GREEN | DOUBLE FLASH YELLOW | AC good, load share fail | <p>1. Charger output settings do not match between units</p> | <p>1. Check that individual unit settings are identical. Adjust as required. After making any adjustments, unplug and re-plug load share cable from unit.</p> |
| SOLID GREEN | DOUBLE FLASH RED | AC good, output disabled | <p>1. Too many devices on the SENSbus network</p> | <p>1. Ensure that less than max allowed number of devices is on the SENSbus.</p> <p>2. If step 1 doesn’t resolve issue, a failed display board is likely. Replace unit.</p> |
| SOLID RED | SOLID GREEN | AC fail, battery voltage good | <p>1. Proper AC voltages or frequency not applied</p> <p>2. Charger failure</p> | <p>1. Using a voltmeter, check that AC input voltage and frequency are in the range 80VAC – 265VAC / 47Hz – 63Hz. Correct charger AC input voltage as required</p> <p>2. If step 1 doesn’t resolve issue, a unit failure is the likely cause. Replace unit.</p> |

| | | | | |
|------------------|---------------------|--------------------------------------|--|---|
| <p>SOLID RED</p> | <p>SOLID YELLOW</p> | <p>AC fail, high battery voltage</p> | <p>1. Proper AC voltages or frequency not applied 2. Charger failure</p> <p>And</p> <p>3. Alarm setpoint incorrect for application 4. DC voltage is high due to an external source such as an alternator</p> | <p>AC LED</p> <p>1. Using a voltmeter, check that AC input voltage and frequency are in the range 80VAC – 265VAC / 47Hz – 63Hz or that >8VDC is present at DC output terminals. Correct charger AC input voltage as required. 2. If step 1 doesn't resolve RED AC light, press the "Sleep" button and remove AC power for 1 minute, then reapply power. 3. If steps 1 and 2 don't resolve RED AC light, unit failure is the likely cause. Replace unit.</p> <p>DC LED</p> <p>1. Check that unit settings and alarms are set appropriately. 2. If settings and alarms are correct, check and correct high output/load voltage due to any other connected equipment.</p> |
| <p>SOLID RED</p> | <p>SOLID YELLOW</p> | <p>AC fail, low battery voltage</p> | <p>1. Proper AC voltages or frequency not applied 2. Charger failure</p> <p>And</p> <p>3. Alarm setpoint incorrect for application 4. Battery discharged or defective</p> | <p>AC LED</p> <p>1. Using a voltmeter, check that AC input voltage and frequency are in the range 80VAC – 265VAC / 47Hz – 63Hz or that >8VDC is present at DC output terminals. Correct charger AC input voltage as required. 2. If step 1 doesn't resolve RED AC light, press the "Sleep" button and remove AC power for 1 minute, then reapply power. 3. If steps 1 and 2 don't resolve RED AC light, unit failure is the likely cause. Replace unit.</p> <p>DC LED</p> <p>1. Check that unit settings and alarms are set appropriately. 2. Verify AC is present and battery is being charged. Measure that output voltage is correct at battery terminals and/or output current is present. If settings and alarms are correct and battery voltage is not improving, likely cause is failed internal battery. Replace unit.</p> |

| | | | | |
|------------------------------|-----------|---|---|--|
| SOLID RED | SOLID RED | AC fail, charger fail or overvoltage shutdown | <ol style="list-style-type: none"> 1. Unit is in fault state 2. Programmed settings are incorrect (OVSD set too low) 3. Charger module failure | <p>AC LED</p> <ol style="list-style-type: none"> 1. Using a voltmeter, check that AC input voltage and frequency are in the range 80VAC – 265VAC / 47Hz – 63Hz or that >8VDC is present at DC output terminals. Correct charger AC input voltage as required. 2. If step 1 doesn't resolve RED AC light, press the "Sleep" button and remove AC power for 1 minute, then reapply power. 3. If steps 1 and 2 don't resolve RED AC light, unit failure is the likely cause. Replace unit. <p>DC LED</p> <ol style="list-style-type: none"> 1. Press "Sleep" button and remove AC power for 1 minute, then reapply power. 2. If fault remains, check overvoltage shutdown settings and again remove power for 1 minute, then reapply power. 3. If steps 1 and 2 don't resolve issue, a charger module failure is the likely cause. Replace unit. |
| ALTERNATING FLASHING YELLOW | | No output | 1. Illegal configuration | 1. Ensure that unit has been programmed to desired and allowable settings. |
| SYNCHRONIZED FLASHING YELLOW | | No output | 1. Missing /damaged internal device | Unit failure is the likely cause. Replace unit. |
| ALTERNATING FLASHING RED | | No output | 1. Missing or invalid code (boot load required) | <ol style="list-style-type: none"> 1. Update unit firmware using setup utility. 2. If step 1 doesn't resolve issue or setup utility is not available, replace unit. |
| ALTERNATING FLASHING GREEN | | Starting-up | <ol style="list-style-type: none"> 1. Unit is still powering-on 2. Failed accessory display board | <ol style="list-style-type: none"> 1. Press the "Sleep" button and remove AC power for 1 minute, then reapply power. Allow unit at least 1 minute to fully boot. 2. If step 1 doesn't resolve issue, a display board failure is the likely cause. Replace unit. |

14 RECYCLING

Contact Stored Energy Systems to recycle SuperTorque 8Z products. Stored Energy Systems will supply new SuperTorque 8Z units and the old units can be shipped to the appropriate recycling center using a provided prepaid shipping label and packaging. Nickel-zinc batteries are recognized and listed in the Call2Recycle program and may be recycled at more than 50,000 collection sites in North America.

