MicroGenius® S2/S4

Automatic Battery Charger/Power Supply

Installation & Operation Manual

SENS Part Number: 101330
Document Revision: L
DCN Number: 108302
Date: 5/29/2024

PATENTED US 9,270,140; 9,385,556; 9,413,186; 9,509,164; 9,466,995; 9,948,125

Installation or service questions?
Call SENS between 8 a.m. and 5 p.m. (Mountain Time), Monday through Friday, or visit our website.

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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 MicroGenius® S2 and S4 battery chargers.

Conserver ces instructions. Ce manuel contient des instructions importantes concernant la sécurité et le fonctionnement.

1.2. Before using battery charger, read all instructions and cautionary markings on battery charger, battery, and product using battery.

1.3. Do not expose charger to rain or snow.

1.4. Use of an attachment not recommended or sold by the battery charger manufacturer may result in a risk of fire, electric shock, or injury to persons.

1.5. **This charger is intended for commercial and industrial use.** ONLY TRAINED AND QUALIFIED PERSONNEL MAY INSTALL AND SERVICE THIS UNIT.

1.6. Do not operate charger if it has received a sharp blow, been dropped, or otherwise damaged in any way; shut off power at the branch circuit protectors and have the unit serviced or replaced by qualified personnel.

1.7. To reduce risk of electric shock, disconnect the branch circuit feeding the charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.

1.8. **WARNING – RISK OF EXPLOSIVE GASES**

1.8.1. **WORKING IN THE VICINITY OF A LEAD-ACID OR NICKEL-CADMIUM BATTERY IS DANGEROUS. 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 CHARGER.**

IL EST DANGEREUX DE TRAVAILLER A PROXIMITÉ D'UNE BATTERIE AU PLOMB. LES BATTERIES PRODUISENT DES GAZ EXPLOSIFS EN SERVICE NORMAL. IL EST AUSSI IMPORTANT DE TOUJOURS RELIRE LES INSTRUCTIONS AVANT D'UTILISER LE CHARGEUR ET DE LES SUIVRE À LA LETTRE.

1.8.2. 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.

1.9. **PERSONAL PRECAUTIONS**

1.9.1. Someone should be within range of your voice or close enough to come to your aid when you work near a storage battery.

1.9.2. Have plenty of fresh water and soap nearby in case battery electrolyte contacts skin, clothing, or eyes.

1.9.3. Wear complete eye protection and clothing protection. Avoid touching eyes while working near a storage battery.

1.9.4. 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.

1.9.5. **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.

1.9.6. 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.

1.9.7. 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.

1.9.8. **When charging batteries, charge LEAD-ACID or LIQUID ELECTROLYTE NICKEL-CADMIUM batteries only.** Charger certified for fire pump and emergency generator applications. For a 24 hour recharge time do not exceed 220 Ampere hours of capacity per 12A charger output current. Do not use this battery charger to supply power to an extra-low voltage electrical system or to charge any type of non-rechargeable, dry cell, alkaline, lithium, nickel-metal-hydride, or sealed nickel-cadmium batteries that are commonly used with home appliances. These batteries may burst and cause injuries to persons and damage to property.

1.9.9. **NEVER** charge a frozen battery.

Ne jamais charger une batterie gelée.

1.9.10. The charger 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.

1.10. **Preparing Battery For Charge.**

1.10.1. Be sure area around battery is well ventilated while battery is being charged.

1.10.2. Ensure battery terminals are clean and properly tightened. Be careful to keep corrosion from coming in contact with eyes.

1.10.3. Add distilled water in each cell until battery acid reaches level specified by battery manufacturer. Do not overfill. For a battery without removable cell caps, such as valve regulated lead acid batteries, carefully follow manufacturer's recharging instructions.

1.10.4. Study all battery manufacturer specific precautions such as removing or not removing cell caps while charging and recommended rate of charge. The recommended charge current range must include the rated output current of the charger.

Prendre connaissance des mesures de précaution spécifiées par le fabricant de la batterie, p. ex., vérifier s'il faut enlever les bouchons des cellules lors du chargement de la batterie, et les taux de chargement recommandés.

1.11. **Charger Location.**

1.11.1. Locate the charger as far away from the battery as DC cables permit.

Placer le chargeur aussi loin de la batterie que les cables c.c. le permettent.

1.11.2. Never place the charger directly above or below the battery being charged; gases from the battery will corrode and damage charger.

Ne jamais placer le chargeur directement sous la batterie à charger ou au-dessus de cette dernière. Les gaz ou les fluides qui s'échappent de la batterie peuvent entraîner la corrosion du chargeur ou l'endommager.

1.11.3. Never allow battery acid to drip on charger when reading electrolyte specific gravity or filling battery.

1.11.4. Do not operate charger in a closed-in area or restrict ventilation in any way.

Ne pas faire fonctionner le chargeur dans un espace clos et/ou ne pas gêner la ventilation.

1.11.5. Do not set anything on top of the charger.

1.11.6. Hot surface - this battery charger should be installed so that it is not likely to be contacted by people.

SURFACE CHAUDE - ce chargeur de batterie doit être installé de manière à ce qu'il ne soit pas susceptible d'être contacté par des personnes.

2 MODEL NUMBER BREAKOUT

S	4	-	C	1	0	-	H	0	0	0	0	0	0	0
A	**B**		**C**	**D**	**E**		**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**

Field	Parameter	Code	Value
A	Product Family	S	MicroGenius S
B	Enclosure	2	S2 chassis
		4	S4 chassis
C	Output and Protection Options	A	Single output, no breakers
		B	Single output, AC and DC breakers (S4 only)
		C	Single output, AC/DC breakers with supplemental surge (S4 only) (protection S4 only)
		D	Multiple output, single ground, no breakers
		E	Multiple output, single ground, AC breaker (S4 only)
		F	Multiple output, single ground, AC breaker, surge (S4 only)
D	Communications	0	J1939 and Modbus RS-485
		1	J1939, Modbus TCP/IP, native SENSbus USB
		2	J1939 and Modbus RS-485 with RJ-45 to terminal block adapter
		3	J1939, Modbus TCP/IP, USB, & RJ45 to terminal block adapter
		6	J1939, Ethernet, Modbus TCP/IP and RS-485, includes protocol communications board
		7	J1939, Ethernet, - DNP3 TCP/IP and RS-485, includes protocol communications board
E	Configuration	0	Standard
		R	19in rack mount ears (S4 only)
		T	23in rack mount ears (S4 only)
F	Output A Code	X	*See output code table*
G	Output A Redundancy	X	*See redundancy code table*
H	Output B Code	X	*See output code table*
I	Output B Redundancy	X	*See redundancy code table*
J	Output C Code	X	*See output code table*
K	Output C Redundancy	X	*See redundancy code table*
L	Output D Code	X	*See output code table*
M	Output D Redundancy	X	*See redundancy code table*

OUTPUT CODE			
CODE	**VOLTAGE**	**CURRENT**	**CASE**
0	N/A	N/A	N/A
B	12 / 24V	20A	S2
C	12 / 24V	25A	S4
D	12 / 24V	30A	S2
E	12 / 24V	40A	S2
G	12 / 24V	50A	S2/S4
J	12 / 24V	75A	S4
K	12 / 24V	100A	S4
N	36 / 48V	12A	S2/S4
P	36 / 48V	25A	S2/S4
Q	36 / 48V	37A	S4
R	36 / 48V	50A	S4
S	120V	6A	S2/S4
T	120V	12A	S2/S4
U	120V	18A	S4
V	120V	24A	S4

REDUNDANCY CODE	
CODE	**REDUNDANCY**
0	N + 0
1	N + 1
2	N + 2

3 PERFORMANCE SPECIFICATIONS

MicroGenius® S2/S4 is a switchmode, regulated, filtered, microprocessor-controlled, current limited battery charger designed for heavy-duty industrial service. Chargers may be configured for three primary applications: 1) DC power and standby battery charging for industrial control and safety systems, 2) DC power supply and battery charging for marine environments and 3) quick recharge and long life maintenance of engine start batteries. The charger is provided in two enclosure sizes (S2 and S4) and with various output options. Every model provides Modbus RS-485 and J1939 communications, 5 alarm relays, easily readable alpha-numeric display, keypad, and Modbus TCP/IP. Optional features include breakers, supplemental surge protectors, TCP/IP Modbus with native USB, IP22 drip shield as well as multiple outputs configured to different output voltages. Charger specifications are detailed in the table below, see following sections for installation and operation instructions.

Specifications

AC Input	Voltage, Frequency	90-265 single-phase VAC, 47-63 Hz
	Input Current	S2: 8 Amps maximum (at 100 VAC) S4: 16 Amps maximum (at 100 VAC) See Optional AC Input Current and Breaker Rating table for details
	Protection	Supplementary overcurrent protection fuse (non-replaceable); transient protected to EN61000-4-5 level 4
		2-pole circuit breaker (optional)
		Supplemental surge protection (optional with S4). Surge protective device is field replaceable.
	Efficiency	Up to 95%; meets CA Energy Commission (CEC) Title 20 Appliance Efficiency Regulations
	Power factor	>.95 typical at maximum rated load current and boost charge voltage
DC output	Voltage	12/24V nominal; multiple output assignments (optional); field selectable; adjustable from 8-34V; unit powers down below 8VDC if AC voltage is not applied.
		36/48V nominal; field selectable; adjustable from 10-68V; unit powers down below 10VDC if AC voltage is not applied.
		120V nominal; adjustable from 60-160V; unit powers down below 60VDC if AC voltage is not applied.
	Current	15-100 Amps, see section 2. Below 170 VAC input, 24V-30A model limited to 24A output and 24V-40A model limited to 37A output. 120V at 6A nominal rated 6A with UL approval and rated 5.7A with CSA approval.
	Soft start	Charger gradually increases current with a maximum of 5 seconds to full-required output
	Charging modes	Multi-stage, including float, boost and commissioning charge modes
	DC power supply operation	Delivers fast-responding, stable, well-filtered DC without battery
	Current limit	100% current capability subject to temperature limits and AC voltage limits; field adjustable
	Charging characteristic	Constant voltage, current limited; patented Dynamic Boost control
	Line/load regulation	±0.5%
	Output ripple	<30mVrms with or without battery
	Battery temperature compensation	On-board sensor controls changes in output voltage when temperature is between 0°C and +40°C at a default rate of – 0.18% per degree C; optional remote battery temperature probe (SENS p/n 209481); remote temperature probe connections provided for each output

	Output protection	Current limit, supplementary overcurrent protection fuse (non-replaceable), transient protected
		2-pole circuit breaker (optional)
		Supplemental surge protection (optional with S4). Surge protective device is field replaceable.
	Dead battery charge	Starts into and recharges zero-volt battery without user intervention (auto starts excludes 120V models)
	Parallel/Load Share operation	Two or more load-sharing chargers operate with all modes synchronized for increased current or fault tolerance, requires load share accessory kit (SENS p/n 209069)
	Load Dump protection	Output voltage over-shoot is limited to 15% to prevent damage to connected devices if battery is disconnected while charger is operating
	Output Blocking protection	Prevents sparking during battery connection when battery is first connected to charger; serves as an "OR" diode to isolate a non-functioning charger from others in a redundant charger configuration
Adjustment & Controls	Charge mode control	Fully automatic patented Dynamic Boost system. Manual boost and battery commissioning available from keypad. Fully automatic patented HELIX system for flooded lead-acid starting batteries that reduces power use and extends battery life.
	Keypad adjustment	Enable or change all settings from front panel
	Battery type programs	Flooded lead-acid, AGM, NiZn, NaCl (salt), NiCd, VRLA, ultracapacitor
	Computer adjustment	Change or customize settings from computer SENS Setup Utility and on-board USB connection. Connect legacy units (on-board USB not included) using computer to charger cable provided in SENS Setup Utility kit, SENS p/n 209254. SENS Setup Utility software available at www.sens-usa.com.
Status display	LEDs	Two multi-color front panel status LEDs
	Digital metering	DC voltmeter accurate to ±1%; DC ammeter to ±1%. AC input voltage is for reference only. If AC waveform is not sinusoidal or is distorted the AC voltage will not be reported accurately.
	Status messages	20-character display of status and alarm messages
Alarms	Alarms	Factory set and field reconfigurable.
	Output via network	Alarms available via either J1939 or Modbus ports. Alarm indication delayed by configured alarm delay value.
	Form C contacts	Five Form C contacts, each rated 30VDC/VAC, 2A resistive, assignable at factory, using keypad or using SENS Setup Utility. Alarm indication delayed by configured alarm delay value.
	Alarm Delay	30 seconds by default, programmable between 5 to 60 seconds using keypad or SENS Setup Utility. Alarm indication delayed for communications ports and relay contacts, LED indication not delayed.
Networking	J1939	CAN 2.0 extended ID on RJ-45 port
	Modbus	Modbus RS-485 on RJ-45 port, Modbus TCP/IP (optional) on RJ-45 port
	DNP3	DNP3 RS-485 or TCP/IP on RJ-45 port (optional)
	SENSbus	Proprietary bus for connection of paralleled chargers and SENS accessories
	USB	USB-C connectivity via SENS Setup Utility
Environ-mental	Operating temperature	-40°C to +70°C; meets full specification from -40°C to +40°C
		LCD: display may be unreadable and life reduced above 65°C

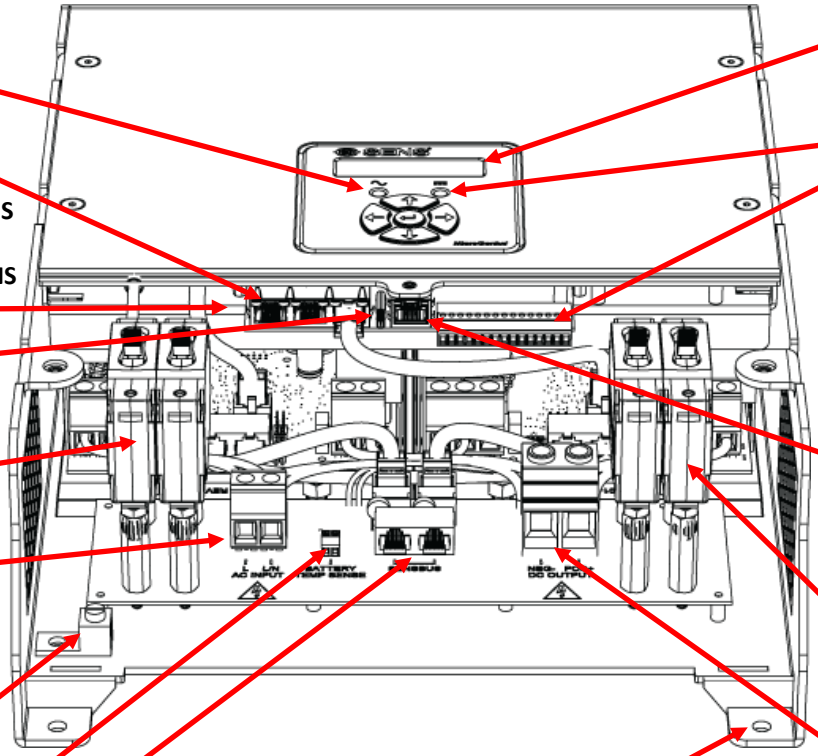
	Cooling	Natural convection cooled
	Storage temperature	-40°C to +70°C
	Cold Start	Cold starts down to -40°C. Requires approximately five seconds additional time to start at temperatures below -20°C.
	Humidity	5% to 95%, non-condensing
	Water ingress	IP20/NEMA1; IP22/NEMA3R with optional drip shield (SENS p/n 209291 for S2 and 209287 for S4)
	Vibration	Swept Sine (EN60068-2-6): 4G, 18-500 Hz, 3 primary axes
		Random: 20-500Hz, .01G^2/Hz
	Shock	EN 60068-2-27 (15G)
	Electrical transient	ANSI/IEEE C62.41 and EN 61000-4-12 on power terminals
Abuse protection	Reverse polarity	Charger self-protects without fuse clearing; indication via LED and LCD; charger recovers automatically after removal of fault condition
	Wrong voltage battery	Charger-battery voltage mismatch shuts down charger after 5 minutes; indication via LED and LCD
	Overvoltage shutdown	Selective; shutdown only operates if charger causes the overvoltage condition. Overvoltage caused by an external voltage source does not shut down the charger.
	Over temperature protection	Gradual output power reduction if heatsink temperature becomes excessive
Regulatory compliance	North America	C-UL-US Listed: • CSA 22.2, No. 107.2 • UL 1012, File E114117, category QQIJ • UL 1236, File E109740 for category BBGQ and File EX6409 for categories BBHH, BBJY and QWIR; certified to UL 1236 supplements SB (marine), SC (fire pump) and SE (emergency generator)
		NFPA-70; NFPA-110 when annunciating to the genset control panel the charger's output voltage, current, and alarm status via J1939 or with alarm relays
		FCC: Part 15, Class A commercial use and ICES-003 (Canada) This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
		Seismic: rigid and non-structure wall mount; max S_{DS} of 2.5G; IBC 2000-2022; California BC 2007-2022
		American Bureau of Shipping: Type Approved
		California Energy Commission: Title 20 Appliance Efficiency Regulations
	European Union (CE)	EMC : 2014/30/EU, UK 2016 EN 61000-6-4 (Emissions – Class A) CISPR 11 – Class A EN 61000-6-2 (Immunity – Industrial Environments) EN 61000-4-2 Electro Static Discharge 4 kV contact, 8 kV air EN 61000-4-3 Radiated Immunity – at 10V/m EN 61000-4-4 Electrical Fast Transients – 2kV AC, 1kV I/O EN 61000-4-5 Surge Immunity – 2 kV cm, 1 kV diff EN 61000-4-6 Conducted power line immunity – 10 V r.m.s.

		EN 61000-4-8 Power frequency magnetic field testing – 30 A/m EN 61000-4-11 Voltage dips and interruptions – per the standard
		LVD: 2014/35/EU, UK 2016 EN 60335-1 & EN 60335-2-29
		RoHS: 2015/863, UK 2012 EN 63000
		WEEE: 2012/19/EU This charger is considered electrical and electronic equipment (EEE) for non-household use and should be recycled accordingly. Do not dispose as unsorted municipal waste. See SENS website (www.sens-usa.com) for information on how to properly recycle.
Construction	Housing/configuration	Aluminum with powder coated finish
		S2 case size: includes three ¾ inch conduit opening
		S4 case size: includes one each ¾ inch, 1 inch and 1-¼ inch conduit openings
		S4 case size: rack mount brackets for 19 and 23 inch racks (optional)
	Dimensions	See drawings and dimensions at back of manual
	Weight	S2 case size: 15.4 lbs (7 kg) maximum S4 case size: 36.8 lbs (16.7 kg) maximum
	Connections	AC and DC terminal blocks or breakers (optional), see section 6 for allowed wire gauges
		J-1939 and Modbus: RJ-45
		Computer with SENS Setup Utility: USB
		Form C alarms terminal block plug: 28 to 16 AWG

4 SYSTEM OVERVIEW

Diagrams follow to demonstrate multiple configurations.

S2 Single Output with Breakers



AC STATUS LED

CONNECT RS-485 MODBUS OR J1939 TO RJ-45

CONNECT ETHERNET, MODBUS OR DNP3 WHEN OPTIONAL PROTOCOL COMMUNICATIONS PCA INCLUDED

CONNECT SENS SETUP UTILITY TO USB WHEN INCLUDED

AC CIRCUIT BREAKER (optional)

CONNECT AC WIRES AT TERMINAL BLOCKS
20–6 AWG (0.5–13.5 mm^2)
Tighten to 10.5 In-Lb (1.2 Nm)

CONNECT GROUND WIRE
28–16 AWG (0.08–1.5 mm^2)
Tighten to 50 In-Lb (5.6 Nm)

CONNECT REMOTE TEMPERATURE SENSORS
One sensor per output
28–16 AWG (0.08–1.5 mm^2)
Tighten to 2.0 In-Lb (0.22 Nm)

SENSbus – CONNECT CHARGER LOAD SHARING CABLE, REMOTE ACCESSORIES OR SENS SETUP UTILITY TO RJ-45 CONNECTOR

MOUNT CHARGER VERTICALLY
Use four ¼ inch (M6) screws to mount charger, fasteners supplied by installer

KEYPAD AND LCD
Adjustments, status and alarms

DC STATUS LED

REMOVE PLUGGABLE ALARM TERMINAL BLOCKS TO INSTALL ALARM WIRES
28–16 AWG (0.08–1.5 mm^2)
Tighten to 2.0 In-Lb (0.22 Nm)
See inside cover label for factory alarm assignments

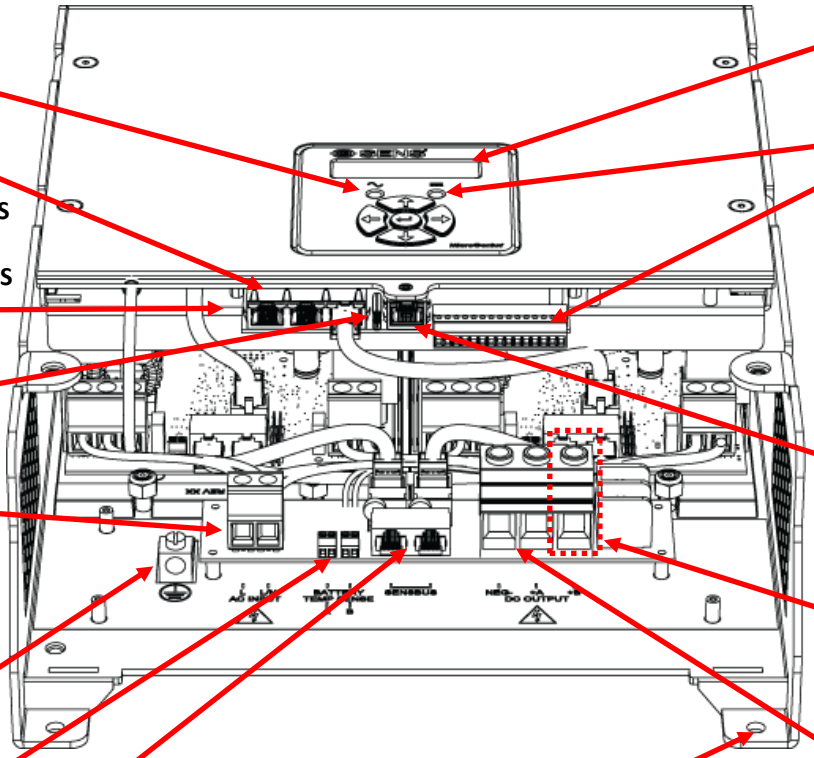
CONNECT TCP/IP MODBUS TO RJ-45 CONNECTOR (optional)

DC CIRCUIT BREAKER (optional)

CONNECT DC WIRES AT TERMINAL BLOCKS
20–2 AWG (0.5–35 mm^2)
Tighten to:
≤#4: 22 In-Lb (2.5 Nm)
>#4: 40 In-Lb (4.5 Nm)
See inside cover label for factory output configuration

Note - contact SENS Customer Service for legacy charger information if communications connections look different than shown.