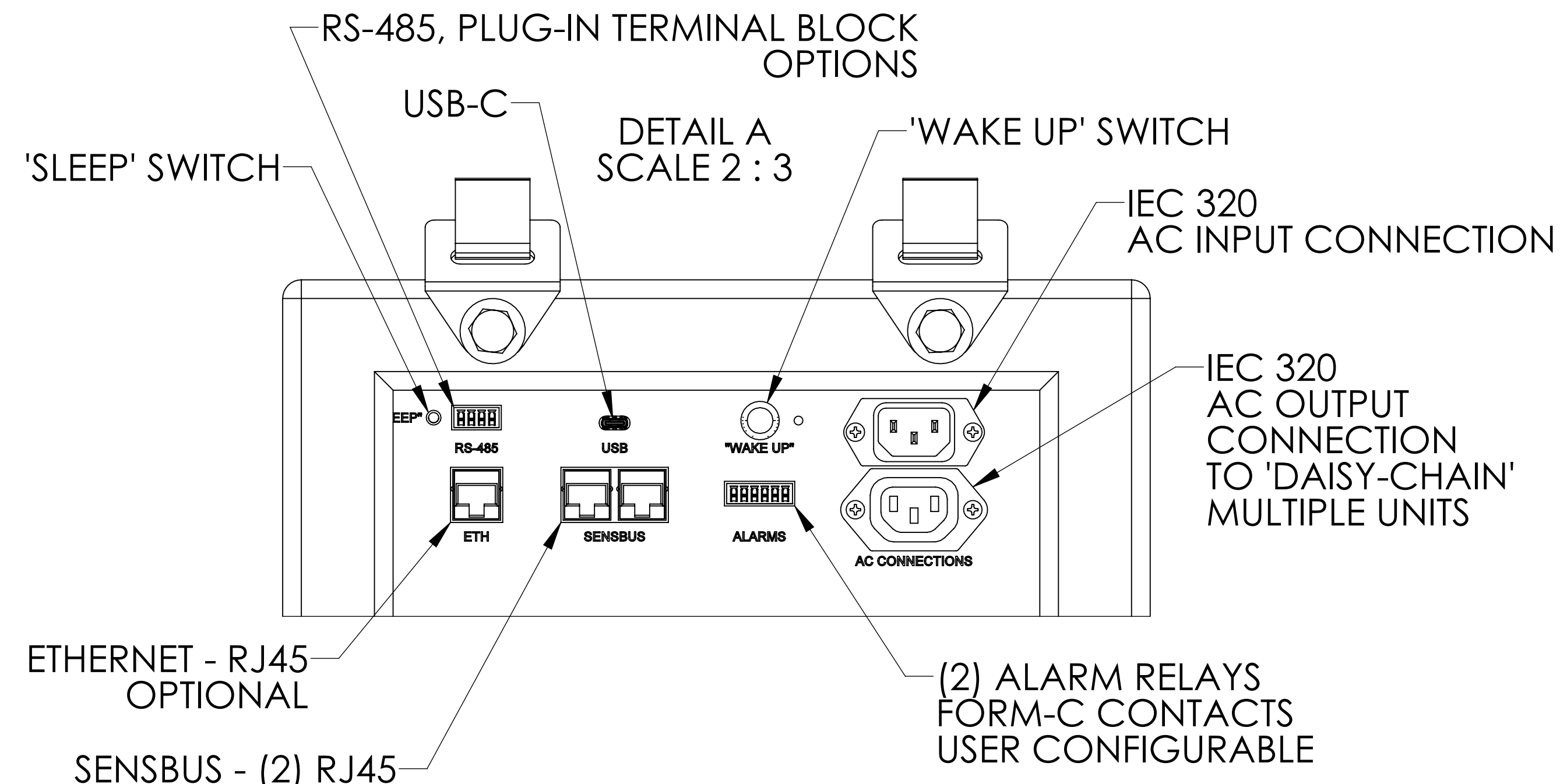
15 GLOSSARY

| | |
|--------------------------------|---|
| Original Factory Configuration | Configuration set at the factory and requires no adjustments before operating. Charger operates using settings configured at the factory per customer order. See configuration details on product label. |
| Float Voltage | Float output voltage is used to maintain batteries in a fully charged state and prevents a fully charged battery from becoming overcharged. |
| Boost Voltage | “Boost” describes an elevated output voltage employed to accelerate the recharge of a battery that is periodically discharged. The voltage employed to boost charge batteries is typically the same as that employed to “equalize” cells of a battery on long-term float charge. The terms “Boost” and “Equalize” are often used interchangeably. SENS’ convention is to employ the term “Boost” when referring to both the fast recharge function and the cell equalization function described under the definition of “Equalize Voltage”. |
| Equalize Voltage | “Equalize” describes an elevated voltage typically employed to reset the series-connected cells of a battery such that cell voltages and capacities more nearly match each other. Equalize charging is employed to improve the performance and life of an already charged battery that is primarily charged using Float voltage. SENS’ convention is to employ the term “Boost” to mean both this cell equalization function and the fast battery recharge function. |
| Configuration Code | Indicates unit relay assignment configuration. Configuration code is included on the product label. |
| Modbus | Modbus is an application layer messaging protocol provided by Modbus Organization and used for client/server communication. Modbus is provided over RS-485 in RTU mode or over TCP/IP as an option. |

SUPER TORQUE 8Z ENGINE STARTING SYSTEM

- 12 OR 24 VOLT ENGINE STARTING SYSTEM
- INTEGRATED BATTERY, CHARGER, AND CONTROL SYSTEM IN AN 8D SIZED PACKAGE
- INTERNAL NICKEL ZINC BATTERIES
- INTERNAL SENS MG2 15A CHARGER
- USER CONNECTIONS ALL EXTERIOR, PROTECTED AND COVERED
- 110-240 VAC INPUT, 4A
- VIA IEC-320 C13 INLET CONNECTOR
- 8FT LOCKING AC CORD PROVIDED STANDARD
- OPTIONAL UL LISTED FIELD TERMINABLE LOCKING CONNECTOR
- IEC-320 C14 OUTLET TO DAISY-CHAIN UP TO TWO UNITS
- COMMUNICATIONS
- STANDARD - (2) ALARM RELAYS, USB, CANBUS
- OPTIONAL - MODBUS RS-485
- OPTIONAL - ETHERNET, MODBUS RS485, AND TCP/IP
- WEIGHT - 89LBS

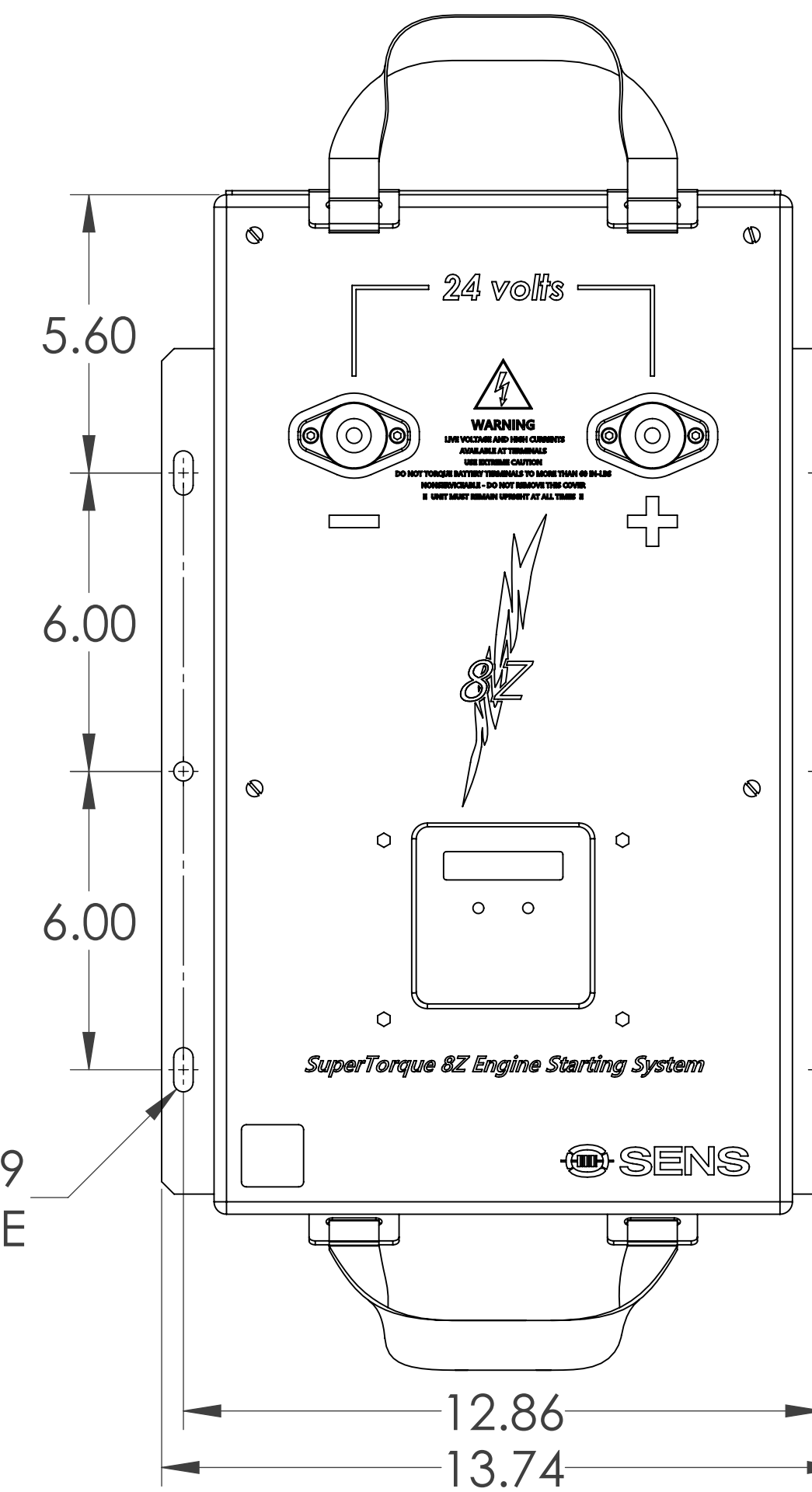
| REVISIONS | | | | |
|-----------|-----|-----------------|-----------|----------|
| DCN | REV | DESCRIPTION | DATE | APPROVED |
| 108283 | A | INITIAL RELEASE | 9/13/2022 | BJB |