S2 Single/Multiple Output without Breakers



AC STATUS LED

CONNECT RS-485 MODBUS OR J1939 TO RJ-45

CONNECT ETHERNET, MODBUS OR DNP3 WHEN OPTIONAL PROTOCOL COMMUNICATIONS PCA INCLUDED

CONNECT SENS SETUP UTILITY TO USB WHEN INCLUDED

CONNECT AC WIRES AT TERMINAL BLOCKS
20–6 AWG (0.5–13.5 mm^2)
Tighten to 10.5 In-Lb (1.2 Nm)

CONNECT GROUND WIRE
28–16 AWG (0.08–1.5 mm^2)
Tighten to 50 In-Lb (5.6 Nm)

CONNECT REMOTE TEMPERATURE SENSORS
One sensor per output
28–16 AWG (0.08–1.5 mm^2)
Tighten to 2.0 In-Lb (0.22 Nm)

SENSbus – CONNECT CHARGER LOAD SHARING CABLE, REMOTE ACCESSORIES OR SENS SETUP UTILITY TO RJ-45 CONNECTOR

MOUNT CHARGER VERTICALLY
Use four ¼ inch (M6) screws to mount charger, fasteners supplied by installer

KEYPAD AND LCD
Adjustments, status and alarms

DC STATUS LED

REMOVE PLUGGABLE ALARM TERMINAL BLOCKS TO INSTALL ALARM WIRES
28–16 AWG (0.08–1.5 mm^2)
Tighten to 2.0 In-Lb (0.22 Nm)
See inside cover label for factory alarm assignments

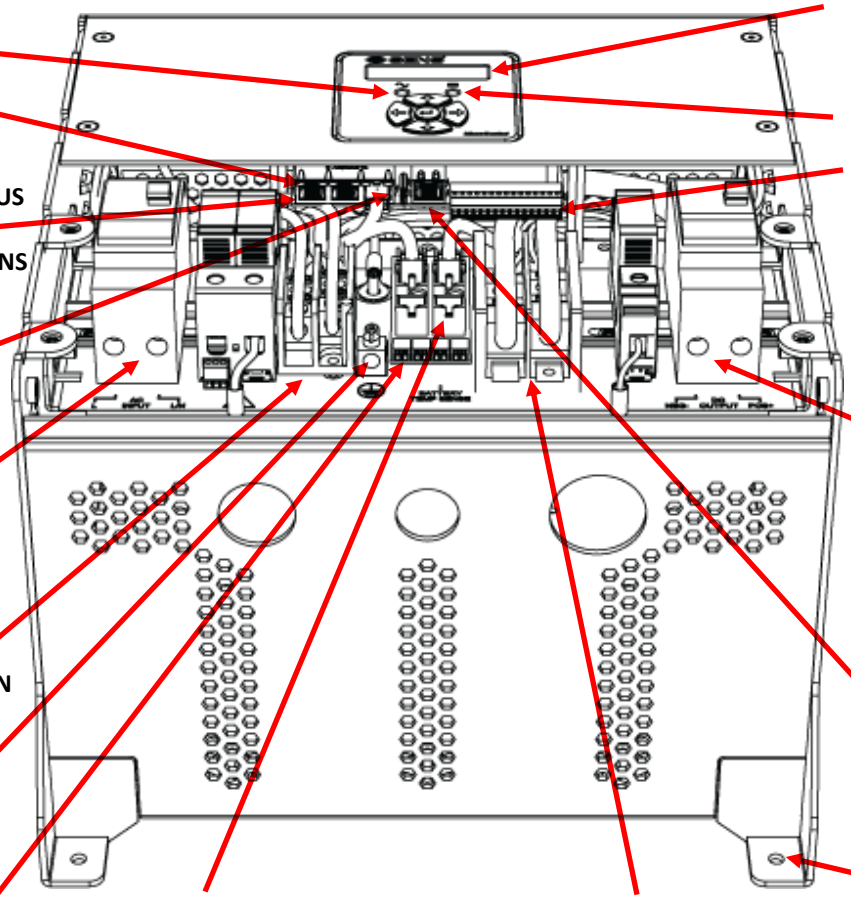
CONNECT TCP/IP MODBUS TO RJ-45 CONNECTOR (optional)

MULTIPLE OUTPUTS OPTIONAL
(outputs share common negative connection)

CONNECT DC WIRES AT TERMINAL BLOCKS
20–2 AWG (0.5–35 mm^2)
Tighten to:
≤#4: 22 In-Lb (2.5 Nm)
>#4: 40 In-Lb (4.5 Nm)
See inside cover label for factory output configuration

Note - contact SENS Customer Service for legacy charger information if communications connections look different than shown.

S4 Single Output with Breakers



AC STATUS LED

CONNECT RS-485 MODBUS OR J1939 TO RJ-45

CONNECT ETHERNET, MODBUS OR DNP3 WHEN OPTIONAL PROTOCOL COMMUNICATIONS PCA INCLUDED

CONNECT SENS SETUP UTILITY TO USB WHEN INCLUDED

CONNECT AC WIRES AT BREAKER TERMINALS
14–2 AWG (2.5–35 mm²)
Tighten to 43 In-Lb (4.9 Nm)

DO NOT CONNECT AT TERMINAL BLOCK WHEN BREAKER PRESENT

CONNECT GROUND WIRE
28–16 AWG (0.08–1.5 mm²)
Tighten to 50 In-Lb (5.6 Nm)

CONNECT REMOTE TEMPERATURE SENSOR
28–16 AWG (0.08–1.5 mm²)
Tighten to 2.0 In-Lb (0.22 Nm)

SENSbus – CONNECT CHARGER LOAD SHARING CABLE, REMOTE ACCESSORIES OR SENS SETUP UTILITY TO RJ-45 CONNECTOR

DO NOT CONNECT AT TERMINAL BLOCK WHEN BREAKER PRESENT

KEYPAD AND LCD
Adjustments, status and alarms

DC STATUS LED

REMOVE PLUGGABLE ALARM TERMINAL BLOCKS TO INSTALL ALARM WIRES
28–16 AWG (0.08–1.5 mm²)
Tighten to 2.0 In-Lb (0.22 Nm)
See inside cover label for factory alarm assignments

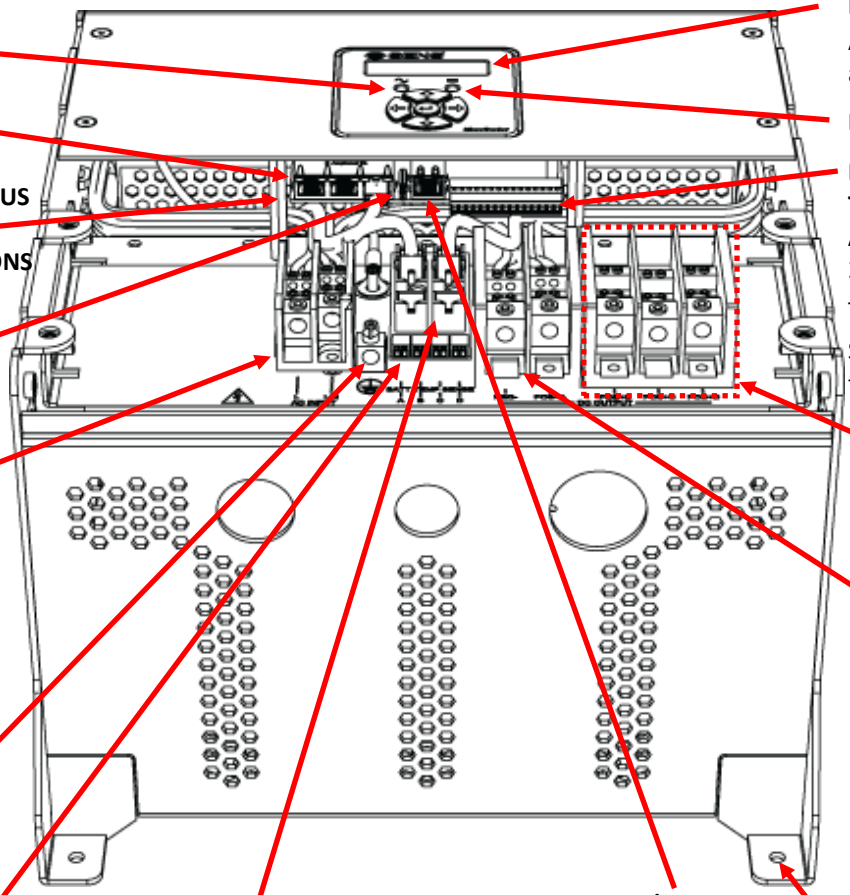
CONNECT DC WIRES AT BREAKER TERMINALS
<50A: 14–2 AWG (2.5–35 mm²)
≥50A: 12 AWG–2/0 (4–70 mm²)
Tighten to 45 In-Lb (5.1 Nm)
See inside cover label for factory output configuration

CONNECT TCP/IP MODBUS TO RJ-45 CONNECTOR (optional)

MOUNT CHARGER VERTICALLY
Use four ¼ inch (M6) screws to mount charger, fasteners supplied by installer

Note - contact SENS Customer Service for legacy charger information if communications connections look different than shown.

S4 Single/Multiple Output without Breakers



AC STATUS LED

CONNECT RS-485 MODBUS OR J1939 TO RJ-45

CONNECT ETHERNET, MODBUS OR DNP3 WHEN OPTIONAL PROTOCOL COMMUNICATIONS PCA INCLUDED

CONNECT SENS SETUP UTILITY TO USB WHEN INCLUDED

CONNECT AC WIRES AT TERMINAL BLOCKS
14–2 AWG (2.5–35 mm²)
Tighten to:
#3-#2: 50 In-Lb (5.6 Nm)
#6-4: 45 In-Lb (5.1 Nm)
#8: 40 In-Lb (4.5 Nm)
#14-#10: 35 In-Lb (4.0 Nm)

CONNECT GROUND WIRE
28–16 AWG (0.08–1.5 mm²)
Tighten to 50 In-Lb (5.6 Nm)

CONNECT REMOTE TEMPERATURE SENSORS
One sensor per output
28–16 AWG (0.08–1.5 mm²)
Tighten to 2.0 In-Lb (0.22 Nm)

SENSbus – CONNECT CHARGER LOAD SHARING CABLE, REMOTE ACCESSORIES OR SENS SETUP UTILITY TO RJ-45 CONNECTOR

CONNECT TCP/IP MODBUS TO RJ-45 CONNECTOR (optional)

KEYPAD AND LCD
Adjustments, status and alarms

DC STATUS LED

REMOVE PLUGGABLE ALARM TERMINAL BLOCKS TO INSTALL ALARM WIRES
28–16 AWG (0.08–1.5 mm²)
Tighten to 2.0 In-Lb (0.22 Nm)
See inside cover label for factory alarm assignments

MULTIPLE OUTPUTS OPTIONAL
(outputs share common negative connection)

CONNECT DC WIRES AT TERMINAL BLOCKS
14 AWG–2/0 (2.5–70 mm²)
Tighten to:
#6-2/0: 120 In-Lb (13.5 Nm)
#8: 40 In-Lb (4.5 Nm)
#14-#10: 35 In-Lb (4.0 Nm)
See inside cover label for factory output configuration

MOUNT CHARGER VERTICALLY
Use four ¼ inch (M6) screws to mount charger, fasteners supplied by installer

Note - contact SENS Customer Service for legacy charger information if communications connections look different than shown.

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 charger by the chassis only. Remove the cover only when access is essential for installation and service, and replace it promptly when finished.

5.1. Mounting Location

The charger is provided in two different enclosure sizes, S2 and S4. See diagrams at back of manual for dimensions and mounting information.

5.1.1. Charger is rated IP22 with optional drip shield installed.

5.1.2. Charger will operate at full specification when located where temperatures are within -40°C (-40°F) to +40°C (104°F). Output power is gradually reduced at higher temperatures.

5.1.3. Mount charger vertically to ensure adequate ventilation.

5.1.4. Leave clear space for ventilation all around the charger: at least 6 inches (15 cm) at the top; at least 4 inches (10.16 cm) at the bottom; at least 0.5 inches (1.27 cm) on each side. Operating temperature ranges stated above assume stated clearances.

5.1.5. Mount to a wall or other vertical support. The mounting surface must safely support the weight of the charger and the fixed wiring. S2 chargers have a maximum weight of 15.4 lbs (7 Kg). S4 chargers have a maximum weight of 36.8 lbs (16.7 Kg).

5.1.6. Allow sufficient room for routing the fixed wiring to the charger. All wires enter the charger from the bottom. See diagrams at back of manual for further information.

5.1.7. Do not mount the charger above any heat generating equipment.

5.2. Mounting Instructions

5.2.1. Drill four wall mounting holes using dimensions provided on diagrams at back of manual. **IMPORTANT: Protect charger from all drill shavings!**

5.2.2. Rack mount brackets (19 inch and 23 inch) are optional for the S4 enclosure size. Mount brackets to charger as shown on diagrams at back of manual before mounting charger in rack.

5.2.3. Mount the charger before connecting AC, DC, communications and alarm wiring to ensure un-obstructed access to mounting holes.

5.2.4. Mount the charger using four ¼ inch (M6) screws with standard flat washers. Mounting hardware is not included with the charger and must be provided by the installer.

6 SETUP AND WIRING

IMPORTANT! The charger is configured at the factory and typically requires no adjustments before operating. Refer to the label on the inside lower cover for factory configured output and alarm relay assignments. The charger may be reconfigured using the front panel keypad or by software programming using the SENS Setup Utility.

All wiring must comply with applicable codes and local ordinances.

WARNING:
ENSURE THAT AC POWER IS DISCONNECTED AT A CIRCUIT BREAKER OR OTHER SAFETY DISCONNECT BEFORE WIRING THE CHARGER

6.1. Wire Ratings and Sizes

6.1.1. All power conductors should be rated for use at 90°C or higher and 400V or higher. Alarm relay conductors and communications data cable should be rated for use at 75°C or higher.

6.1.2. Coordinate the AC input conductor size with the customer-provided branch circuit protection device.

6.1.3. For best performance and recharge time, refer to the following table to determine the appropriate output conductor gauge and length. Use of a remote temperature sensor (SENS p/n 209481, see section 9.13) is highly recommended for best charging performance.

DC Output Cable Size

Charger Rated Output Current (Amps)	Wire Size		Resistance per Foot (mΩ/Ft.)	Maximum Charger to Battery Distance (Ft.)				
	AWG	mm^2		12V	24V	36V	48V	120V
6	14	2.5	2.5					165
	12	4	1.6					260
	10	6	1					415
	8	10	0.63					660
	6	16	0.4					1040
12	14	2.5	2.5			24	32	80
	12	4	1.6			39	52	130
	10	6	1			63	84	210
	8	10	0.63			99	132	330
	6	16	0.4			156	208	520
18	14	2.5	2.5					50
	12	4	1.6					80
	10	6	1					130
	8	10	0.63					200
	6	16	0.4					310
20	14	2.5	2.5	5	10			
	12	4	1.6	8	16			
	10	6	1	13	26			
	8	10	0.63	20	40			
	6	16	0.4	31	62			
24	14	2.5	2.5					40
	12	4	1.6					70
	10	6	1					100
	8	10	0.63					170

	6	16	0.4					260
25	14	2.5	2.5	4	8	12	16	
	12	4	1.6	6	12	18	24	
	10	6	1	10	20	30	40	
	8	10	0.63	16	32	48	64	
	6	16	0.4	25	50	75	100	
30	14	2.5	2.5	3	6			
	12	4	1.6	5	10			
	10	6	1	8	16			
	8	10	0.63	13	26			
	6	16	0.4	21	42			
	4	25	0.25	33	66			
	2	35	0.16	52	104			
37	14	2.5	2.5			9	12	
	12	4	1.6			12	16	
	10	6	1			21	28	
	8	10	0.63			33	44	
	6	16	0.4			51	68	
	4	25	0.25			81	108	
	2	35	0.16			126	168	
40	14	2.5	2.5	NEC - not allowed				
	12	4	1.6	4	8			
	10	6	1	6	12			
	8	10	0.63	10	20			
	6	16	0.4	16	32			
	4	25	0.25	25	50			
	2	35	0.16	39	78			
50	14	2.5	2.5	NEC - not allowed				
	12	4	1.6	NEC - not allowed				
	10	6	1	5	10	15	20	
	8	10	0.63	8	16	24	32	
	6	16	0.4	13	26	39	52	
	4	25	0.25	20	40	60	80	
	2	35	0.16	31	62	93	124	
75	14	2.5	2.5	NEC - not allowed				
	12	4	1.6	NEC - not allowed				
	10	6	1	NEC - not allowed				
	8	10	0.63	5	10			
	6	16	0.4	8	16			
	4	25	0.25	13	26			
	2	35	0.16	21	42			
100	14	2.5	2.5	NEC - not allowed				
	12	4	1.6	NEC - not allowed				
	10	6	1	NEC - not allowed				
	8	10	0.63	NEC - not allowed				
	6	16	0.4	6	12			
	4	25	0.25	10	20			
	2	35	0.16	16	32			

The above lengths consider the resistance of the battery and cables only and do not take into account any additional interconnects.
The above lengths are for operation at 25°C/77°F. For high temperature installations (40°C/104°F) increase wire gauge by 10%.

6.2. Grounding Instructions and Connection

6.2.1. Charger must be grounded to reduce risk of electric shock. The charger must be connected to a grounded, metal, permanent wiring system, or an equipment-grounding conductor (earthing conductor) must be run with the circuit conductors and connected to equipment-grounding terminal on charger.

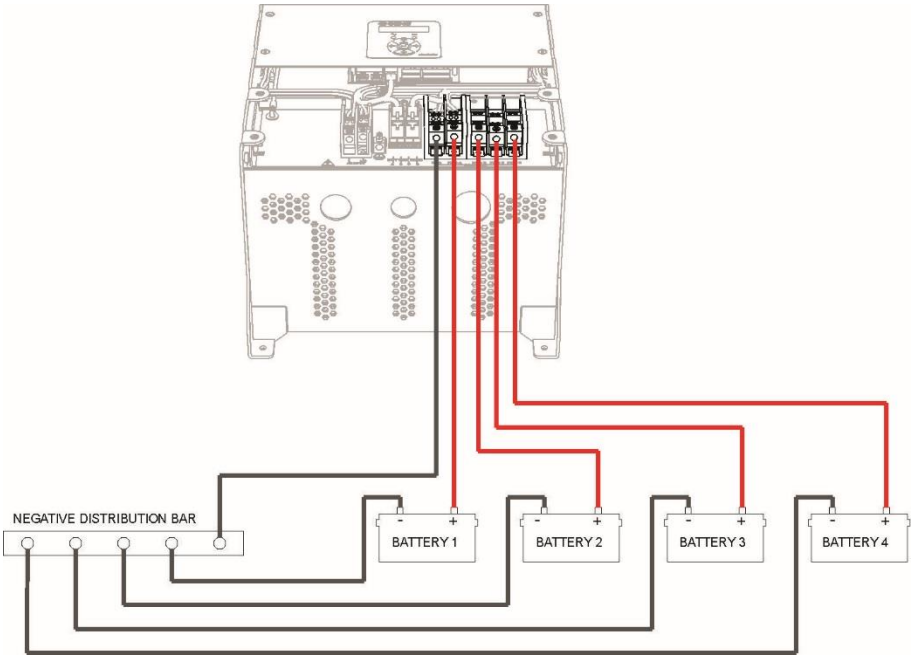
6.2.2. Connect the equipment grounding conductor to the ground lug in the charger (refer to the figures in Section 4). This lug is marked with the ground symbol. This should always be the first wire connected and the last wire disconnected.

6.3. DC Connection

Ensure that any battery disconnect devices in the system, if used, are opened (batteries disconnected from DC bus). Connect the DC output conductors to the DC output terminal block/breaker in the charger (refer to the figures in Section 4). Chargers with multiple outputs share a common negative connection (see Multiple Output Connection). Always observe proper polarity of the DC output leads. Always connect the output leads in the following order – charger output to ungrounded battery terminal, followed by charger output to grounded battery terminal. If the battery must be disconnected for service, remove the output wiring in the reverse order. Tighten connections to torque specified in DC Allowed Wire Gauge and Torque Requirements. Route DC wiring at least ¼ inch (6 mm) away from AC wiring, alarm wiring, and the circuit board.

WARNING:
A MAXIMUM OF 40 VOLTS MAY BE APPLIED AT THE OUTPUT TERMINALS. HIGHER VOLTAGE MAY DAMAGE THE CHARGER.

Multiple Output Connection



DC Allowed Wire Gauge and Torque Requirements

Charger Model	Connection Type	Allowed Wire Gauge	Required Torque	Tool
S2	Terminal Block	20-2 AWG (0.5-35 mm^2)	≤#4: 22 In-Lb (2.5 Nm) >#4: 40 In-Lb (4.5 Nm)	Phillips P2
S4	Breaker	<50A: 14-2 AWG (2.5-35 mm^2) ≥50A: 12 AWG-2/0 (4-70 mm^2)	45 In-Lb (5.1 Nm)	5/16 inch flat-head
S4	Terminal Block	14 AWG-2/0 (2.5-70 mm^2)	#6-2/0: 120 In-Lb (13.5 Nm) #8: 40 In-Lb (4.5 Nm) #14-#10: 35 In-Lb (4.0 Nm)	3/16 inch hex

Optional DC Output Breaker Rating

Charger Rated Output Voltage (Volts)	Charger Rated Output Current (Amps)	DC Breaker Rating (Amps)	DC Breaker Interrupt Rating (KAIC)
12/24	20	25	5
12/24	25	35	5
12/24	30	40	5
12/24	40	60	5
12/24	50	70	5
12/24	75	100	5
12/24	100	125	5
36/48	12	15	5
36/48	25	35	5
36/48	37	45	5
36/48	50	70	5
120	6	8	S2 case size: 5 S4 case size: 10
120	12	16	S2 case size: 5 S4 case size: 10
120	18	25	10
120	24	32	10

6.4. AC Connection

This unit is permanently connected to the AC circuit and to the battery. For models not equipped with an AC input breaker, an external disconnect device must be located in the AC input to the charger. The charger is rated to operate on any AC input within the range of 90-265VAC, 47-63Hz.

Ensure that the AC input supply is de-energized. Connect the AC line and neutral conductors to the AC input terminal block/breaker in the charger (refer to the figures in Section 4). If there is an identified grounded circuit conductor (neutral), attach it to the terminal marked "L2/N." Tighten connections to torque specified in AC Allowed Wire Gauge and Torque Requirements table below. Route AC wiring at least ¼ inch (6 mm) away from DC wiring, alarm wiring, and the circuit board.