ETHERNET - RJ45
OPTIONAL

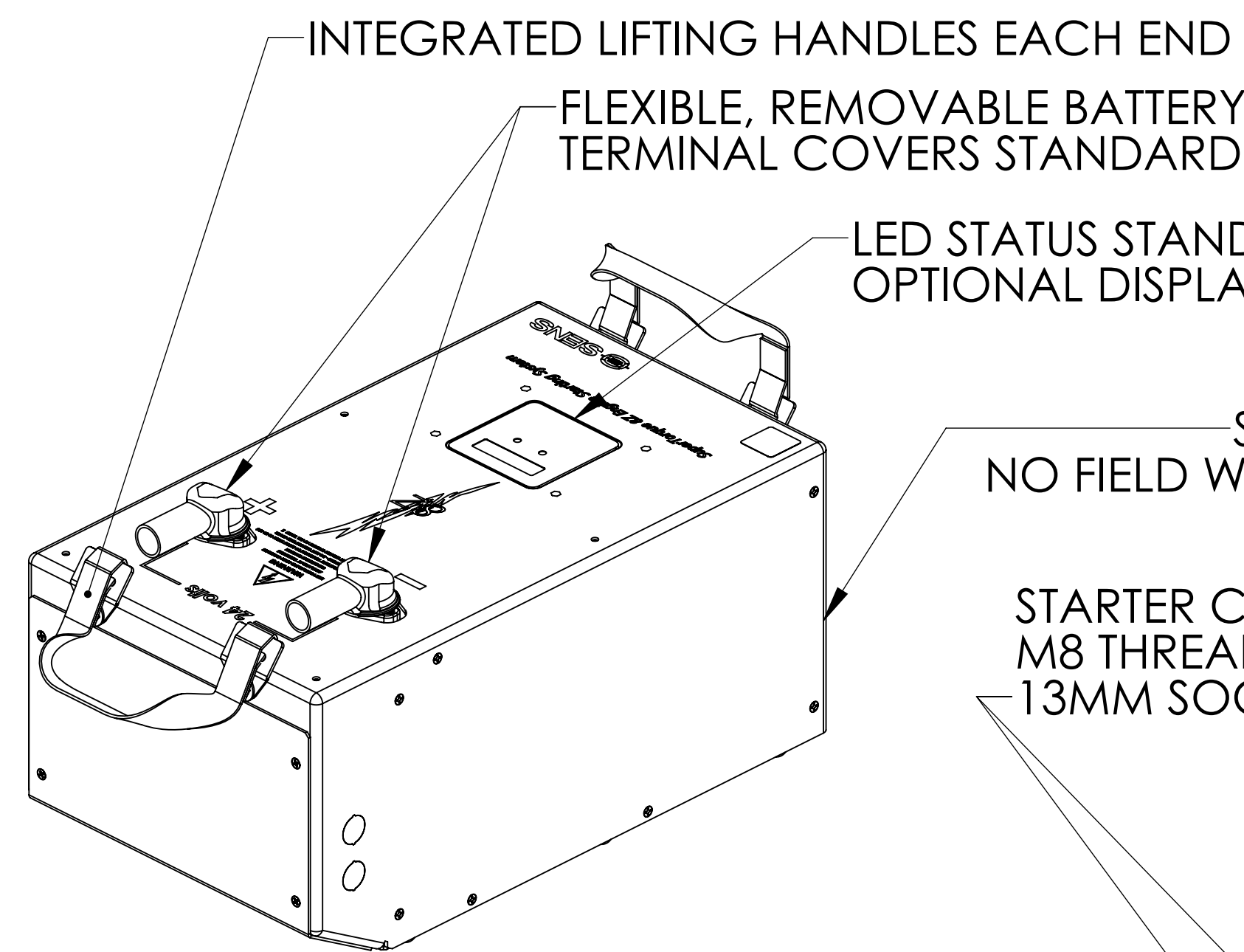
SENSBUS - (2) RJ45

MOUNTING BRACKET
DIMENSIONS



FOR 3/8 IN HARDWARE

2X EACH SIDE
KNOCKOUTS FOR CONDUIT
1/2 INCH NPT

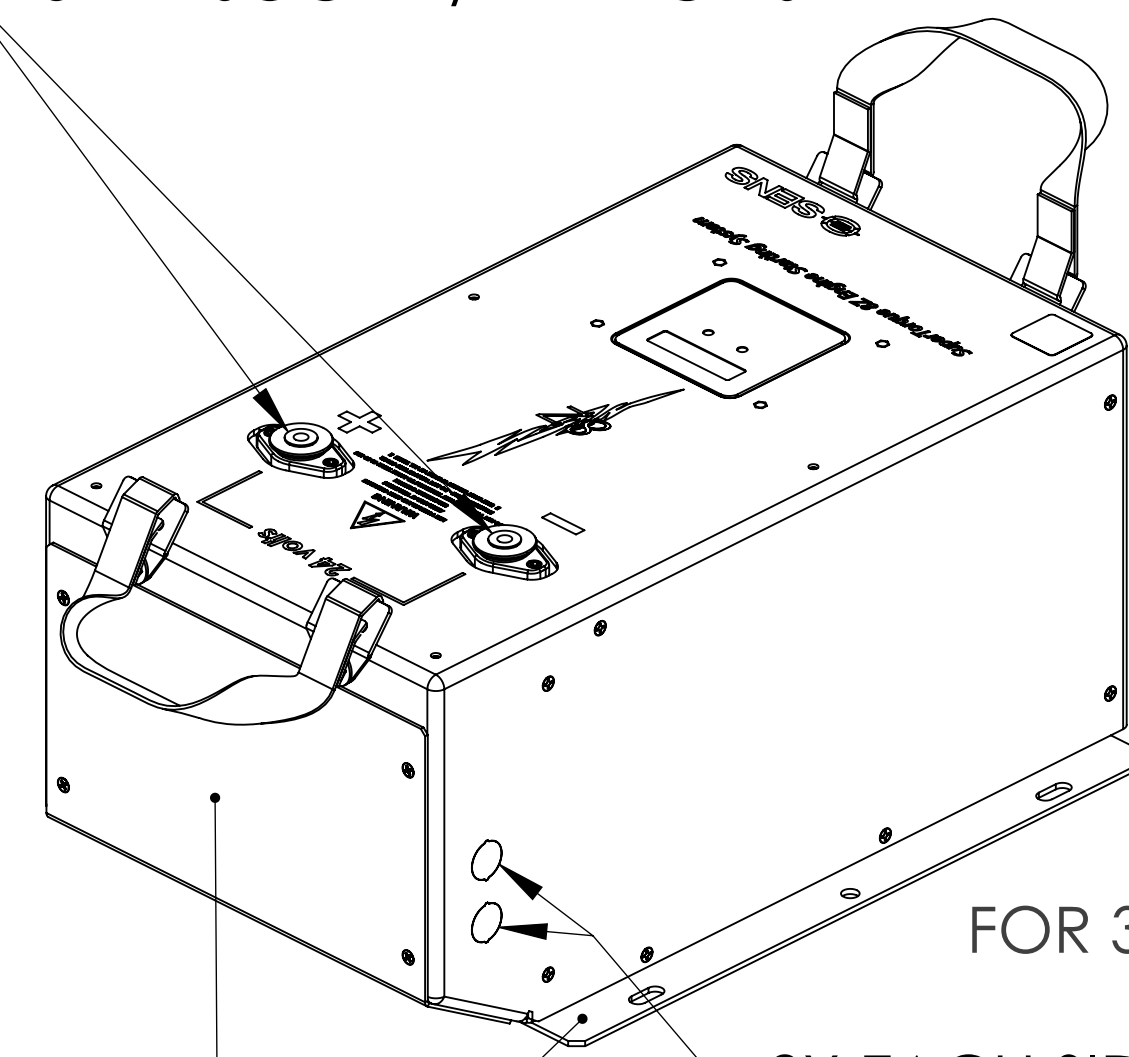


INTEGRATED LIFTING HANDLES EACH END
FLEXIBLE, REMOVABLE BATTERY
TERMINAL COVERS STANDARD

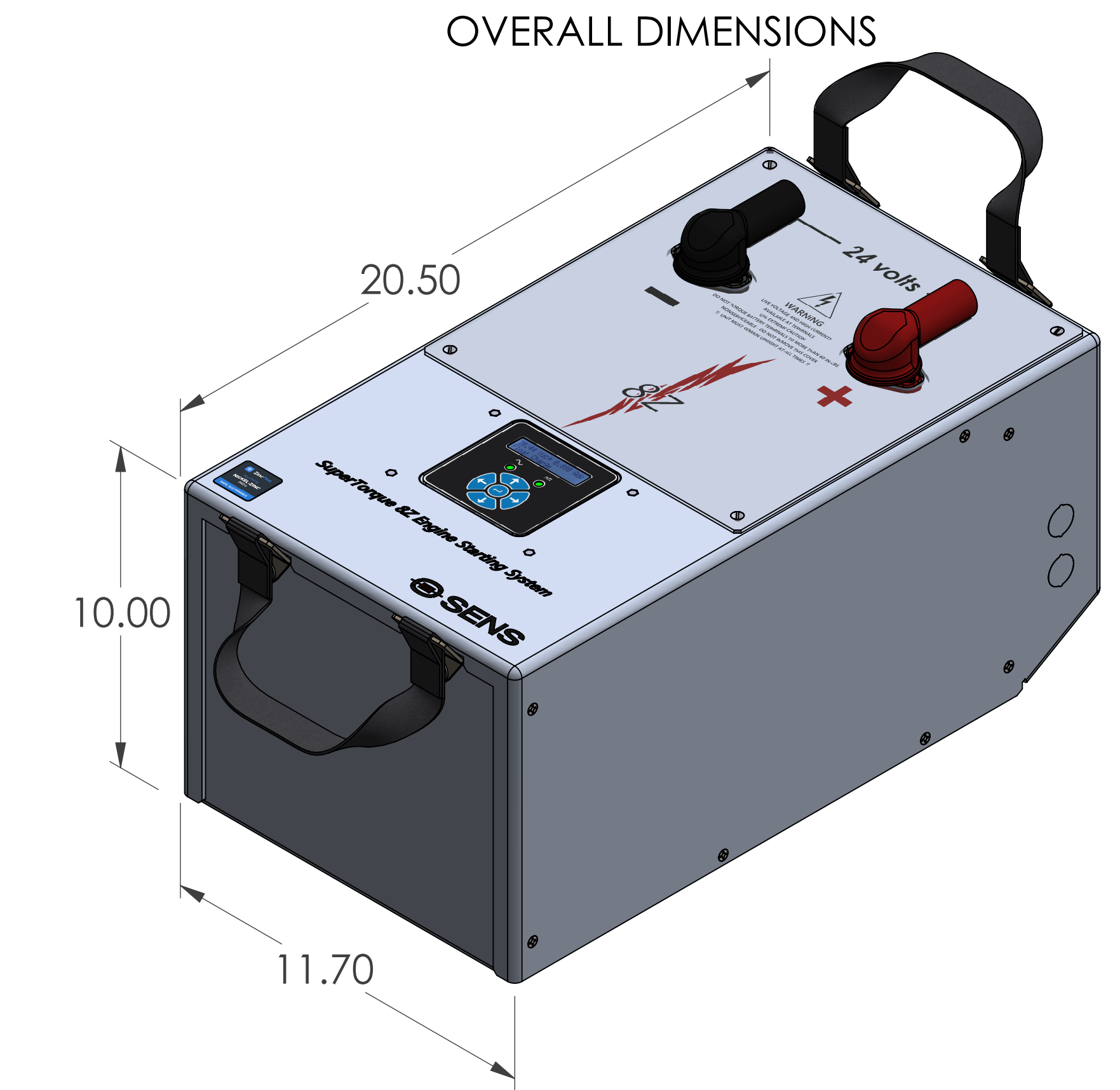
LED STATUS STANDARD
OPTIONAL DISPLAY AND KEYPAD CONTROL