AC Allowed Wire Gauge and Torque Requirements

Charger Model	Connection Type	Allowed Wire Gauge	Required Torque	Tool
S2	Terminal Block	20-6 AWG (0.5-13.5 mm^2)	10.5 In-Lb (1.2 Nm)	Phillips P2
S4	Breaker	14-2 AWG (2.5-35 mm^2)	43 In-Lb (4.9 Nm)	5/16 inch flat-head
S4	Terminal Block	14-2 AWG (2.5-35 mm^2)	#3-#2: 50 In-Lb (5.6 Nm) #6-4: 45 In-Lb (5.1 Nm) #8: 40 In-Lb (4.5 Nm) #14-#10: 35 In-Lb (4.0 Nm)	1/4 inch flat-head

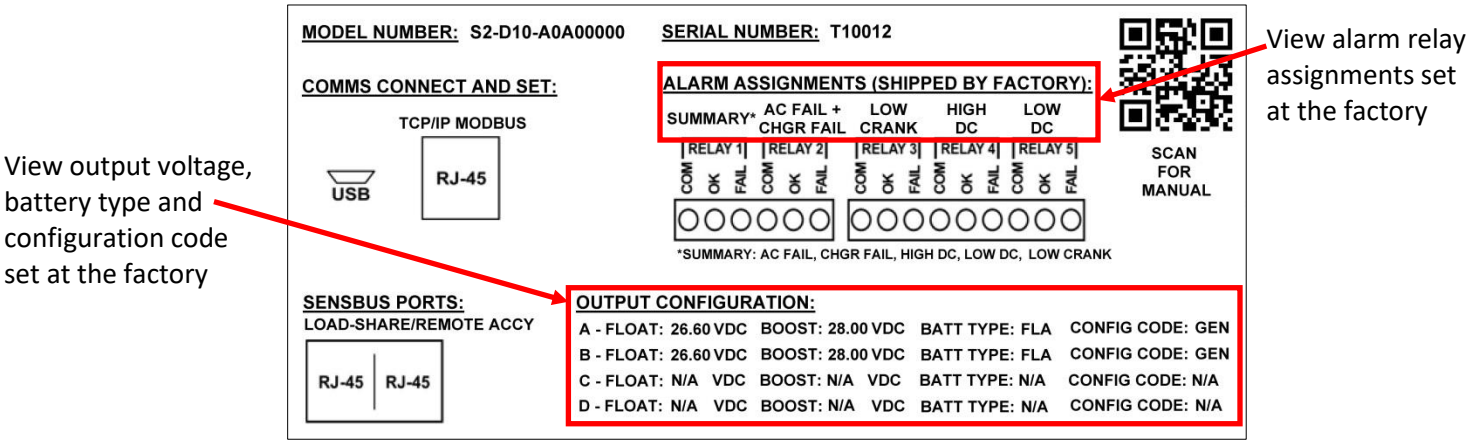
Optional AC Input Current and Breaker Rating

Charger Rated Output Voltage (Volts)	Charger Rated Output Current (Amps)	100VAC Input Current (Amps)	120VAC Input Current (Amps)	208VAC Input Current (Amps)	240VAC Input Current (Amps)	AC Breaker Rating (Amps)	AC Breaker Interrupt Rating (KAIC)
12/24	20	8.0	6.7	3.8	3.3	15	S2 case size: 5 S4 case size: 10
12/24	25	8.0	6.7	3.8	3.3	15	S2 case size: 5 S4 case size: 10
12/24	30	8.0	6.7	3.8	3.3	15	S2 case size: 5 S4 case size: 10
12/24	40	12.0	12.0	10.0	5.8	15	S2 case size: 5 S4 case size: 10
12/24	50	16.0	16.0	13.3	7.7	20	S2 case size: 5 S4 case size: 10
12/24	75	24.0	24.0	20.0	11.5	30	10
12/24	100	32.0	32.0	26.7	15.4	40	10
36/48	12	8.0	8.0	6.7	3.8	15	S2 case size: 5 S4 case size: 10
36/48	25	16.0	16.0	13.3	7.7	20	S2 case size: 5 S4 case size: 10
36/48	37	24.0	24.0	20.0	11.5	30	10
36/48	50	26.7	15.4	13.3	26.7	40	10
120	6	8.0	8.0	6.7	3.8	15	S2 case size: 5 S4 case size: 10
120	12	16.0	16.0	13.3	7.7	20	S2 case size: 5 S4 case size: 10
120	18	24.0	24.0	20.0	11.5	30	10
120	24	32.0	32.0	26.7	15.4	40	10

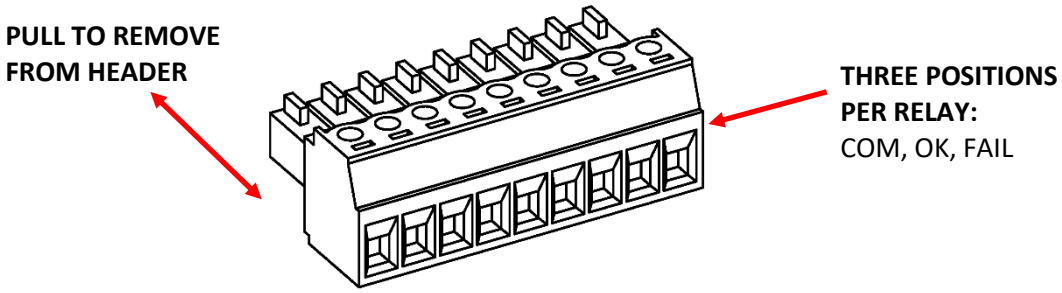
6.5. Alarm Connections

See charger inside cover label for original factory alarm relay assignments (see Configuration Label diagram below). Alarm relay assignments are custom configurable using the front panel keypad (based on application) or the SENS Setup Utility. Connect alarm wiring to the respective terminals on the pluggable terminal block in the charger (refer to the following figures for location in Section 4 and Pluggable Terminal Block for detail). To make wiring easier, the terminal block unplugs from the 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 (Refer to tables regarding Genset config, Marine config, and Stationary Power config). Connect alarm terminals only to low voltage, limited energy ("Class 2") circuits. Alarm circuits are rated 2A at 30V AC or DC. The terminals accept 28-16 AWG (0.08-1.5 mm^2) 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 the circuit board. Relays will change state for an alarm on any output on chargers with multiple outputs.

Configuration Label (on inside lower cover)



Pluggable Terminal Block



Example Alarm Relay Contact Wiring for Genset Configuration

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 3** Latching Coil	**RELAY 4** Latching Coil	**RELAY 5** Latching Coil
Relay Contacts	**AC Fail Alarm**	**Charger Fail Alarm**	**Low Crank Alarm**	**High DC Alarm**	**Low DC Alarm**
Common	COM (TB1-1)	COM (TB1-4)	COM (TB1-7)	COM (TB1-10)	COM (TB1-13)
Open on alarm	OK (TB1-2)	OK (TB1-5)	OK (TB2-2)	OK (TB2-5) Defaults to OK with no AC and DC power	OK (TB2-8)
Close on alarm	FAIL (TB1-3) Defaults to FAIL with no AC and DC power (normally closed)	FAIL (TB1-6) Defaults to FAIL with no AC and DC power (normally closed)	FAIL (TB1-9)	FAIL (TB1-12)	FAIL (TB1-15)

Example Alarm Relay Contact Wiring for Marine Configuration

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 3** Latching Coil	**RELAY 4** Latching Coil	**RELAY 5** Latching Coil
Relay Contacts	**Summary Alarm***	**AC Fail + Charger Fail Alarms**	**Ground Fault Alarm**	**High DC Alarm**	**Low DC Alarm**
Common	COM (TB1-1)	COM (TB1-4)	COM (TB1-7)	COM (TB1-10)	COM (TB1-13)
Open on alarm	OK (TB1-2)	OK (TB1-5)	OK (TB1-8)	OK (TB1-11)	OK (TB1-14)
Close on alarm	FAIL (TB1-3) Defaults to FAIL with no AC and DC power (normally closed)	FAIL (TB1-6) Defaults to FAIL with no AC and DC power (normally closed)	FAIL (TB1-9)	FAIL (TB1-12)	FAIL (TB1-15)

*Summary alarm includes AC Fail, Charger Fail, Ground Fault, High DC and Low DC alarms.

Example Alarm Relay Contact Wiring for Stationary Power Configuration

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 3** Latching Coil	**RELAY 4** Latching Coil	**RELAY 5** Latching Coil
Relay Contacts	**Summary Alarm***	**AC Fail + Charger Fail Alarms**	**Battery Discharging Alarm**	**High DC Alarm**	**Low DC Alarm**
Common	COM (TB1-1)	COM (TB1-4)	COM (TB1-7)	COM (TB1-10)	COM (TB1-13)
Open on alarm	OK (TB1-2)	OK (TB1-5)	OK (TB1-8)	OK (TB1-11)	OK (TB1-14)
Close on alarm	FAIL (TB1-3) Defaults to FAIL with no AC and DC power (normally closed)	FAIL (TB1-6) Defaults to FAIL with no AC and DC power (normally closed)	FAIL (TB1-9)	FAIL (TB1-12)	FAIL (TB1-15)

*Summary alarm includes AC Fail, Charger Fail, Battery Discharging, High DC and Low DC alarms.

6.6. Remote Temperature Sensor Connection—*Optional*

The charger includes local temperature compensation using internal on-board sensors. Alternately, the charger will use remote temperature compensation based on the temperature of the batteries when an optional external sensor is located at the batteries and connected to the remote temperature sensor terminal block in the charger (refer to the figures in Section 4). Chargers with multiple output terminals also include multiple remote temperature sensor terminal blocks (connect one sensor for each output). Remote temperature compensation is highly recommended in all applications and is required for ultracapacitor charging. It is most critical in applications where battery and charger are located in different ambient conditions and in NFPA-20 fire pump and NFPA-110 emergency power system installations in order to return 100% of the battery's ampere-hour rating within 24 hours without causing damage to the battery. Chargers connected to load share only require a remote temperature sensor connected to one charger.

The remote temperature sensor is not polarized; it does not matter which lead connects to each terminal. Route sensor wiring at least ¼ inch (6 mm) away from DC wiring, AC wiring, and the circuit board. Locate the remote sensor where it will accurately detect the battery temperature by connecting it to a *grounded* battery terminal or the battery case. When securing to the battery case, use an adhesive/glue properly rated for the application material and temperature, such as Super Glue®. Temperature compensation is disabled by connecting a short across the remote temperature sensor terminal block or by setting the temperature compensation slope to zero using the keypad or SENS Setup Utility. See section 9.13 for further information regarding temperature compensation. A 50-foot remote temperature sensor is available to order separately (SENS p/n 209481).

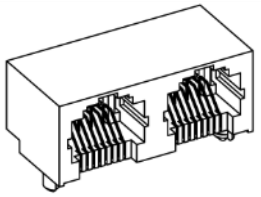
6.7. SAE J1939 Communications Setup (CANbus)

Every charger includes SAE J1939 (CANbus) communications. The J1939 interface provides a highly reliable, low-cost method of delivering to the genset controller all information that NFPA 110 requires the battery charger to deliver. To be operational, the genset controller must support the charger J1939 connection. Contact your genset supplier to determine if your genset supports a J1939-connected charger. See section 10 for further information on J1939 operation and registers.

J1939 communications are disabled by default and until the BCH address is configured (see section 6.7.1). Connect J1939 communications using a twisted pair cable at the RJ-45 connector on the alarm/communications circuit board located on the inside front cover (refer to the figures in Section 4 for

location in charger and RJ-45 Connection for detail). Two RJ-45 ports are provided. The ports are in parallel and either port may be used. See Connector Pinout table below for more detail. Communications are non-isolated and referenced to negative battery terminal. An adapter from RJ-45 to an 8-position terminal block may be connected to the RJ-45 connector and is available to order separately (SENS p/n 208026, see RJ-45 to Terminal Block Adapter figure below).

RJ-45 Connection

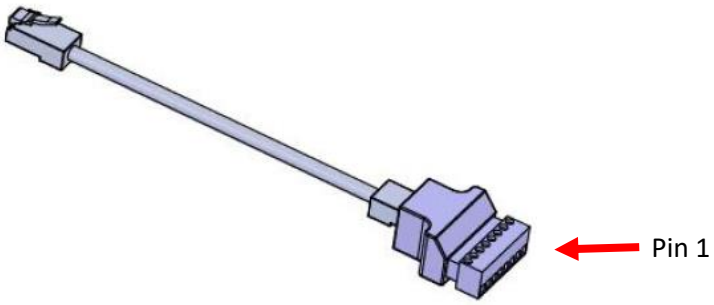


Connector Pinout

Pin #	Purpose
1	J1939 Data High/SENSbus
2	J1939 Data Low/SENSbus
3	No connect pass-through
4	Modbus –D0 (B)
5	Modbus +D1 (A)
6	No connect pass-through
7	Power*
8	Common (referenced to battery negative)

*Main circuit PCA only, used for interconnect between SENS devices

RJ-45 to Terminal Block Adapter — *Optional*



6.7.1. **Battery Charger (BCH) J1939 Address**

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

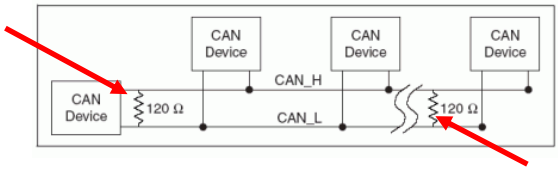
For multiple output chargers, J1939 address 1 (main charger) is assigned to charger output A and address 2 (auxiliary charger) is assigned to output B by default. Use the keypad or the SENS Setup Utility to configure J1939 addresses to any desired charger output.

6.7.2. **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. J1939 Termination figure below shows an example of how to terminate the network. The charger is not equipped with terminators. Termination may be provided as part of

the network cabling or 120-ohm termination plugs for the RJ-45 communications connector on the charger are available to order separately (SENS p/n 803707).

J1939 Termination



6.8. Modbus/DNP3 RS-485 Connection

Every charger includes Modbus communications over RS-485 using RTU mode. DNP3 communications over RS-485 is included on chargers equipped with the optional protocol communications circuit board. See section 11 for further information on Modbus operation and section 12 for further information on DNP3 operation.

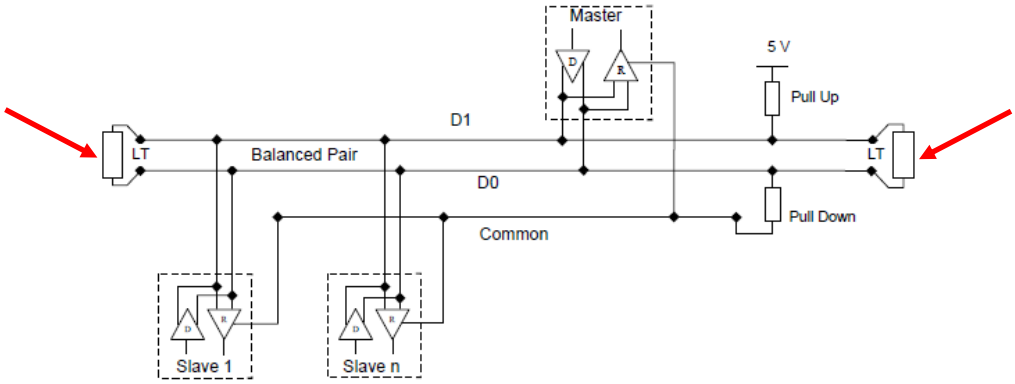
6.8.1. Connection

Connect RS-485 communications using a twisted pair cable at the RJ-45 connector on the alarm/communications circuit board located on the inside front cover (refer to the figures in Section 4 for location in charger and RJ-45 Connection for detail). Two RJ-45 ports are provided. The ports are in parallel and either port may be used. See Connector Pinout for more detail. Communications are non-isolated and referenced to negative battery terminal. An adapter from RJ-45 to an 8-position terminal block may be connected to the RJ-45 connector and is available to order separately (SENS p/n 208026, see RJ-45 to Terminal Block Adapter). Modbus/DNP3 communications settings may be configured using the keypad or SENS Setup Utility prior to initiating.

6.8.1.1. Termination

For proper Modbus/DNP3 RS-485 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. The Termination figure shows an example of how to terminate the network. The charger is not equipped with terminators. Termination may be provided as part of the network cabling or 120-ohm termination plugs for the RJ-45 communications connector on the charger are available to order separately (SENS 803707).

Termination



LT = Line Termination 120-ohm resistor

6.9. **Ethernet Connection—*Optional***

Modbus or DNP3 over TCP/IP is optional. Connect TCP/IP communications using a twisted pair cable at the RJ-45 connector on the circuit board located on the inside front cover (refer to the figures in Section 4 for location in charger). Connect Cat5 or better ethernet cable to provide a 10/100 ethernet connection. See section 11 for further information on Modbus operation and section 12 for further information on DNP3 operation. The ethernet connection may also be used for communication to the charger for monitoring and configuration via the SENS Setup Utility when the optional protocol communications circuit board is included.

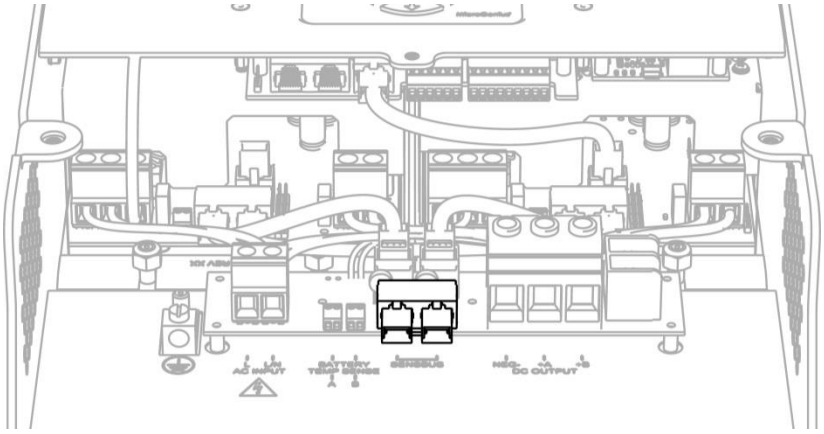
6.10. **USB Connection**

The unit is equipped with a USB-C connector (refer to the figures in Section 4) for monitoring and configuration via the SENS Setup Utility (see section 9.11).

6.11. **Load Share Connection—*Optional***

Multiple chargers may be connected in parallel to provide charger redundancy and increased charging current using a load sharing accessory, available to order separately (SENS p/n 209069). Connect the load sharing accessory from one charger to another using the SENSbus RJ-45 ports on each charger to automatically initiate load sharing. Two SENSbus RJ-45 ports are provided on the inside panel between the AC and DC connections (see S2 RJ-45 Connection and S4 RJ-45 Connection). The ports are in parallel and either port may be used for the load share connection. Connect one charger to the “CHARGER 1” port and the other charger to the “CHARGER 2” port on the load sharing accessory using provided network cables. Connect the other end of the network cables to the SENSbus RJ-45 port on each charger. Leave a factory installed 120-ohm terminator in a SENSbus port on each charger to ensure a terminator is located at both ends of the communications bus.

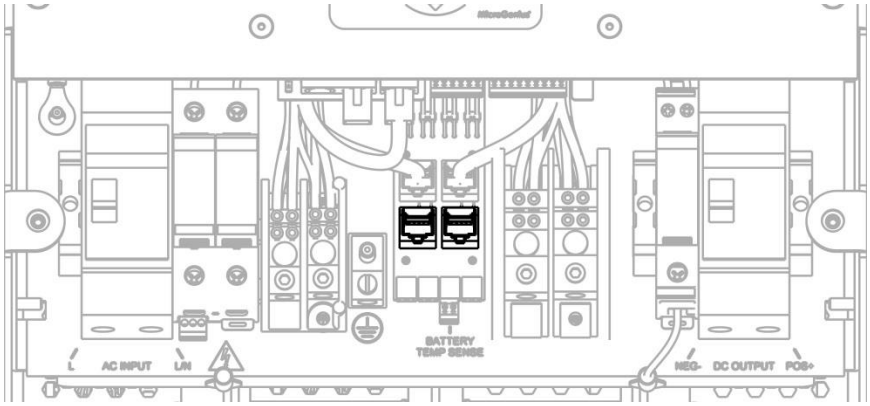
S2 RJ-45 Connection



TWO PORTS:

Remove one terminator plug to connect load share cable to either port

S4 RJ-45 Connection



TWO PORTS:

Remove one terminator plug to connect load share cable to either port

Load sharing is essential to synchronizing operation of the Dynamic Boost and HELIX modes and helps ensure that current is shared within ±10% between chargers. Chargers intended for load sharing must be configured with the same output settings in order to load share. Corresponding outputs must be configured with the same output settings for chargers with multiple outputs. Load sharing operates independently on each output for chargers with multiple outputs. Connect corresponding outputs of load sharing chargers in parallel (i.e. connect output A to output A). Load sharing will not occur if non-corresponding outputs are connected (e.g. do not connect output A to output B). See section 9.13 for further information.

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

The optional remote alarm/communications panel accessory provides the ability to adjust and communicate with multiple chargers using one external device. The remote panel accessory may be configured with different alarm relay assignments than the alarm relays native to the charger. Connect remote accessories to the charger using a network cable connected to the SENSbus RJ-45 port. Two SENSbus RJ-45 ports are provided on the inside panel between the AC and DC connections (see S2 RJ-45 Connection and S4 RJ-45 Connection). Connect a network cable from the remote accessory to one port and leave the factory installed 120-ohm terminator in the second port. Connect the other end of the network cable to the RJ-45 splitter connected to the RJ-45 port on the remote accessory circuit board.

For proper operation, a 120-ohm terminator is required at both ends of the communications bus. Remote accessories are provided with a terminator installed in the 2-position RJ-45 splitter connected to the RJ-45 port located on the remote accessory circuit board. Remove the terminator on the splitter only if the remote accessory is not at the end of the communications bus.

The remote accessory may be connected to multiple chargers. In this case, the remote accessory, chargers or other equipment may be located at the ends of the communications bus. Ensure a terminator is located at both ends of the communications bus.

6.13. **Verify Connections**

6.13.1. Verify that all connections are secure and in the proper locations. Tighten all unused screws on terminal blocks to secure them against vibration.

6.13.2. Ensure all wires are routed in a way that the cover or other objects will not pinch or damage them.

7 START-UP PROCEDURE

7.1. Connect Battery/Outputs

Ensure wiring is correctly connected between charger and battery and/or additional outputs for chargers equipped with multiple outputs. Close any system battery disconnect, if used, to connect batteries to the charger.

7.2. Verify Configuration

Refer to the label on the inside lower cover for factory configured output voltage, battery type and configuration code (see Configuration Label). Values for each output are displayed separately for multiple output chargers. Review and adjust charger configuration using the front panel keypad or the SENS Setup Utility if factory configured settings require modification. See section 9.10 for additional details on keypad navigation.

7.2.1. Output/Battery Voltage

Verify that battery voltage (for applications with batteries) matches charger output voltage. Charger output voltage is displayed on the label on the inside lower cover.

7.2.2. Battery Types

Adjusting battery types using the front panel keypad requires advanced security access. Change "UI Access Control" to "Advanced" in the "Service Tools" menu for access.

7.2.2.1. FLA

This setting is ideal for flooded lead-acid batteries used in engine starting applications. The charging algorithm for flooded lead-acid batteries includes Float mode (see section 9.2), Dynamic Boost™ mode (see section 9.3) and HELIX mode (see section 9.4).

7.2.2.2. AGM

The term, "AGM" in this manual and for the charger refers to AGM (absorbed glass mat) type batteries that are employed in engine starting applications. For AGM type batteries employed in non-engine starting applications please see "VRLA" below. The charging algorithm for absorbed glass mat batteries includes Float mode (see section 9.2) and Dynamic Boost™ mode (see section 9.3).

7.2.2.3. NICD

This setting is appropriate when using nickel-cadmium batteries. The charging algorithm for nickel-cadmium batteries includes Float mode (see section 9.2) and Dynamic Boost™ mode (see section 9.3). Nickel-cadmium batteries are used in all applications.

7.2.2.4. VRLA

The "VRLA" battery profile includes all valve regulated batteries, including AGM types, which are employed in non-engine starting applications. For AGM batteries employed in engine starting applications please see "AGM" above. The charging algorithm for valve-regulated lead-acid batteries includes Float mode only (see section 9.2).

7.2.2.5. **U12/U24**

This setting is appropriate when charging ultracapacitors rather than batteries (see section 9.5). U12 indicates a 12V ultracapacitor and U24 indicates a 24V ultracapacitor.

WARNING:
ULTRACAPACITORS ACCEPT AND DISCHARGE CURRENT RAPIDLY. NEVER ATTEMPT TO JUMP OR CONNECT A BATTERY TO AN ULTRACAPACITOR.

7.2.3. **Configuration Code**

The Configuration Code indicates charging algorithm and alarm setpoints configured at the factory. See sections 8 and 9 for further information.

7.3. **Apply AC Input Voltage**

Verify the AC input is the correct value (90-265 VAC, 47-63 Hz) and apply AC to charger.