SHOWN AS STANDARD CONFIGURATION
NO FIELD WIRING COVER OR MOUNTING BRACKETS
RUBBER FEET ON BASE

STARTER CONNECTION TERMINALS
M8 THREADED INSERT FOR RING LUG CONNECTION
13MM SOCKET/WRENCH SIZE

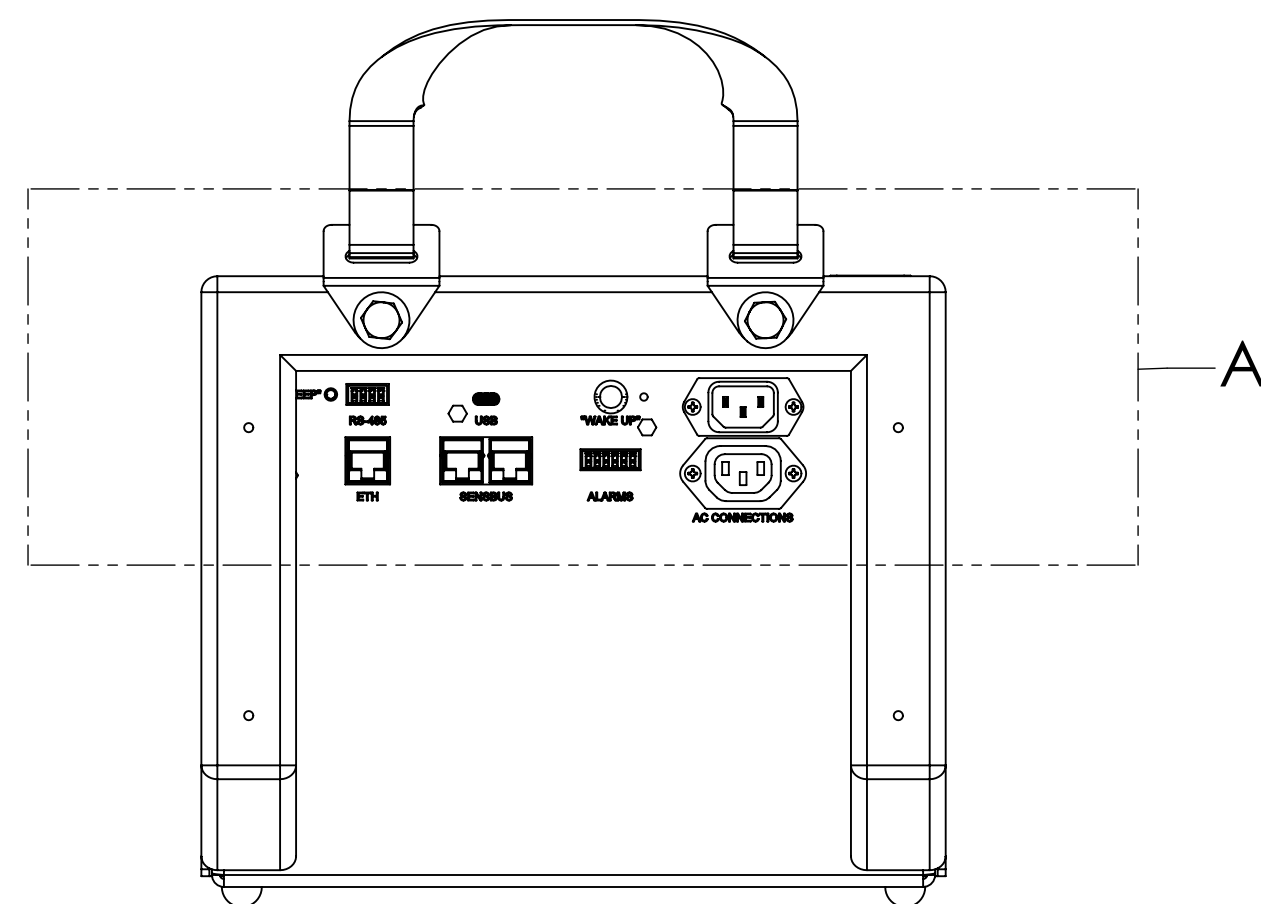


SHOWN AS 'RIGID' CONFIGURATION
WITH OPTIONAL FIELD WIRING COVER
AND RIGID MOUNTING BRACKETS



OVERALL DIMENSIONS

FRONT VIEW



1840 INDUSTRIAL CIRCLE
LONGMONT, CO 80501
303-678-7500
WWW.SENS-USA.COM
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DEFAULT TOLERANCES:
ANGLES ± 1°
TWO PLACE DECIMAL ± .02
THREE PLACE DECIMAL ± .005
DO NOT SCALE DRAWING

| NAME | DATE | DESCRIPTION | REV |
|--|------------|-------------------|-----------------|
| ERS | 12/29/2021 | 2DCAD,8Z,STANDARD | A |
| THIRD ANGLE PROJECTION | | SIZE | DOCUMENT NUMBER |
| DIMENSIONS & TOLERANCES PER ASME Y14.5 - 2009 | | D | 2DCAD,8Z,STD |
| | | | SHEET 1 OF 1 |