Depending on the state of charge of the batteries and the load on the DC bus, the charger may go into current limit at this time, in which case the output voltage will be reduced as the charger operates in constant current mode. Eventually as the battery is charged, the charging current demand should taper to a value below the current limit setpoint of the charger, and the charger should revert to constant voltage output. Chargers configured to use boost may be in boost for up to 24 hours depending on state of charge of the batteries.

7.4. **Power Off**

Power charger off as necessary by disconnecting both AC and DC in any order.

8 ALARMS, LEDS AND DISPLAY

8.1. LED Indicators

The charger is equipped with two LEDs, one for AC status and one for DC status. See further alarm definitions in section 8.4. LEDs indicate an alarm on any output on chargers with multiple outputs. The front panel LCD will indicate which output is in an alarm state.

LED Definitions

AC LED	DC LED	Meaning
OFF	OFF	AC and DC not applied or charger failed or alarm/communications circuit board cannot communicate with main circuit board
*SOLID GREEN	SOLID GREEN	AC good, DC good, in Float Mode
SOLID GREEN	FLASHING GREEN	AC good, in Dynamic Boost Mode
*SOLID GREEN	FLASHING 2X GREEN	AC good, DC in current limit (max charge)
*SOLID GREEN	FLASH LONG-SHORT GREEN	AC good, HELIX Eco-Float mode
*SOLID GREEN	FLASH LONG-2X SHORT GREEN	AC good, HELIX Refresh Charge mode
*SOLID GREEN	FLASH LONG-SHORT YELLOW	AC good, battery commissioning mode active
*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	FLASHING RED/YELLOW	AC good, reverse polarity detected on output
*SOLID GREEN	SOLID YELLOW	AC good, high or low DC voltage (above/below alarm setpoint)
*SOLID GREEN	FLASHING GREEN/RED	AC good, system DC output good, some individual charger module(s) in alarm state
*SOLID GREEN	FLASHING RED/YELLOW	AC good, incompatible battery (charger disabled)
*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 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 RED/YELLOW	AC fail, incompatible battery (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		Charger starting up

*AC LED will flash green when charger is in ultracapacitor mode.

8.2. Individual Alarm Relay Contacts

The alarm/communications circuit board offers five 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 8.4. See charger inside cover label for original factory alarm relay assignments. Refer to tables regarding Genset config, Marine config, and Stationary Power config for typical alarm relay assignments.

Relays will change state for an alarm on any output on chargers with multiple outputs. The front panel LCD will indicate which output is in an alarm state. Alarm setpoints are configured separately for each output using the keypad.

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 9.10) or the SENS Setup Utility. See section 8.4 for alarm definitions.

8.3. LCD Panel

A two line by twenty-character LCD is included with every charger and provides precision digital ammeter and voltmeter as well as information about input, output, charging status and alarms. The voltmeter is accurate to ±1% and the ammeter is accurate to ±5%. 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 +40°C. It may temporarily become unreadable below -20°C but should recover as temperature increases. LCD life is reduced with sustained operation above 65°C.

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 9.10.3), using the SENS Setup Utility or by cycling power.

8.5. Alarm Definitions

See LED Definitions for a description of LED indicator activity. Unless noted otherwise, the following alarms are displayed on the LCD panel. LEDs indicate an alarm on any output on chargers with multiple outputs. The front panel LCD will indicate the alarm and which output is affected.

8.5.1. AC Line Failure

Indicates AC input voltage is not applied or is outside of allowed 90-265 VAC range. Activates solid red AC LED. Alarm/communications circuit board AC FAIL relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.2. High DC Voltage

Indicates DC output voltage is above factory alarm setpoint (see Factory High DC Setpoints table below) or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. Activates solid yellow DC LED. Alarm/communications circuit board HIGH DC relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

Factory High DC Setpoints

Configuration Code*	Battery Type	High DC Setpoint (V / Cell)
GEN	AGM	2.667
	FLA	2.667
	NICD	1.600
	HCB	2.667
	Ultracapacitor	17.00/28.00V
MAR	VRLA	2.440
	AGM/FLA	2.470
	NICD	1.600
NGN	VRLA	2.440
	AGM/FLA	2.470
	NICD	1.600
PSP	N/A	2.200

*Configuration Code displayed on charger label

8.5.3. **Battery Discharging**

Indicates battery is beginning to discharge and DC output voltage is below factory alarm setpoint (see Factory Battery Discharging Setpoints table below) or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. 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. Alarm/communications circuit board BATTERY DISCHARGING relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

Factory Battery Discharging Setpoints

Configuration Code*	Battery Type	Battery Discharging Setpoint (V / Cell)
GEN	AGM	2.083
	FLA	2.083
	NICD	2.083
	HCB	2.083
	Ultracapacitor	14.40/24.00V
MAR	VRLA	2.000
	AGM/FLA	2.000
	NICD	2.000
NGN	VRLA	2.000
	AGM/FLA	2.000
	NICD	2.000
PSP	N/A	1.700

*Configuration Code displayed on charger label.

8.5.4. **Low DC Voltage**

Indicates battery has discharged and DC output voltage is below factory alarm setpoint (see Factory Low DC Setpoints below) or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. Alarm setpoint must be set lower than BATTERY DISCHARGING and higher than END OF DISCHARGE alarms. Activates solid yellow DC LED. Alarm/communications circuit board LOW DC relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

Factory Low DC Setpoints

Configuration Code*	Battery Type	Low DC Setpoint (V / Cell)
GEN	AGM	2.017
	FLA	2.017
	NICD	2.017
	HCB	2.017
	Ultracapacitor	13.00/22.40V
MAR	VRLA	1.833
	AGM/FLA	1.833
	NICD	1.833
NGN	VRLA	1.833
	AGM/FLA	1.833
	NICD	1.833
PSP	N/A	1.700

*Configuration Code displayed on charger label.

8.5.5. **Battery End of Discharge**

Indicates DC output voltage is below factory alarm setpoint (see Factory Battery End of Discharge Setpoints below) or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. This alarm is intended only for longer discharge rates (i.e. not engine starting applications) and indicates the normal end-of-discharge voltage for a lead-acid battery. Alarm setpoint must be set lower than LOW DC and BATTERY DISCHARGING alarms. Activates solid yellow DC LED. Alarm/communications circuit board BATTERY END OF DISCHARGE relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

Factory Battery End of Discharge Setpoints

Configuration Code*	Battery Type	Battery End of Discharge Setpoint (V / Cell)
GEN	AGM	1.750
	FLA	1.750
	NICD	1.750
	HCB	1.750
	Ultracapacitor	10.50/21.00V
MAR	VRLA	1.750
	AGM/FLA	1.750
	NICD	1.750
NGN	VRLA	1.750
	AGM/FLA	1.750
	NICD	1.750
PSP	N/A	1.700

*Configuration Code displayed on charger label.

8.5.6. **Charger Failure**

Indicates the charger is not able to provide the current demanded by the battery and/or load or is providing more current than the charger's control system is commanding. This is typically caused by a charger internal component failure. This alarm does not occur during AC power failures. Activates solid red DC LED. Alarm/communications circuit board CHARGER FAIL relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.7. **Overvoltage Shutdown**

Indicates that the charger has executed a high voltage shutdown and DC output voltage is above factory alarm setpoint (see Factory Overvoltage Shutdown Setpoints below) or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. The charger disables itself whenever excessive output voltage occurs while the charger is 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. Activates solid red DC LED. Alarm/communications circuit board OVERVOLTAGE SHUTDOWN relay contacts change to Fail state after delay when alarm is assigned to relay contacts. Reset the charger by cycling AC and DC power to clear the alarm.

Factory Overvoltage Shutdown Setpoints

Configuration Code*	Battery Type	Overvoltage Shutdown Setpoint (V / Cell)
GEN	AGM	2.833
	FLA	2.833
	NICD	2.833
	HCB	2.833
	Ultracapacitor	17.60/29.20V
MAR	VRLA	2.530
	AGM/FLA	2.568
	NICD	2.833
NGN	VRLA	2.530
	AGM/FLA	2.568
	NICD	2.833
PSP	N/A	2.200

*Configuration Code displayed on charger label.

8.5.8. **Reverse Polarity**

Indicates a battery is connected backwards. Charger output is disabled until the condition is corrected. Activates flashing red/yellow DC LED. Alarm/communications circuit board REVERSE POLARITY relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.9. **Low Cranking Voltage**

Indicates the battery voltage is likely to be inadequate to provide engine-cranking capability. Using the Factory default settings, alarm indicates that DC output voltage during a prior cranking event dropped below default setpoint 50% of the nominal DC output voltage rating (e.g. 6V for a 12V system). **This alarm is latching and must be manually reset by disconnecting both AC and DC power or using keypad**. Chargers intended for marine and standby power applications are shipped with the low cranking voltage alarm disabled. Alarm/communications circuit board LOW CRANK relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.10. **Incompatible Battery**

Indicates charger is connected to an incompatible battery (e.g. a 12V battery is connected to a 24V charger). The charger operates for approximately 5 minutes while observing behavior of the DC voltage. If DC voltage behavior is normal the charger will continue charging. If DC voltage behavior is abnormal, as is typical with a battery voltage mismatch, the charger will shut down and lock off after approximately five minutes. Activates flashing red/yellow DC LED. Alarm/communications circuit board INCOMPATIBLE BATTERY relay contacts change to Fail state after delay when alarm is assigned to relay contacts. After correcting mismatched condition cycle power to reset the charger and begin operation. See section 9.6 for charging a very low or zero-volt battery.

8.5.11. **Invalid Settings**
Indicates a charger setting is not valid. Charger output is disabled until the condition is corrected. Activates alternating flashing yellow AC and DC LEDs. Alarm/communications circuit board INVALID SETTINGS relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.12. **SENSbus Inactive**
Indicates the charger cannot communicate using SENSbus when load sharing and/or remote accessories are connected. Activates flashing long then 2x short yellow AC and DC LEDs. Alarm/communications circuit board SENSBUS INACTIVE relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.13. **Thermal Fold Back**
Indicates charger output is reduced to protect the charger from over-heating damage. The charger will not be able to produce full output until the ambient temperature is lowered. Alarm/communications circuit board THERMAL FOLD BACK relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.14. **No Remote Temp Sense**
Indicates disabled or failed remote temperature sensor. Alarm/communications circuit board NO BATT TEMP SENSOR relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.15. **Current Limiting**
Indicates the charger is operating at maximum allowable output, either the maximum current setting or maximum power output (whichever occurs first). Alarm/communications circuit board CURRENT LIMIT relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

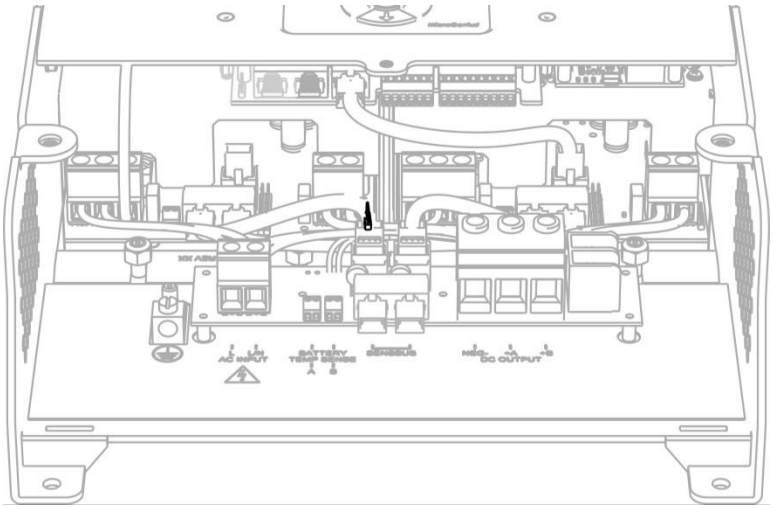
8.5.16. **Ground Fault**
Indicates a short circuit or high impedance leakage current exists from the charger positive or negative output to ground. Chargers intended for genset applications are shipped with the ground fault alarm disabled. Chargers intended for Marine and stationary power applications are shipped with ground fault enabled. The alarm setpoint is set to 500µA by default. Disable or adjust the alarm using the front panel keypad or the SENS Setup Utility. Activates flashing yellow DC LED. Alarm/communications circuit board GROUND FAULT relay contacts change to Fail state after delay when alarm is assigned to relay contacts. Using the keypad, navigate to the “DC Meters” menu to view detected ground fault voltage and current.

The RJ-45 port used for communications is not isolated from the charger output. Non-isolated communications equipment/adapters connected to the RJ-45 port may cause a ground fault alarm.

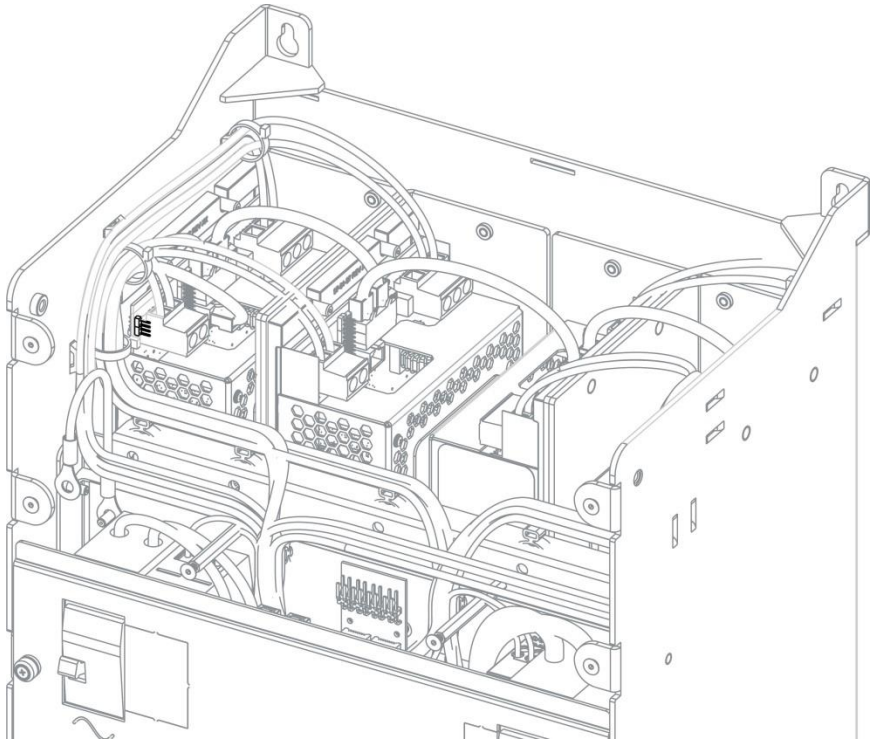
When multiple chargers are operated in parallel and the ground fault alarm is desired, physically remove the ground fault jumper on all but one charger. The ground fault jumper is located on the leftmost internal charger module (see S2 Ground Fault Jumper and S4 Ground Fault Jumper). Access to the jumper requires removing the top cover on the S4 charger. Remove the lower cover first and then remove 6 screws on the upper front of the charger to remove the top cover.

For chargers with multiple outputs, ground fault detection is always indicated on output A. Chargers with multiple outputs have a common output return line and there is a single ground fault alarm for all outputs.

S2 Ground Fault Jumper



S4 Ground Fault Jumper



8.5.17. **Low Current**

Indicates current drawn from the charger is below factory alarm setpoint. Chargers are shipped with the low current alarm disabled. Alarm/communications circuit board LOW CURRENT relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.18. **Load Share Fail**

Indicates that chargers connected for load sharing are not sharing the current load. Activates double flashing yellow DC LED. Alarm/communications circuit board LOAD SHARE FAIL relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.19. **AutoBoost Lockout Active**
Indicates the 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 if charger power is cycled or an engine crank is detected. The Boost time limit is set to 24 hours by default.

8.5.20. **DC Negative Open**
Indicates an open DC negative output connection when chargers are load sharing. Tighten or make connection to remove alarm. Activates double flashing red DC LED. Alarm/communications circuit board DC NEGATIVE OPEN relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.21. **Address Fault**
Indicates an address fault when more than the maximum number of chargers is connected to load share. Activates double flashing red DC LED. Alarm is not displayed on the LCD and cannot be assigned to relay contacts.

8.5.22. **Charger Module Fault**
Indicates one or more individual charger module(s) internal to the charger are in an alarm state. Activates flashing green/red DC LED. Alarm/communications circuit board INDIVIDUAL CHARGER relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.5.1. **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.

8.5.2. **Battery Check**
Indicates battery has failed the most recent battery check. This is a latching alarm. This alarm is cleared by passing a new battery check or by manual reset. When this alarm is assigned to a relay contact BATTERY CHECK will cause the assigned relay to change to the Failed state after the time delay.

8.5.3. **Thermal Fault**
Indicates charger has faulted because it over heated and thermal fold-back has reached zero watts. Charger output has been disabled. Cycle AC and DC power for re-initiation. 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.

8.5.4. **High Battery Temperature**
Indicates battery temperature is above the High Battery Temperature setpoint. This alarm is only available when a remote battery temperature sensor is installed. 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.

8.5.5. **High Battery Temperature Shutdown**
Indicates battery temperature is above the High Battery Temperature Shutdown setpoint and that the charger has shut off as a safety concern. This alarm is only available when a remote battery temperature sensor is installed. 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.

8.5.6. **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.

8.5.7. **Battery Low Temperature**
Indicates battery temperature is below the Low Battery Temperature setpoint. This alarm is only available when a remote battery temperature sensor is installed. 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.

8.5.8. **AC Voltage Over Maximum**
Indicates AC Voltage has gone above maximum allowed by the charger. 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.

8.5.9. **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.

8.5.10. **AC Frequency Out of Range**
Indicates AC Frequency is above the AC High Frequency or below the AC Low Frequency alarm setpoint. 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.

8.5.11. **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.

8.5.12. **TCP/IP Error**
Indicates a setup error on the Modbus TCP/IP device on the optional communications circuit board. Re-apply network settings using the front panel keypad by re-entering the IP address and then pressing the Enter (center arrow) key.

9 OPERATION

9.1. Charging Algorithms

The charger uses charging algorithms appropriate for different battery types. The charging algorithm for each battery type includes various combinations of Float mode, Dynamic Boost™ mode, and HELIX mode, as described in the table below. See following sections for descriptions of each charging mode.

Charging Algorithms

Battery Type	Charging Algorithm		
	Float Mode	Dynamic Boost Mode	HELIX Mode
FLA for Genset	✓	✓	✓
FLA	✓	✓	
AGM	✓	✓	
NICD	✓	✓	
VRLA	✓		

9.1.1. Recharging Batteries

After a battery has been discharged, the charger will enter Dynamic Boost mode if this mode is enabled (see section 9.3). 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 the boost mode continues until the Dynamic Boost control system ends the boost mode or the boost time limit expires (boost time limit set to 24 hours by default). After operating in boost mode the charger switches to Float mode (see section 9.2). If the charger is configured for flooded lead-acid batteries the charger will engage HELIX mode after operating in Float for a short time.

9.2. Float Mode

Float mode is used to maintain stationary batteries and AGM starting batteries in a fully charged state. When the charger is in Float mode the output voltage is maintained at the float voltage setting. See the inside cover label for original factory configuration float value.

Factory Float Voltage Settings

Configuration Code*	Battery Type	Float Voltage (V / Cell)
GEN	AGM	2.270
	FLA	2.218
	NICD	1.430
	HCB	2.230
	Ultracapacitor	15.00/25.40V
FHP	FLA	2.218
MAR	VRLA	2.270
	AGM/FLA	2.218
	NICD	1.430
NGN	VRLA	2.270
	AGM/FLA	2.218
	NICD	1.430
PSP	N/A	2.000

*Configuration Code displayed on charger label.

9.3. Dynamic Boost™ Mode

Dynamic Boost mode utilizes a higher voltage charge to quickly recharge batteries and ensure that all battery cells in a battery string are charged to the same level. Dynamic Boost mode automatically adjusts how long the charger remains in boost mode every recharge cycle. Dynamic Boost automatically adjusts for differing battery sizes, 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 charger depending on battery type selected. See the inside cover label for original factory configuration boost value. Flooded lead-acid, absorbed glass mat (AGM) and nickel-cadmium batteries are automatically charged using Dynamic Boost mode when the battery requires it. 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 24 hours by default. Since boost charging is discouraged by most manufacturers of valve-regulated lead-acid (VRLA) batteries used in stationary applications Dynamic Boost mode is disabled when the charger battery type is VRLA. Boost is also disabled when the battery type is set to ultracapacitor.

Relatively high boost voltages are appropriate in applications where rapid charge recovery is essential or required for strict NFPA-20 fire pump or NFPA-110 emergency power system installations. Order chargers from the factory configured for fire pump/emergency power system installations or configure the charger appropriately using the keypad or SENS Setup Utility. Use of the optional remote temperature compensation probe is highly recommended to maximize charging performance and optimize battery life.

Factory Boost Voltage Settings

Configuration Code*	Battery Type	Boost Voltage (V / Cell)
GEN	AGM	2.387
	FLA	2.363
	NICD	1.520
	HCB	2.400
	Ultracapacitor	Disabled
FHP	FLA	2.617
MAR	VRLA	Disabled
	AGM/FLA	2.300
	NICD	1.520
NGN	VRLA	Disabled
	AGM/FLA	2.300
	NICD	1.520
PSP	N/A	Disabled

*Configuration Code displayed on charger label.

9.4. HELIX Mode

HELIX (High Efficiency, LIfe-eXtending) mode significantly increases the life of flooded lead-acid starting batteries. Battery engineers confirm that continuous flooded SLI (starting batteries) are all designed for vehicle use where they are NOT continuously float charged. Continuous float charging flooded SLI batteries causes these batteries' polyethylene battery separators to oxidize much sooner than would occur in vehicles, where charging is intermittent. Premature separator failure in turn causes earlier failure of the battery than would occur in a vehicle application. Because HELIX allows battery separators to last their entire design life, HELIX also substantially reduces the risk of catastrophic failure of flooded lead-acid batteries.

HELIX is active when the charger is set at the factory for flooded lead-acid battery type with configuration code "GEN" (see inside cover label for configuration code). HELIX operates automatically and no configuration is required by the operator. HELIX mode can be enabled/disabled using the keypad, the SENS Setup Utility, or by selecting a different battery type.

HELIX mode adds two DC output voltage settings to the traditional Boost and Float voltages. These are called Eco-Float and Refresh. The Eco-Float voltage is just above battery open circuit voltage, below traditional float. Refresh voltage is approximately halfway between Float and Boost voltage.

When HELIX is operating, the charger spends more than 90% of its operating hours in the Eco-Float mode. In this mode the charger uses less energy and substantially reduces the rate at which water is lost from the battery. If there are no power outages or other battery discharge events the charger periodically transitions from Eco-Float mode to Refresh mode to ensure that the battery remains fully charged. After operating in Refresh mode the charger reverts to Eco-Float mode.

9.5. Ultracapacitor Mode

Ultracapacitor mode is used to charge ultracapacitors rather than batteries. Ultracapacitor mode is available only on 12V and 24V models. The AC LED will flash green to indicate ultracapacitor mode. The charger output voltage in ultracapacitor mode is 15V for 12V ultracapacitors and 25.4V for 24V ultracapacitors. Dynamic Boost mode is disabled for operation with ultracapacitors.

9.6. Charging Low or Zero-volt Batteries

The charger will initially charge/commission zero-volt or fully discharged batteries without special user intervention. The charger will charge for approximately 5 minutes to determine if the battery voltage will begin to rise. If the voltage rises properly the charger will continue to charge the battery normally using standard output settings (see section 9.7 if alternate output settings are required). If the voltage does not rise appropriately within 5 minutes the charger will shut down. This shut down prevents long-term overcharge in the event of a mismatched battery (e.g. a 12V battery connected to a 24V system). After correcting a mismatched condition, cycle AC and DC power to reset the charger and begin operation.

9.7. Commissioning Batteries

Initially charge/commission zero charge batteries with configurable output voltage and current by activating Commissioning Mode from the keypad or SENS Setup Utility. Using the keypad, navigate to the "Battery Set-up" menu to enable commissioning and configure commissioning voltage, current and duration. Select the appropriate output for chargers with multiple outputs. Each output is configured independently. Commissioning is not available for VRLA, AGM, power supply and ultracapacitor battery types. During commissioning the Over Voltage Shutdown alarm occurs at approximately 102% of the commissioning charge voltage and temperature compensation is not active. After commissioning completes, the charger will automatically revert to the settings configured for normal charging, including temperature compensation and the Over Voltage Shutdown alarm.

9.8. 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. Select the appropriate output for chargers with multiple outputs. Each output is configured independently. 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 chargers are connected to load share, initiating a battery check on one charger will automatically initiate a simultaneous battery check on connected charger(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.

9.9. Restore Factory Defaults

Restore factory defaults using the front panel keypad by scrolling to the “Battery Set-up” menu and selecting “Restore Factory Default Settings.” The following values will revert to original factory settings:

- Battery type
- Cell count
- Float Voltage
- Boost Voltage
- Battery Discharge Voltage
- Low DC Voltage
- Battery End of Discharge Voltage
- Low Crank Voltage
- High DC Voltage
- Battery Check Voltage
- Over Voltage Shutdown
- Charge voltage temperature compensation
- 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

9.10. Keypad Operation

The front panel keypad provides the ability to adjust charger settings without the SENS Setup Utility.

9.10.1. Security Code Protection

Chargers may be security code protected to ensure only authorized personnel may adjust charger settings. The default security code is 000000 meaning security code is not enabled. Change the security code to a unique value by scrolling to the “Service Tools” menu and then the “Change Security Code” option. Contact SENS Customer Service if a custom password is lost or forgotten (800-742-2326 or www.sens-usa.com).

9.10.2. 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 (see Menu Navigation table below). 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. 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

9.10.3. **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.

Chargers with multiple outputs require selecting the appropriate output before configuring. Select the desired output by pressing the UP or DOWN arrow when prompted to "Select DC Output." Each output must be configured individually.

Menus *(Press arrows to scroll through menu options)*		**Configurable/Viewable** *(Press left/right arrows to scroll through menus, press up/down arrows to configure values)*	**Parameter Descriptions**
Main Menu ⇕	**Sub Menu** ⇕	⇔	
Browse Status		Scroll left/right to view basic meters and alarms	
Latched Alarms		Clear All Latched Alarms	Clear status of all latched alarms.
DC	Meters	DC Output *(voltage)*	DC output voltage and current
		DC Output *(power)*	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	Select type of battery to be charged - flooded lead-acid, AGM, nickel-cadmium VRLA, power supply.
		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	Enable or disable HELIX mode
		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%V/°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 *(voltage)*	Adjust battery commissioning output voltage must be greater than or equal to Float voltage
		Batt Commission *(current)*	Adjust battery commissioning output current from 5% to 100% of nominal current rating
		Batt Commission *(duration)*	Adjust battery commissioning hours from 1 to 120 hours
		Batt Commission *(enable)*	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/disable Output A (enabled from factory)
		DC Output #B	Enable/disable Output B for multiple output units
		DC Output #C	Enable/disable Output C for multiple output units
		DC Output #D	Enable/disable Output D for multiple output 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 S2/S4 units
		AC Input #B	Disable for S2/S4 units
User Access		UI Access Control	Select allowed user interface access. Access options include read-only/monitor viewing or full access adjustments for advanced users.
		Change Security Code	Change security code to desired 6 digits. The default security code is 000000 (disabled). Upon entering a security code, the display will automatically prompt user for the code to access protected menus. Menus are protected depending on configured level of access (see UI Access Control definitions above).
		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
		Full Reboot Protocol Board	Press UP arrow to reboot protocol communications device
		Repository Config	Set to Stable
		Minimum System Number of Chargers	Enable or disable whether alarm is indicated or not. Alarm active when the number of charger modules active on SENSbus is less than the minimum charger count for the system. Disabled by default, meaning no alarm. See Error Code 301 for further details.
		Minimum Unit Number of Chargers	Enable or disable whether alarm is indicated or not. Alarm active when the number of charger modules active on SENSbus is less than the minimum charger count for the unit. Disabled by default, meaning no alarm. See Error Code 301 for further details.
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
	DNP3 RS485	DNP3 Configuration	Enable or disable DNP3 RS-485. Only one RS-485 communications protocol is allowed at a time.
		Source Addr	Set DNP3 source address
		Dest Addr	Set DNP3 destination address
		Parity Bit	Set DNP3 parity to none, even or odd
		Baud Rate	Adjust DNP3 baud rate, 230.4 Kbps maximum
		Conf File	Set to factory default DNP3 configuration or select one of two custom configurations. Use SENS DNP3 Config Tool to generate custom configuration file.
	DNP3 TCP	DNP3 Configuration	Enable or disable DNP3 TCP-IP
		Port	Set DNP3 port
		Source Addr	Set DNP3 source address
		Dest Addr	Set DNP3 destination address
		Conf File	Set to factory default DNP3 configuration or select one of two custom configurations. Use SENS DNP3 Config Tool to generate custom configuration file.
	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. Press UP arrow to identify device by temporarily flashing LEDs.

9.11. Configuration with SENS Setup Utility

The SENS Setup Utility is used to monitor, configure, and troubleshoot SENS chargers. Download the SENS Setup Utility software at sens-usa.com/support/download-center/. The setup utility allows configuration of all charger settings including alarm relay assignments. Update charger firmware for all devices except the communications protocol circuit board using the setup utility. Update the communications protocol circuit board using the board webpage (see sections 6.9 and 9.12). See the SENS Setup Utility user manual for information on configuring the charger.

9.11.1. Connect Using USB or SENS Setup Utility

Communication between a computer and the charger using the SENS Setup Utility requires connection via USB-C (see section 6.10) on the alarm/communications circuit board or connection of the SENSbus Adapter (shipped with SENS Setup Utility kit p/n 209254). If connecting the SENSbus Adapter, connect the provided USB cable from the USB port on a PC to the SENSbus Adapter port labeled “USB.” Connect the provided network cable from the SENSbus Adapter RJ-45 port labeled “SENSbus” to the RJ-45 port on the charger. Two SENSbus RJ-45 ports are provided on the inside panel between the AC and DC connections (refer to the figures in Section 4 for location in charger). The ports are in parallel and either port may be used for the SENSbus Adapter connection. Connect using the “USB” option in the SENS Setup Utility.

9.11.2. Connect Using Ethernet

Communication between a computer and the charger using ethernet and the SENS Setup Utility requires connection of a Cat5 minimum RJ-45 cable between the ethernet port on the charger and the ethernet port on the computer (see section 6.9). Ethernet connection using the SENS Setup Utility requires the optional protocol communications circuit board. Connect using the “SENSnet” option in the SENS Setup Utility.

9.12. Protocol Communications Circuit Board—*Optional*

Connect to the optional protocol communications circuit board to update board firmware, download a support bundle, download logs or restart. Connect using the ethernet connection (see section 6.9).

9.12.1. Connect to Protocol Communications Circuit Board

The charger ships from the factory set for DHCP and will automatically/dynamically obtain an IP address. View the IP or configure the charger to use a static IP address, subnet mask and gateway using the front panel display in the “Communications” menu area. Connection is typically to a building network using a router, but a direct ethernet connection to a computer is also possible.

9.12.1.1. Network Using Router/Gateway

Connect a network cable from the ethernet port on the protocol communications circuit board in the charger to the building network (typically at a router). Allow charger to obtain an IP address dynamically or set a static IP.

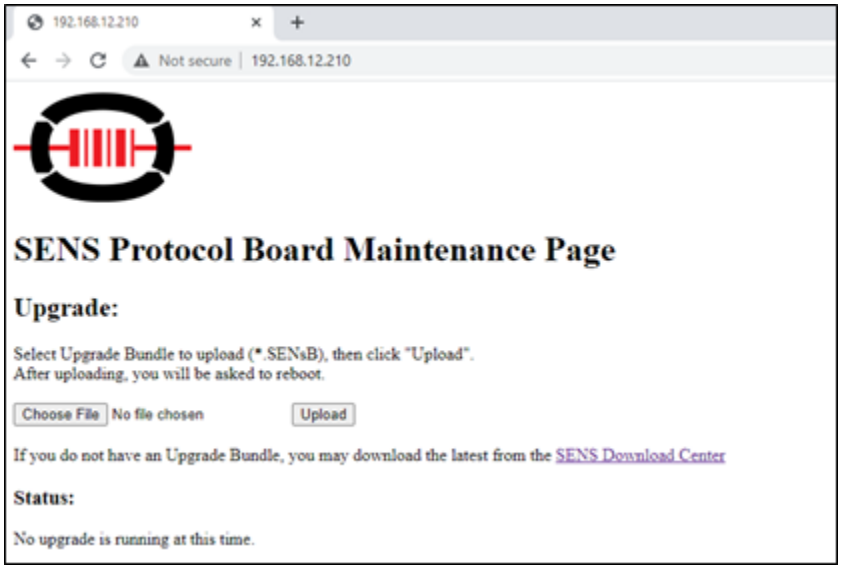
9.12.1.2. Direct Connect Ethernet

Connect a network cable from the ethernet port on the protocol communications circuit board in the charger directly to a computer when a building network is not available. Because the charger is not connected to a network/router it will likely take a "link local" IP address in the range 169.254.0.0 to 169.254.255.255. This works well if the computer is also configured to obtain an IP address automatically because the computer will also take an IP

address in this range. If the charger does not obtain an IP address or communications are not working, review the computer port configuration. On the computer, navigate to Control Panel -> Network and Sharing Center -> Connections: Ethernet/Ethernet Adapter -> Properties -> Internet Protocol Version 4 (TCP/IPv4) -> Properties. If the computer port is configured to "Use the following IP address:" (rather than "Obtain an IP address automatically"), configure the charger to work on that network. Using the front panel, navigate to "Communications" menu area to set IP, subnet mask and gateway. Set a different static IP address on the same subnet as the computer (e.g. if computer is set to 192.168.50.34, set the charger to 192.168.50.35). Set TCP/IP Gateway to the IP address but with a 1 for the last digit (e.g. 192.168.50.1). Set the TCP/IP Subnet Mask to 255.255.255.0.

9.12.2. **Verify Connection Using Webpage**

Navigate to the protocol communications circuit board webpage by typing its IP address into a browser on the computer. A page similar to below will display if a connection exists.



9.12.3. **Update Firmware Using Webpage**

Use this method to update firmware only on the protocol communications circuit board. Update firmware for all other charger devices using the SENS Setup Utility (see section 9.11).

9.12.3.1. Download new protocol communications circuit board firmware bundle from the SENS website (sens-usa.com/support/download-center/). Account activation is required to enter the download center. Select the appropriate download according to the current revision of the protocol communications circuit board. Unzip the file to extract just the firmware bundle (e.g. "SW_PROTOCOLBUNDLE_1.1.2.17405.SENsB").

9.12.3.2. Connect to the protocol communications circuit board webpage (see section 9.12.2).

9.12.3.3. Under the "Upgrade" section, select "Choose File," select the firmware bundle file to upload and press the "Upload" button.

9.12.3.4. Press the "Restart" button on the following page.

9.12.3.5. View update progress on the charger LCD and the protocol communications circuit board webpage. The protocol communications circuit board will restart multiple times. Verify update is complete by confirming the new bundle version stated on the webpage.

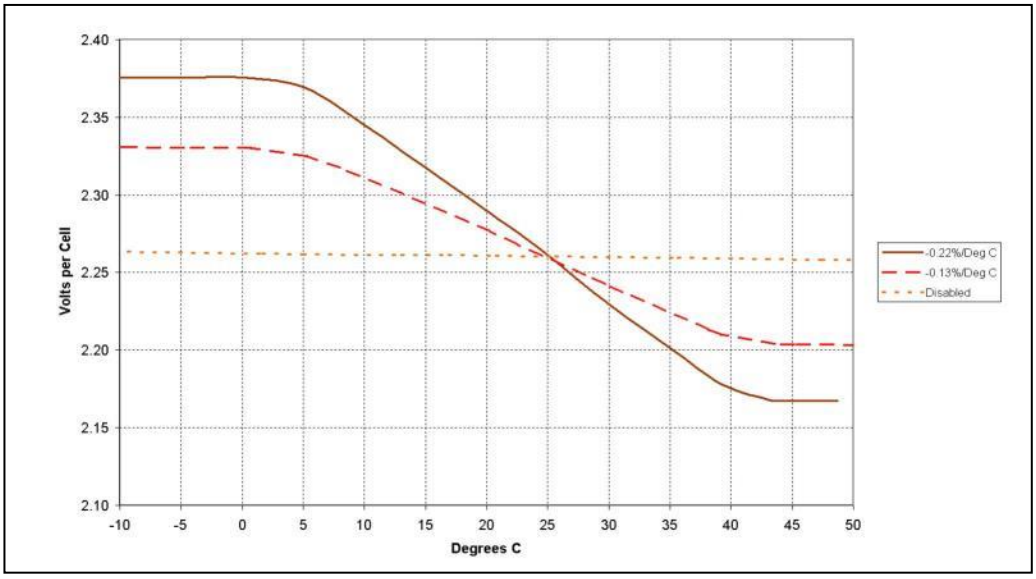
9.13. **Temperature Compensation**

The charger is temperature compensated to match the negative temperature coefficient of the battery. When temperature compensation is 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 (see Example Temperature Compensation Curves graph below).

The charger automatically includes local temperature compensation using internal on-board sensors. Remote temperature compensation is enabled when an optional external sensor is located at the batteries and connected to the remote temperature sensor terminal block in the charger (see section 6.6 for connections). Chargers with multiple output terminals include multiple remote temperature sensor terminal blocks (connect one sensor for each output). Remote temperature compensation is required for ultracapacitor charging and should be used in applications where battery and charger are located in different ambient conditions. Chargers connected to load share only require a remote temperature sensor connected to one charger. Temperature Compensation is set to a slope of -0.18% per °C by default for operation with batteries. The temperature Compensation slope for ultracapacitors is set by the factory and is not adjustable. Temperature compensation is disabled by connecting a short across the remote temperature sensor terminal block(s), using the keypad or by setting the temperature compensation slope to zero using the SENS Setup Utility. The temperature present at a sensor (local or remote) is displayed on the front panel LCD. Actual battery temperature is only displayed if the optional remote temperature sensor is connected to the charger and placed at the batteries.

Example Temperature Compensation Curves



9.14. Load Share Charger Operation

Multiple chargers may be connected in parallel to provide charger redundancy and increased charging current. Load sharing chargers are fault tolerant; one charger failure will not cause failures in paralleled chargers.

9.14.1. Load Sharing and Synchronization

Connection of a network cable between chargers using the SENSbus RJ-45 connectors (see section 6.10) automatically initiates load sharing synchronization of operating modes. Chargers will share the current load within ±10%. For proper load share operation, a 120-ohm terminator is required at the ends of the bus. Chargers intended for load sharing must be configured with the same output settings in order to load share properly. A charger in a multi-charger load sharing system with different output settings will not load share properly. Corresponding outputs must be configured with the same output settings for chargers with multiple outputs. Load sharing operates independently on each output for chargers with multiple outputs. Connect corresponding outputs of load sharing chargers in parallel (i.e. connect output A to output A). Load sharing will not occur if non-corresponding outputs are connected (e.g. do not connect

output A to output B). The LOAD SHARE FAIL alarm will occur any time a charger is unable to load share. If a charger in a multi-charger load sharing system fails or is disconnected the remaining chargers will still load share and ignore the faulted charger. Each load sharing charger will alarm independently using individually configured alarm setpoints.

The output voltage and current of each individual charger will be shown on the front panel LCD. If an optional remote alarm/communications panel accessory (not included internal to charger) is connected it will display only the system output voltage and current. An alarm/communications circuit board that is configured for an individual charger can be set to show system information by using the SENS Setup Utility.

Chargers connected in parallel without the load sharing network cable will operate but without synchronization. Current is not shared between chargers, Boost and HELIX modes are not synchronized and the system voltage is not displayed on the LCD. The chargers must be set for the same voltage range and Float voltage. When load sharing is disabled, boost mode should also be disabled on all but one charger to avoid conflicts between chargers. As a result, redundancy of Boost output voltage is not included when load sharing is not employed.

9.15. 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 chargers using one external device. Connection of a network cable between the accessory and charger(s) using the SENSbus RJ-45 connectors (see section 6.11) 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 9.10 for keypad operation.

10 J1939 COMMUNICATIONS

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

In most cases, charger default J1939 settings are sufficient to automatically begin using J1939 communications after connecting the charger to the network. Use the SENS Setup Utility to adjust J1939 settings (e.g. baud rate, vehicle system instance, etc.) if required.

10.1. 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

11 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).

11.1. Modbus RS-485

Serial Modbus communications over RS-485 using RTU mode requires configuration using the SENS Setup Utility or the keypad. 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

11.2. Modbus TCP/IP—*Optional*

Modbus communications over TCP/IP is optional and requires configuration using the SENS Setup Utility or the keypad. 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 slave address and enable/disable Modbus write access as desired. See section 6.9 for connection information.

Modbus TCP/IP Default Settings

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

11.3. Modbus Holding Registers

MicroGenius S2/S4 charger 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	System Serial Number	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 11.4)	Bitfield	1
44	0x02C	45	0x02D	Charging Status	Charging Status bits (see section 11.5)	Bitfield	1
46	0x02E	47	0x02F	Charging Alarms Extended	Charging Alarm Extended status bits (see section 11.6)	Bitfield	1
48	0x030	49	0x031	Charging AC Alarms	Charging AC Alarm status bits (see section 11.7)	Bitfield	1
62	0x03E	63	0x03F	Uptime Counter Value	Charger uptime counter value	Sec	1
212	0x0D4	213	0x0D5	Output A Voltage	Voltage currently being supplied by the charger to the battery	V	32768

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
214	0x0D6	215	0x0D7	Output A Output Current	Current currently being supplied by the charger to the battery	A	32768
216	0x0D8	217	0x0D9	Output A Power Output	Power currently being supplied by the charger	W	32768
218	0x0DA	219	0x0DB	Output A Factory Float Setting	Float Cell Voltage set at Factory	V/cell	32768
220	0x0DC	221	0x0DD	Output A Factory Boost Setting	Boost Cell Voltage set at Factory	V/cell	32768
222	0x0DE	223	0x0DF	Output A Remote Temp	Remote temp sense temperature in 0.0°C	°C	32768
224	0x0E0	225	0x0E1	Output A Internal Temp	Ambient air temperature near charger input connectors (tp 1)	°C	32768
226	0x0E2	227	0x0E3	Output A Boost Elapsed Time	Boost time	Sec	1
228	0x0E4	229	0x0E5	Output A Periodic Boost Countdown	Time until next Boost	Sec	1
230	0x0E6	231	0x0E7	Output A AC Line Frequency	AC Line Frequency	Hz	10
232	0x0E8	233	0x0E9	Output A AC Line Voltage 1	AC Line 1 Voltage	V	32768
234	0x0EA	235	0x0EB	Output A AC Line Current 1	AC Line 1 Current (not applicable to single phase chargers)	A	32768
236	0x0EC	237	0x0ED	Output A AC Line Voltage 2	AC Line 2 Voltage (not applicable to single phase chargers)	V	32768
238	0x0EE	239	0x0EF	Output A AC Line Current 2	AC Line 2 Current (not applicable to single phase chargers)	A	32768
240	0x0F0	241	0x0F1	Output A AC Line Voltage 3	AC Line 3 Voltage (not applicable to single phase chargers)	V	32768
242	0x0F2	243	0x0F3	Output A AC Line Current 3	AC Line 3 Current (not applicable to single phase chargers)	A	32768
244	0x0F4	245	0x0F5	Output A Battery Check Time Elapsed	Battery Check time elapsed	Sec	1
246	0x0F6	247	0x0F7	Output A Battery Check Due	Time until next Battery Check	Sec	1
248	0x0F8	249	0x0F9	Output A Number of Chargers	Number of chargers detected on SENSbus, 0 - 30	Num	1
272	0x110	273	0x111	Output A Maximum Power	Maximum rated power	V/Cell	32768
274	0x112	275	0x113	Output A Maximum Voltage	Maximum rated voltage in x.xx V	V/Cell	32768
276	0x114	277	0x115	Output A Maximum Current	Maximum rated current in x.xxA	A	32768
278	0x116	279	0x117	Output A Program Float Setting	Float Cell Voltage used in Program Mode	V/Cell	32768
280	0x118	281	0x119	Output A Program Boost Setting	Boost Cell Voltage used in Program Mode	V/Cell	32768
282	0x11A	283	0x11B	Output A Program Mode	Mode callouts for Program Mode setting (battery type… etc.)	Custom	1
284	0x11C	285	0x11D	Output A Program Cell Count	Number of cells set in Program Mode	Cells	32768
286	0x11E	287	0x11F	Output A Program Temp comp slope	In 0.xx°C per output volt x -1	°C/V	32768
288	0x120	289	0x121	Output A Low DC Program	Alarm setpoint for low DC (used for Program Mode setting)	V/Cell	32768

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
290	0x122	291	0x123	Output A Low Crank Program	Alarm setpoint for low Crank (used for Program Mode setting)	V/Cell	32768
292	0x124	293	0x125	Output A Low Current Program	Alarm setpoint for low Current (used for Program Mode setting)	A	32768
296	0x128	297	0x129	Output A High DC Program	Alarm setpoint for high DC (used for Program Mode setting)	V/Cell	32768
298	0x12A	299	0x12B	Output A OVSD Program	Alarm setpoint for OVSD (used for Program Mode setting)	V/Cell	32768
300	0x12C	301	0x12D	Output A Batt Discharge Program	Alarm setpoint for Batt Discharge (used for Program Mode setting)	V/Cell	32768
302	0x12E	303	0x12F	Output A Batt End Discharge Program	Alarm setpoint for End Discharge (used for Program Mode setting)	V/Cell	32768
304	0x130	305	0x131	Output A Program Boost Time Limit	Boost time limit (used for Program Mode setting)	Hr	3600
306	0x132	307	0x133	Output A Current Limit Setting	Current Limit setpoint in % of output current as a 10 bit value	% Rated A	32768
308	0x134	309	0x135	Output A Default Output Helix Float Time	Helix Float Time	Hr	3600
310	0x136	311	0x137	Output A Default Output Helix Refresh Time	Helix Refresh Time	Hr	3600
312	0x138	313	0x139	Output A Default Output Helix Eco Time	Helix Eco Time	Hr	3600
314	0x13A	315	0x13B	Output A Default Output Periodic Boost Time	Interval between scheduled Periodic Boost	Days	86400
316	0x13C	317	0x13D	Output A Battery Check Voltage Setting	Battery check failure threshold	V/Cell	32768
318	0x13E	319	0x13F	Output A Battery Check Interval	Interval between scheduled automatic battery checks	Days	86400
320	0x140	321	0x141	Output A Battery Check Duration	Duration of battery check	Min	60
322	0x142	323	0x143	Output A Default Output Commissioning VPC	Commissioning VPC	V/Cell	32768
324	0x144	325	0x145	Output A Default Output Commissioning Duration	Commissioning Duration	Hr	3600
326	0x146	327	0x147	Output A Default Output Commissioning A	Commissioning Amps	A	32768
328	0x148	329	0x149	Output A Default Output Rated Power	Output Rated Power	W	32768
330	0x14A	331	0x14B	Output A Default Output Rated Current	Output Rated Current	A	32768
332	0x14C	333	0x14D	Output A Periodic Boost Duration	Periodic Boost Duration	Bits	3600
334	0x14E	335	0x14F	Channel A Min Allowed Voltage Setting	Min Allowed Voltage Setting	V/Cell	32768
356	0x164	357	0x165	Output B Voltage	Voltage currently being supplied by the charger to the battery	V	32768
358	0x166	359	0x167	Output B Output Current	Current currently being supplied by the charger to the battery	A	32768
360	0x168	361	0x169	Output B Power Output	Power currently being supplied by the charger	W	32768
362	0x16A	363	0x16B	Output B Factory Float Setting	Float Cell Voltage set at Factory	V/cell	32768