Confirmation of Product Type Approval

Company Name: STORED ENERGY SYSTEMS, LLC

Address: 1840 INDUSTRIAL CIRCLE CO 80501 United States

Product: Battery Charger

Model(s): SuperTorque 8Z

Endorsements:

| Certificate Type | Certificate Number | Issue Date | Expiry Date |
|---------------------------------|---------------------------|-------------------|--------------------|
| Product Design Assessment (PDA) | 22-2316015-PDA | 09-JAN-2023 | 08-JAN-2028 |
| Manufacturing Assessment (MA) | 23-5820693 | 15-MAY-2023 | 30-MAY-2028 |
| Product Quality Assurance (PQA) | NA | NA | NA |

Tier

5 - Unit Certification Required

Intended Service

Engine starting and support of DC loads for Marine and Offshore Applications

Description

Genset starting system with integrated batteries and charger.

Ratings

AC Charger Input Voltage: 90-265VAC

AC Charger Input Frequency: 47-63Hz

DC Output Voltage: 12 or 24 VDC

Internal Battery Capacity: 40 Ahr, 80 Ahr, or 160 Ahr

DC Charging Rated Current: 15A

DC Charging Characteristic: Constant voltage, current limited; patented Dynamic Boost control

Communication options: LED for status, SENSbus, USB-C, Modbus RS-485, Ethernet, Keypad

Output Power: 450W max

Operational temperature at full rated output: -10C to +55C

Enclosure: IP 44

Service Restrictions

Unit Certification is not required for this product (ratings less than 25 kW).

If the manufacturer or purchaser requests an ABS Certificate for compliance with a specification or standard, the specification or standard, including inspection standards and tolerances, must be clearly defined.

Not suitable for installation in hazardous areas.

Comments

The Manufacturer has provided a declaration about the control of, or the lack of Asbestos in this product.

End-user must use output cables that have sufficient current-carrying capacity as per ABS Marine Vessel Rules 4-8-2/7.7.1.

Notes, Drawings and Documentation

Drawing No. 8Z , 8Z Drawing, Revision: A, Pages: 1

Drawing No. 8Z Rain Test Report, Test Report per UL 1012, Revision: -, Pages: 5

Drawing No. Alarms, 8Z Alarms, Revision: A, Pages: 1

Drawing No. Model, 8Z Model Designation, Revision: A, Pages: 1

Drawing No. Tests, Charge Discharge Tests, Revision: A, Pages: 1

Drawing No. UL 9540A Cell Level Test Details Summary - AACD, UL 9540A Cell Level Test Details Summary, Revision: -, Pages: 1

Drawing No. UL Eval, UL Evaluation, Revision: A, Pages: 1

Drawing No. UL Info, UL Signed Letter, Revision: A, Pages: 1

Drawing No. ZincFive-BAZR2-MH62854, UL MH62854 Batteries Standby Component, Revision: -, Pages: 1

Term of Validity

This Product Design Assessment (PDA) Certificate remains valid until 08/Jan/2028 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or previous to the effective date of the ABS Rules and standards applied at the time of PDA issuance. Use of the Product for non-ABS units is subject to agreement between the manufacturer and intended client.

ABS Rules

2022 Rules for Conditions of Classification, Part 1: 1-1-4/7.7, 1-1-A3, 1-1-A4, which covers the following:

2022 Marine Vessel Rules: 4-8-3/1.3, 1.7, 1.11.1, 1.17.1 4-8-1/7.3.3, 4-8-3/5.9

2022 Rules for Conditions of Classification, Part 1 - Offshore Units and Structures: 1-1-4/9.7, 1-1-A2, 1-1-A3, which covers the following:

2022 Mobile Offshore Units Rules: 4-3-1/11, 15, 17.1, 6-1-1/3.7, 6-1-7/9.17

International Standards

NA

EU-MED Standards

NA

National Standards

UL 9540A, November 12, 2019

Government Standards

N/A

Other Standards

N/A



A handwritten signature in blue ink, appearing to read "James W. White".

Corporate ABS Programs
American Bureau of Shipping
Print Date and Time: 05-Jun-2023 3:18

ABS has used due diligence in the preparation of this certificate, and it represents the information on the product in the ABS Records as of the date and time the certificate is printed.

If the Rules and/or standards used in the PDA evaluation are revised or if there is a design modification (whichever occurs first), a PDA revalidation may be necessary.

The continued validity of the MA is dependent on completion of satisfactory audits as required by the ABS Rules. The validity of both PDA and MA entitles the product to receive a **Confirmation of Product Type Approval**.

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or prior to the effective date of the ABS Rules and standards applied at the time of PDA issuance. ABS makes no representations regarding Type Approval of the Product for use on vessels, MODUs or facilities built after the date of the ABS Rules used for this evaluation.

Type Approval requires Drawing Assessment, Prototype Testing and assessment of the manufacturer's quality assurance and quality control arrangements. The manufacturer is responsible to maintain compliance with all specifications applicable to the product design assessment. Unless specifically indicated in the description of the product, certification under type approval does not waive requirements for witnessed inspection or additional survey for product use on a vessel, MODU or facility intended to be ABS classed or that is presently in class with ABS.