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
364	0x16C	365	0x16D	Output B Factory Boost Setting	Boost Cell Voltage set at Factory	V/cell	32768
366	0x16E	367	0x16F	Output B Remote Temp	Remote temp sense temperature in 0.0°C	°C	32768
368	0x170	369	0x171	Output B Internal Temp	Ambient air temperature near charger input connectors (tp 1)	°C	32768
370	0x172	371	0x173	Output B Boost Elapsed Time	Boost time	Sec	1
372	0x174	373	0x175	Output B Periodic Boost Countdown	Time until next Boost	Sec	1
374	0x176	375	0x177	Output B AC Line Frequency	AC Line Frequency	Hz	10
376	0x178	377	0x179	Output B AC Line Voltage 1	AC Line 1 Voltage	V	32768
378	0x17A	379	0x17B	Output B AC Line Current 1	AC Line 1 Current (not applicable to single phase chargers)	A	32768
380	0x17C	381	0x17D	Output B AC Line Voltage 2	AC Line 2 Voltage (not applicable to single phase chargers)	V	32768
382	0x17E	383	0x17F	Output B AC Line Current 2	AC Line 2 Current (not applicable to single phase chargers)	A	32768
384	0x180	385	0x181	Output B AC Line Voltage 3	AC Line 3 Voltage (not applicable to single phase chargers)	V	32768
386	0x182	387	0x183	Output B AC Line Current 3	AC Line 3 Current (not applicable to single phase chargers)	A	32768
388	0x184	389	0x185	Output B Battery Check Time Elapsed	Battery Check time elapsed	Sec	1
390	0x186	391	0x187	Output B Battery Check Due	Time until next Battery Check	Sec	1
392	0x188	393	0x189	Output B Number of Chargers	Number of chargers detected on SENSbus, 0 - 30	Num	1
416	0x1A0	417	0x1A1	Output B Maximum Power	Maximum rated power	V/Cell	32768
418	0x1A2	419	0x1A3	Output B Maximum Voltage	Maximum rated voltage in x.xx V	V/Cell	32768
420	0x1A4	421	0x1A5	Output B Maximum Current	Maximum rated current in x.xxA	A	32768
422	0x1A6	423	0x1A7	Output B Program Float Setting	Float Cell Voltage used in Program Mode	V/Cell	32768
424	0x1A8	425	0x1A9	Output B Program Boost Setting	Boost Cell Voltage used in Program Mode	V/Cell	32768
426	0x1AA	427	0x1AB	Output B Program Mode	Mode callouts for Program Mode setting (battery type… etc.)	Custom	1
428	0x1AC	429	0x1AD	Output B Program Cell Count	Number of cells set in Program Mode	Cells	32768
430	0x1AE	431	0x1AF	Output B Program Temp comp slope	In 0.xx°C per output volt x -1	°C/V	32768
432	0x1B0	433	0x1B1	Output B Low DC Program	Alarm setpoint for low DC (used for Program Mode setting)	V/Cell	32768
434	0x1B2	435	0x1B3	Output B Low Crank Program	Alarm setpoint for low Crank (used for Program Mode setting)	V/Cell	32768
436	0x1B4	437	0x1B5	Output B Low Current Program	Alarm setpoint for low Current (used for Program Mode setting)	A	32768
440	0x1B8	441	0x1B9	Output B High DC Program	Alarm setpoint for high DC (used for Program Mode setting)	V/Cell	32768
442	0x1BA	443	0x1BB	Output B OVSD Program	Alarm setpoint for OVSD (used for Program Mode setting)	V/Cell	32768

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
444	0x1BC	445	0x1BD	Output B Batt Discharge Program	Alarm setpoint for Batt Discharge (used for Program Mode setting)	V/Cell	32768
446	0x1BE	447	0x1BF	Output B Batt End Discharge Program	Alarm setpoint for End Discharge (used for Program Mode setting)	V/Cell	32768
448	0x1C0	449	0x1C1	Output B Program Boost Time Limit	Boost time limit (used for Program Mode setting)	Hr	3600
450	0x1C2	451	0x1C3	Output B Current Limit Setting	Current Limit setpoint in % of output current as a 10 bit value	% Rated A	32768
452	0x1C4	453	0x1C5	Output B Default Output Helix Float Time	Helix Float Time	Hr	3600
454	0x1C6	455	0x1C7	Output B Default Output Helix Refresh Time	Helix Refresh Time	Hr	3600
456	0x1C8	457	0x1C9	Output B Default Output Helix Eco Time	Helix Eco Time	Hr	3600
458	0x1CA	459	0x1CB	Output B Default Output Periodic Boost Time	Interval between scheduled Periodic Boost	Days	86400
460	0x1CC	461	0x1CD	Output B Battery Check Voltage Setting	Battery check failure threshold	V/Cell	32768
462	0x1CE	463	0x1CF	Output B Battery Check Interval	Interval between scheduled automatic battery checks	Days	86400
464	0x1D0	465	0x1D1	Output B Battery Check Duration	Duration of battery check	Min	60
466	0x1D2	467	0x1D3	Output B Default Output Commissioning VPC	Commissioning VPC	V/Cell	32768
468	0x1D4	469	0x1D5	Output B Default Output Commissioning Duration	Commissioning Duration	Hr	3600
470	0x1D6	471	0x1D7	Output B Default Output Commissioning A	Commissioning Amps	A	32768
472	0x1D8	473	0x1D9	Output B Default Output Rated Power	Output Rated Power	W	32768
474	0x1DA	475	0x1DB	Output B Default Output Rated Current	Output Rated Current	A	32768
476	0x1DC	477	0x1DD	Output B Periodic Boost Duration	Periodic Boost Duration	Bits	3600
478	0x1DE	479	0x1DF	Channel B Min Allowed Voltage Setting	Min Allowed Voltage Setting	V/Cell	32768
500	0x1F4	501	0x1F5	Output C Voltage	Voltage currently being supplied by the charger to the battery	V	32768
502	0x1F6	503	0x1F7	Output C Output Current	Current currently being supplied by the charger to the battery	A	32768
504	0x1F8	505	0x1F9	Output C Power Output	Power currently being supplied by the charger	W	32768
506	0x1FA	507	0x1FB	Output C Factory Float Setting	Float Cell Voltage set at Factory	V/cell	32768
508	0x1FC	509	0x1FD	Output C Factory Boost Setting	Boost Cell Voltage set at Factory	V/cell	32768
510	0x1FE	511	0x1FF	Output C Remote Temp	Remote temp sense temperature in 0.0°C	°C	32768
512	0x200	513	0x201	Output C Internal Temp	Ambient air temperature near charger input connectors (tp 1)	°C	32768
514	0x202	515	0x203	Output C Boost Elapsed Time	Boost time	Sec	1

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
516	0x204	517	0x205	Output C Periodic Boost Countdown	Time until next Boost	Sec	1
518	0x206	519	0x207	Output C AC Line Frequency	AC Line Frequency	Hz	10
520	0x208	521	0x209	Output C AC Line Voltage 1	AC Line 1 Voltage	V	32768
522	0x20A	523	0x20B	Output C AC Line Current 1	AC Line 1 Current (not applicable to single phase chargers)	A	32768
524	0x20C	525	0x20D	Output C AC Line Voltage 2	AC Line 2 Voltage (not applicable to single phase chargers)	V	32768
526	0x20E	527	0x20F	Output C AC Line Current 2	AC Line 2 Current (not applicable to single phase chargers)	A	32768
528	0x210	529	0x211	Output C AC Line Voltage 3	AC Line 3 Voltage (not applicable to single phase chargers)	V	32768
530	0x212	531	0x213	Output C AC Line Current 3	AC Line 3 Current (not applicable to single phase chargers)	A	32768
532	0x214	533	0x215	Output C Battery Check Time Elapsed	Battery Check time elapsed	Sec	1
534	0x216	535	0x217	Output C Battery Check Due	Time until next Battery Check	Sec	1
536	0x218	537	0x219	Output C Number of Chargers	Number of chargers detected on SENSbus, 0 - 30	Num	1
560	0x230	561	0x231	Output C Maximum Power	Maximum rated power	V/Cell	32768
562	0x232	563	0x233	Output C Maximum Voltage	Maximum rated voltage in x.xx V	V/Cell	32768
564	0x234	565	0x235	Output C Maximum Current	Maximum rated current in x.xxA	A	32768
566	0x236	567	0x237	Output C Program Float Setting	Float Cell Voltage used in Program Mode	V/Cell	32768
568	0x238	569	0x239	Output C Program Boost Setting	Boost Cell Voltage used in Program Mode	V/Cell	32768
570	0x23A	571	0x23B	Output C Program Mode	Mode callouts for Program Mode setting (battery type… etc.)	Custom	1
572	0x23C	573	0x23D	Output C Program Cell Count	Number of cells set in Program Mode	Cells	32768
574	0x23E	575	0x23F	Output C Program Temp comp slope	In 0.xx°C per output volt x -1	°C/V	32768
576	0x240	577	0x241	Output C Low DC Program	Alarm setpoint for low DC (used for Program Mode setting)	V/Cell	32768
578	0x242	579	0x243	Output C Low Crank Program	Alarm setpoint for low Crank (used for Program Mode setting)	V/Cell	32768
580	0x244	581	0x245	Output C Low Current Program	Alarm setpoint for low Current (used for Program Mode setting)	A	32768
584	0x248	585	0x249	Output C High DC Program	Alarm setpoint for high DC (used for Program Mode setting)	V/Cell	32768
586	0x24A	587	0x24B	Output C OVSD Program	Alarm setpoint for OVSD (used for Program Mode setting)	V/Cell	32768
588	0x24C	589	0x24D	Output C Batt Discharge Program	Alarm setpoint for Batt Discharge (used for Program Mode setting)	V/Cell	32768
590	0x24E	591	0x24F	Output C Batt End Discharge Program	Alarm setpoint for End Discharge (used for Program Mode setting)	V/Cell	32768
592	0x250	593	0x251	Output C Program Boost Time Limit	Boost time limit (used for Program Mode setting)	Hr	3600
594	0x252	595	0x253	Output C Current Limit Setting	Current Limit setpoint in % of output current as a 10 bit value	% Rated A	32768

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
596	0x254	597	0x255	Output C Default Output Helix Float Time	Helix Float Time	Hr	3600
598	0x256	599	0x257	Output C Default Output Helix Refresh Time	Helix Refresh Time	Hr	3600
600	0x258	601	0x259	Output C Default Output Helix Eco Time	Helix Eco Time	Hr	3600
602	0x25A	603	0x25B	Output C Default Output Periodic Boost Time	Interval between scheduled Periodic Boost	Days	86400
604	0x25C	605	0x25D	Output C Battery Check Voltage Setting	Battery check failure threshold	V/Cell	32768
606	0x25E	607	0x25F	Output C Battery Check Interval	Interval between scheduled automatic battery checks	Days	86400
608	0x260	609	0x261	Output C Battery Check Duration	Duration of battery check	Min	60
610	0x262	611	0x263	Output C Default Output Commissioning VPC	Commissioning VPC	V/Cell	32768
612	0x264	613	0x265	Output C Default Output Commissioning Duration	Commissioning Duration	Hr	3600
614	0x266	615	0x267	Output C Default Output Commissioning A	Commissioning Amps	A	32768
616	0x268	617	0x269	Output C Default Output Rated Power	Output Rated Power	W	32768
618	0x26A	619	0x26B	Output C Default Output Rated Current	Output Rated Current	A	32768
620	0x26C	621	0x26D	Output C Periodic Boost Duration	Periodic Boost Duration	Bits	3600
622	0x26E	623	0x26F	Channel C Min Allowed Voltage Setting	Min Allowed Voltage Setting	V/Cell	32768
644	0x284	645	0x285	Output D Voltage	Voltage currently being supplied by the charger to the battery	V	32768
646	0x286	647	0x287	Output D Output Current	Current currently being supplied by the charger to the battery	A	32768
648	0x288	649	0x289	Output D Power Output	Power currently being supplied by the charger	W	32768
650	0x28A	651	0x28B	Output D Factory Float Setting	Float Cell Voltage set at Factory	V/cell	32768
652	0x28C	653	0x28D	Output D Factory Boost Setting	Boost Cell Voltage set at Factory	V/cell	32768
654	0x28E	655	0x28F	Output D Remote Temp	Remote temp sense temperature in 0.0°C	°C	32768
656	0x290	657	0x291	Output D Internal Temp	Ambient air temperature near charger input connectors (tp 1)	°C	32768
658	0x292	659	0x293	Output D Boost Elapsed Time	Boost time	Sec	1
660	0x294	661	0x295	Output D Periodic Boost Countdown	Time until next Boost	Sec	1
662	0x296	663	0x297	Output D AC Line Frequency	AC Line Frequency	Hz	10
664	0x298	665	0x299	Output D AC Line Voltage 1	AC Line 1 Voltage	V	32768
666	0x29A	667	0x29B	Output D AC Line Current 1	AC Line 1 Current (not applicable to single phase chargers)	A	32768
668	0x29C	669	0x29D	Output D AC Line Voltage 2	AC Line 2 Voltage (not applicable to single phase chargers)	V	32768

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
670	0x29E	671	0x29F	Output D AC Line Current 2	AC Line 2 Current (not applicable to single phase chargers)	A	32768
672	0x2A0	673	0x2A1	Output D AC Line Voltage 3	AC Line 3 Voltage (not applicable to single phase chargers)	V	32768
674	0x2A2	675	0x2A3	Output D AC Line Current 3	AC Line 3 Current (not applicable to single phase chargers)	A	32768
676	0x2A4	677	0x2A5	Output D Battery Check Time Elapsed	Battery Check time elapsed	Sec	1
678	0x2A6	679	0x2A7	Output D Battery Check Due	Time until next Battery Check	Sec	1
680	0x2A8	681	0x2A9	Output D Number of Chargers	Number of chargers detected on SENSbus, 0 - 30	Num	1
704	0x2C0	705	0x2C1	Output D Maximum Power	Maximum rated power	V/Cell	32768
706	0x2C2	707	0x2C3	Output D Maximum Voltage	Maximum rated voltage in x.xx V	V/Cell	32768
708	0x2C4	709	0x2C5	Output D Maximum Current	Maximum rated current in x.xxA	A	32768
710	0x2C6	711	0x2C7	Output D Program Float Setting	Float Cell Voltage used in Program Mode	V/Cell	32768
712	0x2C8	713	0x2C9	Output D Program Boost Setting	Boost Cell Voltage used in Program Mode	V/Cell	32768
714	0x2CA	715	0x2CB	Output D Program Mode	Mode callouts for Program Mode setting (battery type… etc.)	Custom	1
716	0x2CC	717	0x2CD	Output D Program Cell Count	Number of cells set in Program Mode	Cells	32768
718	0x2CE	719	0x2CF	Output D Program Temp comp slope	In 0.xx°C per output volt x -1	°C/V	32768
720	0x2D0	721	0x2D1	Output D Low DC Program	Alarm setpoint for low DC (used for Program Mode setting)	V/Cell	32768
722	0x2D2	723	0x2D3	Output D Low Crank Program	Alarm setpoint for low Crank (used for Program Mode setting)	V/Cell	32768
724	0x2D4	725	0x2D5	Output D Low Current Program	Alarm setpoint for low Current (used for Program Mode setting)	A	32768
728	0x2D8	729	0x2D9	Output D High DC Program	Alarm setpoint for high DC (used for Program Mode setting)	V/Cell	32768
730	0x2DA	731	0x2DB	Output D OVSD Program	Alarm setpoint for OVSD (used for Program Mode setting)	V/Cell	32768
732	0x2DC	733	0x2DD	Output D Batt Discharge Program	Alarm setpoint for Batt Discharge (used for Program Mode setting)	V/Cell	32768
734	0x2DE	735	0x2DF	Output D Batt End Discharge Program	Alarm setpoint for End Discharge (used for Program Mode setting)	V/Cell	32768
736	0x2E0	737	0x2E1	Output D Program Boost Time Limit	Boost time limit (used for Program Mode setting)	Hr	3600
738	0x2E2	739	0x2E3	Output D Current Limit Setting	Current Limit setpoint in % of output current as a 10 bit value	% Rated A	32768
740	0x2E4	741	0x2E5	Output D Default Output Helix Float Time	Helix Float Time	Hr	3600
742	0x2E6	743	0x2E7	Output D Default Output Helix Refresh Time	Helix Refresh Time	Hr	3600
744	0x2E8	745	0x2E9	Output D Default Output Helix Eco Time	Helix Eco Time	Hr	3600
746	0x2EA	747	0x2EB	Output D Default Output Periodic Boost Time	Interval between scheduled Periodic Boost	Days	86400

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
748	0x2EC	749	0x2ED	Output D Battery Check Voltage Setting	Battery check failure threshold	V/Cell	32768
750	0x2EE	751	0x2EF	Output D Battery Check Interval	Interval between scheduled automatic battery checks	Days	86400
752	0x2F0	753	0x2F1	Output D Battery Check Duration	Duration of battery check	Min	60
754	0x2F2	755	0x2F3	Output D Default Output Commissioning VPC	Commissioning VPC	V/Cell	32768
756	0x2F4	757	0x2F5	Output D Default Output Commissioning Duration	Commissioning Duration	Hr	3600
758	0x2F6	759	0x2F7	Output D Default Output Commissioning A	Commissioning Amps	A	32768
760	0x2F8	761	0x2F9	Output D Default Output Rated Power	Output Rated Power	W	32768
762	0x2FA	763	0x2FB	Output D Default Output Rated Current	Output Rated Current	A	32768
764	0x2FC	765	0x2FD	Output D Periodic Boost Duration	Periodic Boost Duration	Bits	3600
766	0x2FE	767	0x2FF	Channel D Min Allowed Voltage Setting	Min Allowed Voltage Setting	V/Cell	32768

11.4. **Alarm Bit Definition**

Bit Address		Name	Description
Decimal	Hex		
0	0x00	Alarm AC Fail	Charger does not have usable AC input
1	0x01	Alarm High DC	Charger output exceeds alarm threshold
2	0x02	Alarm Low DC	Charger output below alarm threshold
3	0x03	Alarm Charger Fail	Charger not operating because of an internal failure
4	0x04	Alarm Over Voltage Shutdown	Charger disabled by selective overvoltage shutdown
5	0x05	Alarm Reverse Polarity	Charger disabled because battery polarity is reversed
6	0x06	Alarm Low Cranking	Low cranking voltage event has been detected
7	0x07	Alarm Incompatible Battery	Charger disabled because it does not match battery (12V vs. 24V)
8	0x08	Alarm Invalid Settings	Charger disabled because jumper setting is not correct
9	0x09	Unused	Unused
10	0x0A	Alarm Thermal Foldback	Available output is reduced because of high temperature
11	0x0B	Alarm No Temperature Probe	Battery temperature probe is not connected
12	0x0C	Alarm Current Limiting	Operating in current limit mode (below output voltage set point)
13	0x0D	Alarm Ground Fault Positive	Ground fault alarm enabled and positive ground detected
14	0x0E	Alarm Low Current	Low current alarm enabled and output below alarm threshold
15	0x0F	Alarm Load Share Fault	Charger fails to provide its share of the output current
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	Alarm SENSbus Inactive	Display board is not receiving any charger data
19	0x13	Alarm Battery On Discharge	Battery in range where discharge occurs (below open circuit voltage)
20	0x14	Alarm Battery End Discharge	Battery voltage below safe discharge range threshold
21	0x15	Alarm Ground Fault Negative	Ground fault alarm enabled and negative ground detected
22	0x16	Alarm DC Negative Open	Charger disabled because common negative lead is open
23	0x17	DC Below Startup Voltage	Battery voltage is below the Startup Voltage setpoint. Unit output voltage is disabled. Forced startup feature overrides.

Bit Address		Name	Description
Decimal	Hex		
24	0x18	Unused	Unused
25	0x19	Alarm Load Disconnect	Load relay open: set at "end discharge", clear when not "on discharge"
26	0x1A	Alarm Individual Unit Fault	Alarm flag 32-54 active for one, but not all, chargers in any Output
27	0x1B	Alarm Battery Check	Battery check failed

11.5. **Status 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

11.6. **Extended Status 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.

11.7. 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.

11.8. Writable Control Flags (Coils)

Single coil writes: 0xFF00 for ON, 0x0000 for OFF
Multiple coil writes: 1 for ON, 0 for OFF

Address		Description	Details
Decimal	Hex		
16	0x010	Start/stop manual boost, Channel A	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, Channel A	ON to start, OFF to stop
19	0x013	Reset periodic battery check schedule	ON to reset schedule, OFF is no-op
20	0x014	Clear battery check failure, Channel A	ON to reset alarm, OFF is no-op
21	0x015	Clear low cranking failure, Channel A	ON to reset alarm, OFF is no-op
22	0x016	Force DC Startup	ON to start, OFF to stop
23	0x017	Reset Latched Alarms	ON to reset alarm, OFF is no-op
32	0x020	Start/stop manual boost, Channel B	ON to start, OFF to stop
33	0x021	Reset periodic boost charge schedule	ON to reset schedule, OFF is no-op
34	0x022	Start/stop battery check, Channel B	ON to start, OFF to stop
35	0x023	Reset periodic battery check schedule	ON to reset schedule, OFF is no-op
36	0x024	Clear battery check failure, Channel B	ON to reset alarm, OFF is no-op
37	0x025	Clear low cranking failure, Channel B	ON to reset alarm, OFF is no-op
38	0x026	Force DC Startup	ON to start, OFF to stop
39	0x027	Reset Latched Alarms	ON to reset alarm, OFF is no-op
48	0x030	Start/stop manual boost, Channel C	ON to start, OFF to stop
49	0x031	Reset periodic boost charge schedule	ON to reset schedule, OFF is no-op
50	0x032	Start/stop battery check, Channel C	ON to start, OFF to stop
51	0x033	Reset periodic battery check schedule	ON to reset schedule, OFF is no-op
52	0x034	Clear battery check failure, Channel C	ON to reset alarm, OFF is no-op
53	0x035	Clear low cranking failure, Channel C	ON to reset alarm, OFF is no-op
54	0x036	Force DC Startup	ON to start, OFF to stop
55	0x037	Reset Latched Alarms	ON to reset alarm, OFF is no-op
64	0x040	Start/stop manual boost, Channel D	ON to start, OFF to stop
65	0x041	Reset periodic boost charge schedule	ON to reset schedule, OFF is no-op
66	0x042	Start/stop battery check, Channel D	ON to start, OFF to stop
67	0x043	Reset periodic battery check schedule	ON to reset schedule, OFF is no-op
68	0x044	Clear battery check failure, Channel D	ON to reset alarm, OFF is no-op
69	0x045	Clear low cranking failure, Channel D	ON to reset alarm, OFF is no-op
38	0x046	Force DC Startup	ON to start, OFF to stop
39	0x047	Reset Latched Alarms	ON to reset alarm, OFF is no-op

12 DNP3 COMMUNICATIONS

DNP3 is a messaging protocol used for client/server communication and is implemented according to IEEE Standard 1815-2012. The charger is compliant with DNP3 Subset Level 2 and supports various features of Level 3 and Level 4. MicroGenius S2/S4 products provide an extensive amount of DNP3 information. The information in below sections includes common data points that are applicable to most applications. The entire list of DNP3 data points is available in the SENS DNP3 Config Tool (see section 12.3).