Due to wide variety of specifications used in the products ABS has evaluated for Type Approval, it is part of our contract that; whether the standard is an ABS Rule or a non-ABS Rule, the Client has full responsibility for continued compliance with the standard.

Questions regarding the validity of ABS Rules or the need for supplemental testing or inspection of such products should, in all cases, be addressed to ABS.

EC Declaration of Conformity
In accordance with EN ISO 17050-1:2004

| | |
|---|--|
| Manufacturer: | Stored Energy Systems |
| Manufacture Address: | 1840 Industrial Circle Longmont, CO 80501 U.S.A. |
| Product Type: | SuperTorque 8Z Engine Starting System |
| Model Numbers: | 8Z-XX-X-XX-X-X-XX, where X = any digit |
| Conformance to Directives: | <p>Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast)</p> <p>Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits (recast)</p> <p>Commission Delegated Directive (EU) 2015/863 of 31 March 2015 amending Annex II to Directive 2011/65/EU of the European Parliament and of the Council as regards the list of restricted substances.</p> |
| Harmonized and/or technical specifications applied in full: | <p>Directive 2014/30/EU (EMC) EN IEC 61000-6-2:2019 EN IEC 61000-6-4:2019 – Class B</p> <p>Directive 2014/35/EU (LVD) EN IEC 60335-1:2023+A11:2023 EN IEC 60335-2-29:2021+A1:2021</p> <p>Directive (EU) 2015/863 (RoHS) EN IEC 63000:2018</p> |
| Place and date of first issue: | Longmont, CO USA on January 5, 2023 |

Under the sole responsibility of Stored Energy Systems, the undersigned hereby declares that the equipment specified above conforms to the essential requirements of the above Directive(s) and Standard(s).



Sam Coleman
Compliance Manager
Stored Energy Systems, LLC

May 30, 2024
Date

UKCA Declaration of Conformity

| | |
|---|--|
| Manufacturer: | Stored Energy Systems |
| Manufacture Address: | 1840 Industrial Circle Longmont, CO 80501 U.S.A. |
| Product Type: | SuperTorque 8Z Engine Starting System |
| Model Numbers: | 8Z-XX-X-XX-X-X-XX, where X = any digit |
| Conformance to Directives: | Electromagnetic Compatibility Regulations 2016 Electrical Equipment (Safety) Regulations 2016 The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (UK RoHS) |
| Harmonized and/or technical specifications applied in full: | UK EMC EN IEC 61000-6-2:2019 EN IEC 61000-6-4:2019 – Class B UK Safety EN IEC 60335-1:2023+A11:2023 EN IEC 60335-2-29:2021+A1:2021 UK RoHS EN IEC 63000:2018 |
| Place and date of first issue: | Longmont, CO USA on April 5, 2023 |

Under the sole responsibility of Stored Energy Systems, the undersigned hereby declares that the equipment specified above conforms to the essential requirements of the above Regulation(s) and Standard(s).



Sam Coleman
Compliance Manager
Stored Energy Systems, LLC

May 30, 2024
Date



SENS Limited Warranty: Engine Starting Systems

What is covered?

This warranty covers any defect in material and workmanship on 8Z Engine Starting Systems provided by Stored Energy Systems, a Colorado Limited Liability Company (SENS).

What this warranty does not cover:

This warranty does not cover customizations, or damages, defects or failures of equipment resulting from shipping damage, accidents, installation errors, unauthorized adjustment or repair, unauthorized third-party service, failure to follow instructions, misuse, fire, flood, acts of persons not in our control, and acts of God.

For how long:

End Use Within the United States or Canada: 10 years from date of shipment.

Outside of the United States or Canada: Consult Factory for warranty details.

What we will do:

If your system is defective within the warranty period, we will, at our option, repair or replace the failed system component at no charge to you.

If we choose to replace a system component, we may replace it with a new or refurbished one of the same or similar design. The repair or replacement will be warranted for the remainder of the original warranty period. If we determine that the system cannot be repaired or replaced, we will refund its purchase price to you.

What we ask you to do:

Contact SENS service department to obtain warranty service instructions. To obtain warranty service the system must be returned, freight prepaid, to the service facility specified by SENS under a Return Material Authorization (RMA) number provided by SENS. If, in SENS' opinion, the problem can be rectified in the field, SENS may elect to ship replacement parts for customer installation instead or in advance of returning the system component to the service facility.

Limitation:

This warranty is limited to defects in material or workmanship of the system and its components. It does not cover loss of time, inconvenience, property damage or any consequential damages. Repair, replacement or refund of the purchase price of the equipment is your exclusive remedy. No warranty is made or implied for the merchantability or fitness of the system or its components for any particular purpose.

Operating Conditions:

All operating, storage, and maintenance instructions contained in the product's user manual must be followed, including, but not limited to:

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| <i>Battery Temperature:</i> | Within -10°C to 55°C during all operation. Not outside of 0°C to 50°C for more than 10% of operating life. |
| <i>Discharge Voltage:</i> | System shall not be discharged below open-cell voltage of 10.5VDC (12V nominal systems) or 21.0VDC (24V nominal systems). |
| <i>Alternator or External Charge Voltage:</i> | Max 15.0VDC (12V nominal systems) or 30.0VDC (24V nominal systems). |
| <i>Top-Off Charge:</i> | The system must be connected to 110-240VAC at least every 6 months. |
| <i>Settings:</i> | Charging voltage and algorithm shall not be changed from factory settings. |