12.1. DNP3 RS-485—*Optional*

Serial DNP3 communications over RS-485 is optional. Communications settings may be configured using the keypad or SENS Setup Utility. Configure DNP3 values and enable/disable DNP3 access as desired. See section 6.8 for connection and termination requirements. Only one RS-485 protocol is allowed at a time. Enable/disable either DNP3 RS-485 or Modbus RS-485 using the keypad or SENS Setup Utility.

DNP3 RS-485 Default Settings

Setting	Value
Source Address	4
Destination Address	3
Baud Rate	9600
Parity	None

12.2. DNP3 TCP/IP—*Optional*

DNP3 communications over TCP/IP is optional and requires configuration using the SENS Setup Utility or the keypad (see section 9.10.3). 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. Configure remaining DNP3 values and enable/disable DNP3 access as desired. See section 6.9 for connection information. Both DNP3 TCP/IP and Modbus TCP/IP may be used simultaneously.

DNP3 TCP/IP Default Settings

Setting	Value
IP Address	0.0.0.0 DHCP/AUTO
Source Address	4
Destination Address	3
Port Number	20000

12.3. SENS DNP3 Config Tool

The SENS DNP3 Config Tool is a worksheet that allows user configuration of all DNP3 data points. MicroGenius S2/S4 products ship with a default DNP3 configuration. Use the SENS DNP3 Config Tool to create a customized DNP3 configuration file. The SENS DNP3 Config Tool is available from the communications protocol circuit board webpage (see sections 6.9 and 9.12). Follow instructions on the "Overview" tab of the SENS DNP3 Config Tool to modify configuration and load the configuration file to the communications protocol circuit board. Select to use the custom configuration on the charger using the SENS Setup Utility or keypad.

12.4. **Implementation Table**

Object	Variation Number	Description
1	0	Binary Input (default)
1	1 (default)	Binary Input
1	2	Binary Input With Status
2	0	Binary Input Change (default)
2	1	Binary Input Change without Time
2	2	Binary Input Change with Time
2	3 (default)	Binary Input Change With Relative Time
10	0	Binary Output (default)
10	1	Binary Output
10	2 (default)	Binary Output Status
12	1	Control Relay Output Block
30	0	Analog Input (default)
30	1	32-Bit Analog Input with Flag
30	2	16-Bit Analog Input with Flag
30	3 (default)	32-Bit Analog Input without Flag
30	4	16-Bit Analog Input without Flag
30	5	32-Bit Floating Point with Flag
30	6	64-Bit Floating Point with Flag
32	0	Analog Change Event (default)
32	1 (default)	32-Bit Analog Change Event without time
32	2	16-Bit Analog Change Event without time
32	5	32-Bit Floating Point Analog Change Event without Time
32	6	64-Bit Floating Point Analog Change Event without Time
32	7	32-Bit Floating Point Analog Change Event with Time
32	8	64-Bit Floating Point Analog Change Event with Time
34	0	Analog Input Reporting Deadband (default)
34	1	16-Bit Analog Input Reporting Deadband
34	2 (default)	32-Bit Analog Input Reporting Deadband
34	3	32-Bit Floating Point Analog Input Reporting Deadband
40	0	Analog Output Status
40	1 (default)	32-Bit Analog Output Status
40	2	16-Bit Analog Output Status
40	3	32-Bit Floating Point Analog Output Status
40	4	64-Bit Floating Point Analog Output Status
50	0	Time and Date
50	1 (default)	Time and Date
50	3	Time and Date Last Recorded Time
60	0	Class 0, 1, 2, and 3 Data
60	1	Class 0 Data
60	2	Class 1 Data
60	3	Class 2 Data
60	4	Class 3 Data
80	1	Internal Indications (IIN)

12.5. **Binary Inputs**

Point	Name	Description	Default Class
0	Summary High DC	High DC detected at output terminals of unit	1
1	Summary Low DC	Output voltage is below the Low DC Voltage Threshold	1
2	Summary Charger Fail	Unit has failed or cannot produce output. Reset charger to clear alarm. If alarm continues, contact customer service.	1
3	Summary AC Fail	AC not detected by the unit	1
4	Summary Ground Fault Positive	Ground fault current to the positive output terminal is above the threshold.	1
5	Summary Ground Fault Negative	Ground fault current to the negative output terminal is above the threshold.	1
6	Summary Alarm Summary	Summary of first 6 Binary Inputs	1
7	Summary Over Voltage Shutdown	High DC voltage and output current seen on unit. Reset charger to clear alarm. If alarm continues, contact customer service.	1
9	Summary Forced Load Sharing Enabled	Load sharing is enabled when multiple charger modules are present	1
10	Summary Using Battery Temperature	Charger has a battery temperature and is compensating the voltage	1
11	Summary Temperature Probe Fault	The unit does not detect a temperature probe or the probe connection is shorted (temp comp is forced off if shorted).	1
12	Summary Equalize mode	Charger is in either Auto Boost or Periodic Boost mode	1
20	Summary AC Phase Missing	An AC phase is missing or out of range in a 3-phase capable device	2
21	Summary AC Voltage Over Maximum	AC Voltage has gone above max allowed by the charger on any phase. NOTE: This alarm has a delay of 3 seconds	2
22	Summary AC Voltage Low	AC Voltage has gone below specification of the charger	2
23	Summary AC Frequency Out Of Range	AC Frequency is outside of adjustable limits	2
24	Summary AC Voltage High	AC Voltage is above the max adjustable limit	2
40	Summary Reverse Polarity	Reverse Polarity Voltage is seen at the output terminals of the unit.	2
41	Summary Low Cranking	A low crank has been detected. Reset with the crank analyzer or by resetting the charger.	2
42	Summary Incompatible Battery	Charger was unable to bring up the output voltage after a set period of time. Example: Connecting a 12V battery when the charger is set for 24V. To clear alarm reset the charger or remove and replace a jumper.	2
43	Summary Invalid Settings	The current settings in the charger (Factory, Program, or Jumper) are not compatible with this charger. Please re-check and try again.	2

44	Summary Thermal Fold Back	Charger components are over maximum temperature; so, the power output has been lowered.	2
45	Summary Current Limiting	Charger is outputting maximum current.	2
46	Summary Low Current	Output Current is under the low current alarm threshold.	2
47	Summary Load Share Fault	Unit is unable to fully load share with other units on the SENSbus. This is typically caused by units not having the same settings.	2
48	Summary AutoBoost Lockout Active	Boost mode is disabled because the charger hit the boost time limit. This will reset upon detection of a crank, or detection of loss of AC for a set period of time.	2
49	Summary Battery On Discharge	Output voltage is below the Battery Discharge Voltage Threshold	2
50	Summary Battery End Discharge	Output voltage is below the Battery End Discharge Voltage Threshold	2
51	Summary 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	2
52	Summary DC Below Startup Voltage	DC is below the startup voltage; so, the charger cannot startup.	2
53	Summary Fan Fail	There is a problem with one or more of the fans	2
54	Summary Battery Check Failed	Battery has failed the most recent battery check	2
55	Summary Helix Float Charge	Charger Mode	2
56	Summary Float Charge	Charger Mode	2
57	Summary Helix Refresh Charge	Charger Mode	2
58	Summary Auto Boost Charge	Charger Mode	2
59	Summary Periodic Boost Charge	Charger Mode	2
60	Summary Battery Check Active	Charger Mode	2
61	Summary Commission Charge	Charger Mode	2
62	Summary Battery Check Passed	Battery has passed the most recent Battery Check	2
63	Summary Check Filter	Charger has experienced a thermal roll back which can be caused by a clogged filter. Please check the filter and clean it if needed	2
64	Summary Thermal Fault	Charger has faulted because it over heated. This can be environmental or a sign that a fan is not working properly	2
65	Summary High Battery Temperature	Battery is above the high battery temp threshold	2
66	Summary High Battery Temperature Shutdown	Battery Temperature is high enough that the charger has shut off as a safety concern	2
67	Summary High AC Ripple Detected on Output	Charger's output ripple is above limit	2

68	Summary DC Output Open	Charger has detected that the output is not connected to anything	2
69	Summary Charger Low Temperature	Charger is currently below its rated temperature, output may be derated	2
70	Summary Battery Low Temperature	Battery is below adjustable temperature limit (disabled if no temperature is available)	2
71	Summary Invalid Settings DC	Settings on this channel are invalid and must be corrected before settings may be sent to the chargers on this channel.	2
72	Summary Invalid System Config	Configuration of system is conflicted. Charger will continue to run, but may not be fully functional until the issue is resolved.	2
73	Summary AC1 SPD	The surge arrestor has faulted	2
74	Summary AC1 Breaker	The breaker has faulted	2
75	Summary AC2 SPD	The surge arrestor has faulted	2
76	Summary AC2 Breaker	The breaker has faulted	2
77	Summary DC SPD	The surge arrestor has faulted	2
78	Summary DC Breaker	The breaker has faulted	2
79	Summary SENSbus Inactive	There are no other devices found on SENSbus	2
80	Summary No Power Board Data	There are no power boards found on SENSbus	2
81	Summary Module Missing	Number of modules in system or unit is less than expected	2
82	Summary Individual Module Fault	Charger module has a fault	2
83	Summary Invalid Settings AC	Settings on this channel are invalid and must be corrected before settings may be sent to the chargers on this channel.	2
84	Summary DNP Config File Error	Invalid configuration file for DNP, usually a file syntax error.	2

12.6. **Binary Outputs**

Point	Name	Description
10	DC ChannelA Start/stop manual boost	Start/stop manual boost. PULSE_ON to start, PULSE_OFF to stop
11	DC ChannelA Reset periodic boost charge schedule	Reset periodic boost charge schedule. PULSE_ON to reset schedule.
12	DC ChannelA Start/stop battery check	Start/stop battery check. PULSE_ON to start, PULSE_OFF to stop
13	DC ChannelA Reset periodic battery check schedule	Reset periodic battery check schedule. PULSE_ON to reset schedule.
14	DC ChannelA Clear battery check failure	Clear battery check failure. PULSE_ON to reset alarm.
15	DC ChannelA Clear low cranking failure	Clear low cranking failure. PULSE_ON to reset alarm.
16	DC ChannelA Force DC Startup	Force DC Startup. PULSE_ON to force DC Startup.
17	DC ChannelA Reset Latched Alarms	Reset Latched Alarms. PULSE_ON to Reset Latched Alarms.

12.7. **Analog Inputs**

Point	Name	Description	Units	Default Class	Default Deadband
0	Program Revision	Revision of application code	Num	2	1
1	DNP Revision	Revision of DNP	Num	2	1
8	Setup Error Code	Error Code defined in manual (0=No Error)	Num	2	1
20	Unit Serial	Unit Serial Number of Device	Num	2	1
21	Serial	Serial Number of Protocol Board	Num	2	1
22	Build Date	Build date (byte0=Day, byte1=Month, byte2-3=Year)	Num	2	1
40	DC ChannelA Voltage	Output Voltage	mV	1	10
41	DC ChannelA Current	Output Current	mA	1	10
42	DC ChannelA Power	Output Power	W	1	10
43	DC ChannelA Battery Temperature	Temperature used for compensation if applicable	mC	1	10
44	DC ChannelA Number Of Chargers	Number of Charger Modules on this DC channel	Num	2	1
45	DC ChannelA Maximum Power	Maximum power rating	W	2	1
46	DC ChannelA Maximum Voltage	Maximum voltage rating	mV	2	10
47	DC ChannelA Maximum Current	Maximum current output	mA	2	10
48	DC ChannelA Periodic Boost Countdown	Number of seconds until next scheduled boost	Sec	2	1
49	DC ChannelA Battery Check Due	Number of seconds until next battery check	Sec	2	1
50	DC ChannelA State Timer	Number of seconds elapsed in present state	Sec	2	1
60	AC ChannelA Line Voltage 1	AC Line Voltage on Phase 1	mVac	1	10
61	AC ChannelA Line Current 1	AC Line Current on Phase 1	mAac	1	10
62	AC ChannelA Line Voltage 2	AC Line Voltage on Phase 2	mVac	1	10
63	AC ChannelA Line Current 2	AC Line Current on Phase 2	mAac	1	10
64	AC ChannelA Live Voltage 3	AC Line Voltage on Phase 3	mVac	1	10
65	AC ChannelA Line Current 3	AC Line Current on Phase 3	mAac	1	10
66	AC ChannelA Line Frequency	AC Line Frequency	mHz	1	10
67	AC ChannelA Number Of Chargers	Number of Charger Modules on this AC channel	Num	2	1

12.8. **Analog Outputs**

Point	Name	Units
10	DC Alarm Delay	Sec
11	AC Alarm Delay	Sec
30	DC ChannelA End Discharge VPC	mV/cell
31	DC ChannelA Low DC VPC	mV/cell
32	DC ChannelA Battery Discharge VPC	mV/cell
33	DC ChannelA Battery Check VPC	mV/cell
34	DC ChannelA High DC VPC	mV/cell
35	DC ChannelA OVSD VPC	mV/cell
36	DC ChannelA Float Charge VPC	mV/cell
37	DC ChannelA Boost Charge VPC	mV/cell
38	DC ChannelA Commissioning VPC	mV/cell
39	DC ChannelA Cell Count	Num
40	DC ChannelA Commissioning Duration	Min
41	DC ChannelA Periodic Boost Interval	Hour
42	DC ChannelA Temp Comp Slope (400 = -4mV/cell/C)	-mVdc/cell/C
43	DC ChannelA Current Limit	A/A rated
44	DC ChannelA Ground Fault Trip Point	uA
48	DC ChannelA Low Crank VPC	mV/cell
49	DC ChannelA Low Current Alarm	A/A rated
50	DC ChannelA Auto Boost Time Limit	Min
52	DC ChannelA Battery Check Interval	Min
53	DC ChannelA Battery Check Duration	Min
54	DC ChannelA Commissioning Current	A/A rated
55	DC ChannelA Channel Rated Unit Current	mA
56	DC ChannelA Channel Rated Unit Power	W
57	DC ChannelA Startup Voltage	mV/cell
58	DC ChannelA Periodic Boost Duration	Min
62	DC ChannelA AC Voltage On Output Limit	mVac
63	DC ChannelA Battery High Temperature Limit	mC
64	DC ChannelA Battery High Temperature Shutdown	mC
65	DC ChannelA Battery Low Temperature Limit	mC
66	DC ChannelA High Battery Room Temperature Limit	mC
67	DC ChannelA Battery Over Room Temperature Limit	mC
101	AC ChannelA AC Low Frequency Limit	mHz
102	AC ChannelA AC High Frequency Limit	mHz
103	AC ChannelA High Voltage Limit	mVac
104	AC ChannelA Low Voltage Limit	mVac
105	AC ChannelA Number Of Phases Expected	Num

13 TROUBLESHOOTING/ERROR CODES

13.1. Configuration Error Codes

Error codes are displayed on front panel LCD.

Error	Scope	Description	Corrective Action
101	Charger Module	**Invalid charger position jumper setting** for a charger module used in a multi-module and multi-output unit. Jumpers must uniquely identify the module position. Not compatible with jumper-selected output settings for stand-alone chargers. Note – single-output units prior to firmware version 6.0.28 require jumpers.	- Each module in the unit must be set to a different position number. Install one jumper per module to select module positions 1 - 4.
104	Charger Module	**Invalid output configuration**. Charger modules must be set to a valid output: either output A through D for use in multiple output units or A for use in single output units. Combining charger modules configured for use in single output units with those configured for multiple output units in the same unit (or system) is **not** supported.	- If necessary, enable the output using the keypad "DC Output #" selection in the "Other Settings" menu (f/w version ≤2.4.7), "DC -> Advanced Settings" menu (f/w version >2.4.7) or the setup utility. - To select a different output, reassign the module to match its actual output connection using the "Set DC Output" setting in the "Other Settings" menu (f/w version ≤2.4.7 only) or by using the setup utility.
105	Charger Module	**Duplicate charger location** settings within a unit with multiple charger modules, not using the default output. Every charger module must have a unique location setting. Duplication is allowed for modules in different units, *i.e.* with different "Unit Serial Numbers". Modules using the "default" output do not use charger positions.	- Use a different position number (jumper setting) for each module in a multi-module unit. See Error Code 101 for more detail. - When replacing a charger in a multi-module unit, set the replacement charger for the same position as the module being removed.
201	Charger (or system)	**No charger modules assigned** to output. Every enabled charger output must have at least one module assigned to it. When none is found, it is presumed that a module has failed, has lost SENSbus data communication, or has an incorrect output setting.	- Check for a module that has failed (indicated by its LED status). - Check for disconnected or damaged SENSbus data cables. - If the output is not to be used, disable it by using the keypad "DC Output #" setting in the "Other Settings" menu (f/w version ≤2.4.7), "DC -> Advanced Settings" menu (f/w version >2.4.7) or the setup utility.
202	Charger (or system)	**Too few charger modules operating**. The combined output rating of all modules operating on this charger output is less than the rated output. This can occur because a module has failed, has an open AC input or DC output connection, has lost SENSbus data communication, or is configured for the wrong output.	- Use the "Set DC Output" setting in the "Other Settings" menu (f/w version ≤2.4.7), "DC -> Advanced Settings" menu (f/w version >2.4.7) or the setup utility to verify all chargers output settings. Each module must be set for the output corresponding to its electrical DC output connection. - If necessary, install additional modules to meet the required output rating (plus the additional modules needed for "N+1" or "N+2" redundant operation). - Verify that each output is assigned enough modules to meet the required DC output rating (plus any extra modules needed to provide "N+1" or "N+2" redundant operation). - Check for a module that has failed (indicated by its LED status). - Check for disconnected or damaged SENSbus data cables. - Check for miswired, disconnected, or damaged input and output connections.
203	Charger (or system)	**Charger Module assigned to a disabled output**. All modules must either be set for single output operation (0, Default output) or to a valid output that is enabled in this unit or system.	- To use this output, enable it using the keypad "DC Output #" selection in the "Other Settings" menu (f/w version ≤2.4.7), "DC -> Advanced Settings" menu (f/w version >2.4.7) or the setup utility. Verify that the DC

Error	Scope	Description	Corrective Action
			outputs of all modules assigned to each output are electrically connected to that output. - To select a different output, reassign the module to match its actual output connection using the "Set DC Output" setting in the "Other Settings" menu (f/w version ≤2.4.7only) or by using the setup utility.
305	Charger (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	1. Proper AC or DC voltages not applied 2. Frozen accessory display board or main power board 3. Main power board to accessory display board cable is incorrectly installed 4. Main power board to accessory board cable failure or poor connection 5. Main power board failure 6. Accessory display board failure	1. Using a voltmeter, check that AC input voltage and frequency at AC input terminal block/breaker are in the range 80VAC – 264VAC / 47Hz – 63Hz or that >8VDC is present at DC output terminal block/breaker and that the DC polarity is correct. Correct charger AC input and DC output voltage as required. 2. If step 1 doesn't resolve issue, remove both AC and DC power for 1 minute, then reapply power. 3. If steps 1 and 2 don't resolve issue, determine if main power board AC and DC LEDs are on (any color). If main power board LEDs are off, remove cable between accessory display board and main power board. If main power board LEDs remain off, a main power board failure is the likely cause. Replace charger. If main power board LEDs are on, proceed to step 4. 4. If step 3 doesn't resolve issue, check that the main power board to accessory display board cable is correctly installed between main power board J900 and accessory display board J1, and that both ends of the cable are fully inserted. 5. If step 4 doesn't resolve issue, unplug the main power board to accessory display board cable and, using an ohmmeter, check for continuity across the cable on each pin of the cable (cable is a straight pass through). If an open connection is found, replace cable (208117). If cable ohms out ok, a failed accessory display board is the likely cause. Replace accessory display board.
OFF	OFF	Both AC and DC LEDs are off and display is on	1. Charger communication terminator is missing 2. Failed main power board 3. Jumper installed in address 1 or address 2 header on main power board 4. Main power board to accessory display board cable failure 5. Failed accessory display board	1. Verify that a terminator is installed in port 1 or 2 of main power board J901. If terminator is missing, install missing terminator. 2. If terminator is installed, disconnect one end of the main power board to accessory display board cable. Verify that main power board AC and DC LEDs are on (any color). If main power board LEDs remain off, replace charger, main power board has most likely failed. 3. If power board LEDs are on, make sure there are no jumpers installed in Address 1 or Address 2 on main power board header JP900. Remove any address jumpers. 4. If step 3 doesn't resolve issue, unplug the main power board to accessory display board cable and, using an ohmmeter, check for continuity across the cable on each pin of the cable (cable is a straight pass through). If an open connection is found, replace cable (208117). If cable ohms out ok, a failed

AC LED	DC LED	Symptom	Possible Causes	Recommended Actions
				accessory display board is the likely cause. Replace accessory display board.
*SOLID GREEN	FLASH LONG-SHORT GREEN	AC LED is green, DC LED flashes Long-Short green, and output voltage is lower than expected	1. Charger is in HELIX Eco-Float mode	1. Output voltage is automatically lowered to extend battery life in the HELIX Eco-Float mode. Charger will automatically refresh the battery as required and no action is needed (this is normal operation). If a customer wishes to disable HELIX mode, use a battery type other than FLA, disable it using the Setup Utility, or disable it via the option keypad.
*SOLID GREEN	FLASH LONG-SHORT-SHORT GREEN	AC LED is green, DC LED flashes Long-Short-Short green, and output voltage is higher than expected float voltage	1. Charger is in HELIX REFRESH mode	1. Charger will automatically refresh the battery as required and no action is needed (this is normal operation). If a customer wishes to disable HELIX mode, use a battery type other than FLA, disable it using the Setup Utility, or disable it via the option keypad.
*SOLID GREEN	FLASH or SOLID GREEN	Unable to Communicate using J1939	1. Charger address is not correct 2. No communication bus termination installed 3. Communication cable is plugged into the wrong charger port 4. Wiring is incorrect 5. Unsupported or incorrect J1939 command 6. Incorrect address or address conflict	1. Verify that Battery Charger (BCH) 1 or Battery Charger (BCH) 2 (depending on selected address) is the correct address for desired output. Correct using the keypad if incorrect address. 2. Verify that a terminator is installed in port 1 or 2 of display board J2 (note that a terminator is not required if the charger is not at the end of the communication bus). 3. If step 3 didn't resolve the issue, verify that communication cable is connected to port 1 or port 2 of J2 on the display board. 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 of J2 and that J1939 Data Low goes to pin 2 of J2. 5. If cable wiring is correct, verify that requested command is supported by SENS charger per J1939 table in charger 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	1. SENS extended J1939 commands are not enabled	1. Enable SENS extended J1939 commands using setup utility
*SOLID GREEN	FLASH or SOLID GREEN	Unable to Communicate using MODBUS	1. No communication bus termination installed 2. Communication cable is plugged into the wrong charger port 3. Wiring is incorrect 4. Incorrect MODBUS settings (baud rate, type (RTU or ASCII), address)	1. Verify that a terminator is installed in port 1 or 2 of display board J2 (note that a terminator is not required if the charger is not at the end of the communication bus). 2. If terminator is installed, verify that communication cable is connected to port 1 or port 2 of J2 on the display board. Correct cabling as required. 3. If cable is connected correctly, verify that cabling is correct and that Modbus +D1 (A) goes to pin 5 of J2 and that Modbus –D0 (B) goes to pin 4 of J2. 4. If cable wiring is correct, verify that charger and application MODBUS settings are as required. Adjust settings using setup utility as required.
*SOLID GREEN	SOLID RED	AC good, charger fail or overvoltage shutdown	1. Charger has experienced an unexpected fault 2. Programmed setting are incorrect (OVSD set too low) 3. Charger module failure	1. Remove both AC and DC power for 1 minute, then reapply power. 2. If fault remains, check overvoltage shutdown settings and again remove both AC and DC 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 module.
*SOLID GREEN	FLASHING RED/YELLOW	Charger's output is not enabled	1. A battery is connected to the charger output with reverse polarity	1. Correct DC polarity applied to DC output terminal block/breaker.
*SOLID GREEN	SOLID YELLOW	AC good, high battery voltage	1. Alarm setpoint incorrect for application 2. DC voltage is high due to an external source such as an alternator	1. Check that charger battery settings and alarms are set appropriately for the application and battery under charge.

AC LED	DC LED	Symptom	Possible Causes	Recommended Actions
				2. If settings and alarms are correct, check and correct battery / load voltage (consider battery surface charge, alternator, and any connected equipment).
*SOLID GREEN	SOLID YELLOW	AC good, low battery voltage	1. Alarm setpoint incorrect for application 2. Battery discharged or defective	1. Check that charger battery settings and alarms are set appropriately for the application and battery under charge. 2. If settings and alarms are correct, check and correct battery / load voltage (consider loads and any connected equipment).
*SOLID GREEN	FLASHING GREEN/ RED	AC good, system DC output good, some individual charger module(s) in alarm state	1. One or more system chargers has an alarm.	1. Troubleshoot issue using fault code from individual charger module(s).
*SOLID GREEN	FLASHING YELLOW	AC good, low incompatible battery error (charger disabled)	1. Voltage range improperly set	1. Check that charger voltage range is set correctly for the battery. After making any correction to the range setting, remove both AC and DC power for 1 minute, then reapply power.
*SOLID GREEN	FLASHING GREEN/YELLOW	AC good, output power limited	1. Charger power is reduced to protect charger due to high temperatures	1. Reduce operating environment temperature. Charger will automatically increase power as temperature is lowered.
*SOLID GREEN	DOUBLE FLASH YELLOW	AC good, load share fail	1. Charger output settings do not match between chargers	1. Check that individual charger settings are identical. Adjust as required. After making any adjustments, unplug and re-plug SENSbus cable from charger.
*SOLID GREEN	DOUBLE FLASH RED	AC good, output disabled	1. Negative DC connection is broken to one of the chargers 2. Too many devices on the SENSbus network	1. Check that the negative DC connection is made and that connection is tight. 2. If step 1 doesn't resolve issue, look for break in the DC ground cable. 3. If steps 1 and 2 don't resolve the issue, ensure that less than max allowed number of devices is on the SENSbus. 4. If none of the above steps resolved the issue, a failed display board is likely, replace display board.
SOLID RED	SOLID GREEN	AC fail, battery voltage good	1. Proper AC voltages or frequency not applied 2. Charger module failure	1. Using a voltmeter, check that AC input voltage and frequency at AC input terminal block/breaker are in the range 80VAC – 264VAC / 47Hz – 63Hz. Correct charger AC input voltage as required 2. If step 1 doesn't resolve issue, a charger module failure is the likely cause. Replace module.
SOLID RED	SOLID YELLOW	AC fail, high battery voltage	1. Proper AC voltages or frequency not applied 2. Charger module failure And 3. Alarm setpoint incorrect for application 4. DC voltage is high due to an external source such as an alternator	AC LED 1. Using a voltmeter, check that AC input voltage and frequency at AC input terminal block/breaker are in the range 80VAC – 264VAC / 47Hz – 63Hz or that > 8VDC is present at DC output terminal block/breaker and that the DC polarity is correct. Correct charger AC input and DC output voltage as required. 2. If step 1 doesn't resolve RED AC light, remove both AC and DC power for 1 minute, then reapply power. 3. If steps 1 and 2 don't resolve RED AC light, a charger module failure is the likely cause. Replace module. DC LED 4. Check that charger battery settings and alarms are set appropriately for the application and battery under charge. 5. If settings and alarms are correct, check and correct battery / load voltage (consider battery surface charge, alternator, and any connected equipment).
SOLID RED	SOLID YELLOW	AC fail, low battery voltage	1. Proper AC voltages or frequency not applied 2. Charger module failure And 3. Alarm setpoint incorrect for application 4. Battery discharged or defective	AC LED 1. Using a voltmeter, check that AC input voltage and frequency at AC input terminal block/breaker are in the range 80VAC – 264VAC / 47Hz – 63Hz or that > 8VDC is present at DC output terminal block/breaker and that the DC polarity is correct. Correct charger AC input and DC output voltage as required. 2. If step 1 doesn't resolve RED AC light, remove both AC and DC power for 1 minute, then reapply power.

AC LED	DC LED	Symptom	Possible Causes	Recommended Actions
				3. If steps 1 and 2 don't resolve RED AC light, a charger module failure is the likely cause. Replace module. DC LED 4. Check that charger battery settings and alarms are set appropriately for the application and battery under charge. 5. If settings and alarms are correct, check and correct battery / load voltage (consider loads and any connected equipment). 6. If fault remains after the above steps, check battery health. Replace battery if weak.
SOLID RED	SOLID RED	AC fail, charger fail or overvoltage shutdown	1. Charger is in a fault state 2. Charger module failure	AC LED 1. Using a voltmeter, check that AC input voltage and frequency at AC input terminal block/breaker are in the range 80VAC – 264VAC / 47Hz – 63Hz or that > 8VDC is present at DC output terminal block/breaker and that the DC polarity is correct. Correct charger AC input and DC output voltage as required. 2. If step 1 doesn't resolve RED AC light, remove both AC and DC power for 1 minute, then reapply power. 3. If steps 1 and 2 don't resolve RED AC light, a charger module failure is the likely cause. Replace module. DC LED 4. Remove AC and DC power from charger for 1 minute before reapplying power. Ensure AC voltage and/or DC voltage is within specified operating limits of the charger. 5. If fault remains, check overvoltage shutdown settings and again remove both AC and DC power for 1 minute, then reapply power. 6. If steps 1 and 2 don't resolve issue, a charger module failure is the likely cause. Replace module.
SOLID RED	FLASHING YELLOW	AC fail, low incompatible battery error	1. Proper AC voltages or frequency not applied 2. Charger module failure And 3. Voltage improperly set	AC LED 1. Using a voltmeter, check that AC input voltage and frequency at AC input terminal block (J100) are in the range 80VAC – 264VAC / 47Hz – 63Hz or that >8VDC is present at DC output terminal block/breaker and that the DC polarity is correct. Correct charger AC input and DC output voltage as required. 2. If step 1 doesn't resolve RED AC light, remove both AC and DC power for 1 minute and then reapply power. 3. If steps 1 and 2 don't resolve RED AC light, a charger module failure is the likely cause. Replace module. DC LED 4. Check that charger voltage is set correctly for the battery. After making any correction to the setting, remove both AC and DC power for 1 minute, then reapply power.
ALTERNATING FLASHING YELLOW		No output	1. Illegal configuration	1. Ensure that charger has been programmed to desired and allowable settings.
ALTERNATING FLASHING RED		No output	1. Missing or invalid code (boot load required)	1. Update charger firmware using setup utility. 2. If step 1 doesn't resolve issue or setup utility is not available, replace charger
ALTERNATING FLASHING GREEN		Starting-up	1. Charger is still powering-on 2. Failed display board	1. Remove both AC and DC power for 1 minute and then reapply power. Allow charger at least 1 minute to fully boot. 2. If step 1 doesn't resolve issue, a display board failure is the likely cause. Replace display board.

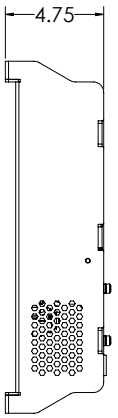
*AC LED will flash green when charger is in ultracapacitor mode.

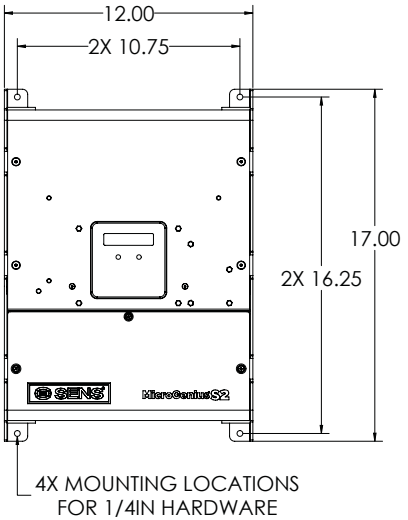
14 GLOSSARY

Original Factory Configuration	Configuration set at the factory. Charger operates using settings configured at the factory per customer order. See configuration details on inside cover 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.
Battery Type	Indicates the type of battery being charged. Battery type is selected when ordering charger and may be adjusted using the front panel keypad. Supported battery types include flooded lead-acid, absorbed glass mat (AGM), valve-regulated lead-acid, nickel-cadmium and ultracapacitors.
Configuration Code	Indicates charger output voltage configuration. Configuration code is included on the inside cover label.
SAE J1939 (CANbus)	J1939 is a communications protocol provided by SAE International and used in the commercial vehicle area for communication between the charger and genset controller.
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 ASCII or RTU mode or over TCP/IP as an option.

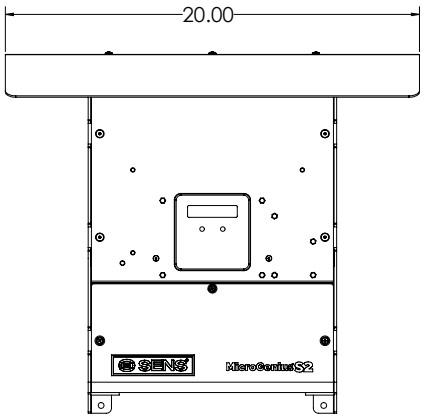
NOTES:
1. DRIPSHIELD IS OPTIONAL
2. THE INSTALLATION OF THIS EQUIPMENT SHALL COMPLY WITH ALL LOCAL AUTHORITY AND APPLICABLE BUILDING CODES
3. PROVIDE A MINIMUM CLEARANCE (FROM CHARGER CHASSIS) OF 6.0IN ON TOP, 4.0IN ON BOTTOM, AND 0.5IN ON SIDES OF UNIT FOR VENTILATION

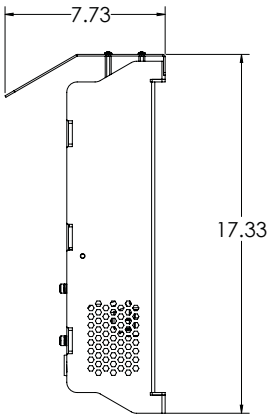
REVISIONS				
DCN	REV	DESCRIPTION	DATE	APPROVED
107342	A	INITIAL RELEASE	9/8/2017	ERS



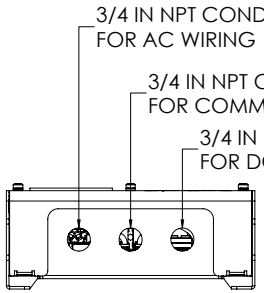


4X MOUNTING LOCATIONS
FOR 1/4IN HARDWARE





THESE VIEWS SHOWN WITH OPTIONAL DRIP SHIELD



SENS
STORED ENERGY SYSTEMS
1040 INDUSTRIAL CIRCLE
LONGMONT, CO 80501
303-678-7500
WWW.SENS-USA.COM

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN **INCHES**
DEFAULT TOLERANCES:
ANGLES ± 1°
TWO PLACE DECIMAL ± .02
THREE PLACE DECIMAL ± .005
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	ERS	9/8/2017
CHECKED		

THIRD ANGLE PROJECTION
DIMENSIONS & TOLERANCES PER ASME Y14.5 - 2009

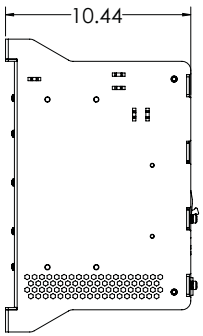
DESCRIPTION: 2DCAD,S2,STANDARD

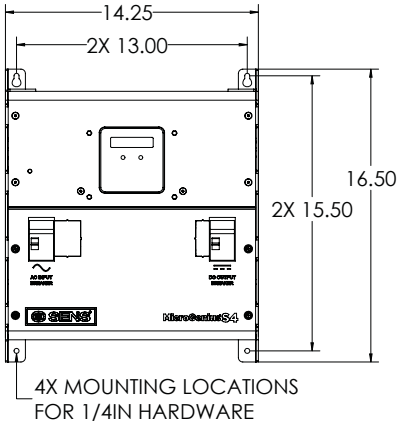
SIZE: D
DOCUMENT NUMBER: 2DCAD-S2-STD
REV: A
SHEET 1 OF 1

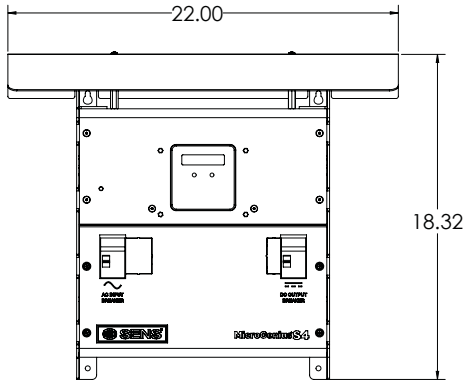
NOTES:
1. DRIPSHIELD IS OPTIONAL
2. 19IN AND 23IN RACKMOUNT BRACKETS ARE OPTIONAL
3. THE INSTALLATION OF THIS EQUIPMENT SHALL COMPLY WITH ALL LOCAL AUTHORITY AND APPLICABLE BUILDING CODES
4. PROVIDE A MINIMUM CLEARANCE (FROM CHARGER CHASSIS) OF 6.0IN ON TOP, 4.0IN ON BOTTOM, AND 0.5IN ON SIDES OF UNIT FOR VENTILATION

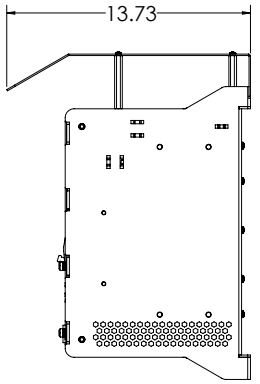
REVISIONS				
DCN	REV	DESCRIPTION	DATE	APPROVED
107342	A	INITIAL RELEASE	9/8/2017	ERS

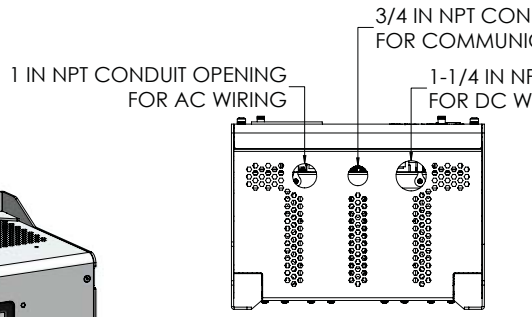
THESE VIEWS SHOWN WITH OPTIONAL DRIP SHIELD

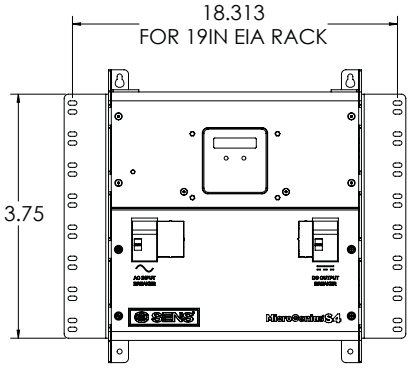




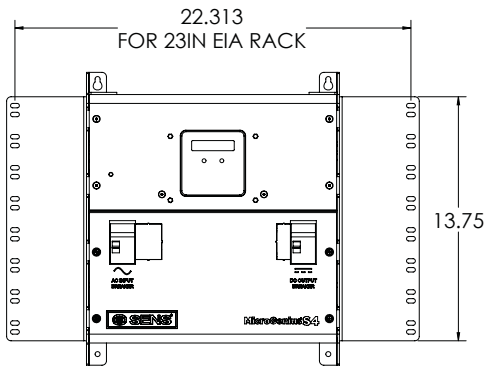








19IN RACKMOUNT BRACKETS



23IN RACKMOUNT BRACKETS

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STORED ENERGY SYSTEMS
1840 INDUSTRIAL CIRCLE
LONGMONT, CO 80501
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UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN **INCHES**
DEFAULT TOLERANCES:
ANGLES ± 1°
TWO PLACE DECIMAL ± .02
THREE PLACE DECIMAL ± .005
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	ERS	9/8/2017
CHECKED		

THIRD ANGLE PROJECTION
DIMENSIONS & TOLERANCES PER ASME Y14.5 - 2009

DESCRIPTION: 2DCAD,S4,STANDARD

SIZE	DOCUMENT NUMBER	REV
D	2DCAD-S4-STD	A

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): MicroGenius S2 and S4

Endorsements:

Certificate Type	Certificate Number	Issue Date	Expiry Date
Product Design Assessment (PDA)	23-2367895-PDA	10-MAR-2023	09-MAR-2028
Manufacturing Assessment (MA)	23-5820693	15-MAY-2023	30-MAY-2028
Product Quality Assurance (PQA)	NA	NA	NA

Tier
3 - Type Approved, unit certification not required

Intended Service
Marine and Offshore Applications

Description
MicroGenius S2 and S4: Switchmode, regulated, filtered, microprocessor-controlled, current limited battery charger designed for heavy-duty industrial service.

Primary application: quick recharge and long-life maintenance of engine start batteries and ultracapacitors.

Ratings
Output Voltage:12 or 24 VDC Nominal

Output Current:15-60 Amps

Input Voltage: 90-265VAC

Input Frequency: 47/63 Hz

Input Current: S2: 8Amps Max (at 100 VAC), S4: 16 Amps Max (at 100 VAC)

Operational temperature meets full specification: -40 ºC to +40 ºC

Enclosure: IP 22 aluminum/stainless steel enclosure

Service Restrictions
- Unit Certification is not required for this product. If the manufacturer or purchaser request 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
COMPLIANCE SPEC_MicroGenius S2 and S4, Specification, Date: February 2 2018, Pages: 4

Drawing No. 2DCAD-S2-STD, 2DCAD, S2, STANDARD, Revision: A, pages:1

Drawing No. 2DCAD-S4-STD, 2DCAD, S4, STANDARD, Revision: A, pages:1

Drawing No. ABS alarm reqs mapped to S2 and S4 charger, Pages:1

Drawing No. MG2_ABS_Discharge_2016-09-09, MG2_ABS_Discharge

Drawing No. MG2_ABS_Recharge_2016-09-09, MG2_ABS_Recharge

Drawing No. S2_ABS_Discharge_2017_09_22, S2_ABS_Discharge

Drawing No. S2_ABS_Recharge_2017_09_25, S2_ABS_Recharge

Drawing No. S4_ABS_Disharge_200Ahr_2017_09_19, S4_ABS_Disharge_200Ahr

Drawing No. S4_ABS_Recharge_200Ahr_2017_09_20, S4_ABS_Recharge_200Ahr

Drawing No. S4_ABS_Disharge_310Ahr_2017_10_03, S4_ABS_Disharge_310Ahr

Drawing No. S4_ABS_Recharge_310Ahr_2017_10_04, S4_ABS_Recharge_310Ahr

Drawing No. MicroGenius_S2_and_S4_Model_Series_Designation, pages:2

Drawing No. SENS S2 IP22 Test, MICROGENIUS S2 IP22 DRIP AND SOLD INTRUSION TEST, pages:15

Drawing No. SENS S4 IP22 Test, MICROGENIUS S4 IP22 DRIP AND SOLD INTRUSION TEST, pages:13

Drawing No. UL_Reverse_Polarity_Test_S2_and_S4, pages:2

Drawing No. SENS NofA-4788116939-Sep-28-2017, NOTICE OF COMPLETION AND AUTHORIZATION TO APPLY THE UL MARK, pages:1

Drawing No. MicroGenius_S2_and_S4, pages:128

Term of Validity
This Product Design Assessment (PDA) Certificate remains valid until 09/Mar/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
The Rules for Conditions of Classification, Part 1 2023 Marine Vessel Rules 1-1-4/7.7, 1-1-A3, 1-1-A4, which covers the following:

2023 Marine Vessel Rules: 4-8-3/1.11.1, 4-8-3/5.9;

The Rules for Conditions of Classification, Part 1 2023 Offshore Units and Structures 1-1-4/9.7, 1-1-A2, 1-1-A3, which covers the following:

2023 Mobile Offshore Unit Rules: 4-3-3/3.1.1(a), 6-1-7/9.17.

International Standards
CSA 22.2 No 107.2, R2021, Battery Chargers (UL File E109740);

IEC 60529, Degrees of Protection Provided by Enclosures (IP Code) IEC 60529:1989+A1:1999+A2:2013;

EN 61000-6-4:2019. Electromagnetic compatibility (EMC). Generic standards;

EN 61000-6-2:2019 Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments.

EU-MED Standards
NA

National Standards
UL 1236 Battery Chargers for Charging Engine-Starter Batteries, Edition 8 (UL File E109740 and EX6409)

Government Standards
NA

Other Standards
NA

Corporate ABS Programs
American Bureau of Shipping
Print Date and Time: 05-Jun-2023 3:08

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.

SENS®

Powering Critical Infrastructure

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:	MicroGenius S2/S4 Battery Charger
Model Numbers:	SX-YYY-YYYYYYYY, where X = 2 or 4; Y = any digit;
Conformance to Directives:	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) 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) 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.
Harmonized and/or technical specifications applied in full:	Directive 2014/30/EU (EMC) EN 61000-6-2:2019 EN 61000-6-4:2019 – Class A Directive 2014/35/EU (LVD) EN 60335-1:2012/A13:2017 EN 60335-2-29:2004/A2:2010 Directive 2015/863 (RoHS) EN 63000:2018
Place and date of first issue:	Longmont, CO USA on, February 2 2018

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 Directives(s) and Standard(s).

Sam Coleman
Compliance Manager
Stored Energy Systems, LLC

September 1, 2021
Date

SENS Limited Warranty: NRG and MicroGenius® Battery Chargers

What is covered?
This warranty covers any defect in material and workmanship on NRG and MicroGenius battery chargers manufactured by Stored Energy Systems, a Colorado Limited Liability Company (SENS).

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

For how long:
MicroGenius LE: One year from date of shipment.
MicroGenius 2, S2, NRG: Three (3) years from date of shipment
MicroGenius S4: Five (5) years from date of shipment except for the modules which are covered for three (3) years.

What we will do:
If your battery charger is defective within the warranty period, we will repair it or, at our option, replace it at no charge to you.

If we choose to replace your charger, 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 your charger 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 product must be returned, freight prepaid, to the factory 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 of having the product returned to the factory.

Limitation:
This warranty is limited to defects in material or workmanship of the product. It does not cover replacement of consumables such as surge protective devices, unless defective. 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.

Extended Warranty: NRG and MicroGenius Battery Chargers

Extended Warranty Period
At any time during the standard Limited Warranty period, customer may purchase extended warranty to lengthen the warranty period to 5 or 10 years from date of original shipment. All other terms of SENS Limited Warranty (see above) apply. Extended warranty not available for MicroGenius LE.

5-year extended warranty is included at no extra cost when SENS Commissioning Services are ordered at the time of charger purchase.