EnerGenius® DC

WALLBOX

Automatic Battery Charger/Power Supply

Installation & Operation Manual

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Installation or service questions?
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1 IMPORTANT SAFETY INSTRUCTIONS FOR INSTALLER AND OPERATOR

1.1. **SAVE THESE INSTRUCTIONS –** This manual contains important safety and operating instructions for EnerGenius® DC Wallbox battery chargers.

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. Use appropriate lockout / tagout procedures to ensure safety of all personnel installing and servicing this equipment. The input and output breakers are equipped with provision to lock breakers in the OFF position.

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

1.9.1. **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.**

1.9.2. 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.

1.10. **PERSONAL PRECAUTIONS**

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

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

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

1.10.4. 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.

1.10.5. **NEVER** smoke or allow a spark or flame in vicinity of battery or engine.

1.10.6. 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.

1.10.7. 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.

1.10.8. **When charging batteries, charge LEAD-ACID or LIQUID ELECTROLYTE NICKEL-CADMIUM batteries only.** Consult SENS before using with any other type of battery - other batteries may burst and cause injuries to persons and damage to property.

1.10.9. **NEVER** charge a frozen battery.

1.10.10. Consult national and local ordinances to determine if additional battery fault protection is necessary in your installation.

1.11. Preparing Battery For Charge

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

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

1.11.3. 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.

1.11.4. 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.

1.12. Charger Location

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

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

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

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

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

2 MODEL NUMBER BREAKOUT

D	W	-	F	S	-	120	S	-	100	-	0	-	A	0	A	-	0	00
A	**B**	**-**	**C**	**D**	**-**	**E**	**F**	**-**	**G**	**-**	**J**	**-**	**K**	**L**	**M**	**-**	**N**	**P**

	Parameter	**Code**	**Value**		
A	Product Family	D	EnerGenius DC		
B	Enclosure Type	W	Wallbox		
C	AC Input Voltage	F	Three Phase - 480VAC		
D	AC Interrupt	S	Standard Interrupt Rating (25kAIC)		
		H	High Interrupt Rating (65kAIC)		
E	DC Output Voltage	120	120 VDC		
		240	240 VDC		
F	DC Interrupt	S	Standard Interrupt Rating (10kAIC)		
		H	High Interrupt Rating (25kAIC), not available on 240VDC units		
G	Output Current			120 VDC	240 VDC
		025	25A		✓
		035	35A		✓
		050	50A	✓	✓
		075	75A	✓	
		100	100A	✓	
J	Redundancy	0	No Redundancy		
		1	N+1 Redundancy		
K	Communications and Interface	A	Standard - (LCD, Keypad, 5 Form-C Relays, Ethernet)		
		B	Standard with Breaker Status		
L	Accessory Hardware	0	None		
		A	High Current AC Alarm Relays (2X 120VAC, 5A)		
		B	High Current AC/DC Alarm Relays (2X 150VDC 3A / 240VAC 10A)		
		C	AC Breaker Shunt Trip		
		D	Option B and Option C		
M	Surge Protection	A	Standard Surge Protection		
		B	Supplemental AC/DC Surge Protection		
N	Mounting	0	Wall mount		
P	Configuration	00	Standard Configuration		
		01	PIP Compliant (requires Accessory Hardware selection to be A, B, or D)		
		##	Factory Specified Custom Configuration		

3 PERFORMANCE SPECIFICATIONS

EnerGenius DC high power industrial/utility class 3-phase battery charger/power supply, specially hardened for use in harsh industrial environments. Advanced technology switch mode power conversion is significantly smaller & lighter than conventional line frequency (e.g. SCR) power conversion and, even without a battery connected, delivers lower output ripple and much faster dynamic response.

Forced Conduction™ cooling keeps the high efficiency power electronics free of dust and dirt, making EnerGenius DC well-suited for operation in industrial, utility, power plant, and other harsh environments. Two variable speed, premium ball-bearing fans cool each rectifier. Rectifiers maintain nearly full output capability even if one fan fails. A fan failure alarm system with local and remote indication enables service dispatch while the second fan continues to run. The fan module is easily replaced in the field with common tools.

5 standard Form C contact alarms are factory set and field reconfigurable, with indication via communication port, front panel LCD and five assignable alarm relays. Two additional high current alarm relays are optional.

Options include supplemental surge suppression, and data communication including Modbus and DNP3. Chargers can be equipped with one or multiple communication protocols. Specifications are detailed in the table below, see following sections for installation and operation instructions.

Table 1 – Specifications

AC input	Voltage, frequency	Full output power: 358-528 VAC 3-phase line to line connected, 50% power limit from 188-357 VAC. 47-63 Hz.
	Input current	24A maximum at 358VAC for maximum configured unit.
	Overcurrent protection	3-pole UL 489 listed circuit breaker
		25 kAIC standard, 65 kAIC optional, lockable
	Loss of phase	Continues operating with current limit reduced to 50%
	AC transient protection	Layered electrical transient defenses. Optional UL1449 Type 1 Listed supplemental surge protection, alarmed and with field replaceable elements, surge capacity rated 75kA 8/20 µs; visual and remote indications.
	Loss of phase	Continues operating with current limit reduced to 50%
	Efficiency	Up to 95%, see section 9.14
	Power Factor and Total Harmonic Distortion	>.98 typical at maximum rated load current and boost charge voltage. Total Harmonic Distortion <3%
DC output	Voltage	120 VDC or 240 VDC nominal: 120 VDC: output adjustable from 8-160V. 240 VDC: output adjustable from 16-320V. If AC voltage is not applied, charger powers down below 60VDC.
	Current	Output limit: 14kW or 100A for 120VDC models, whichever is less or 14kW or 50A for 240VDC models, whichever is less
	Soft Start	System gradually increases current with a maximum of 5 seconds to full-required output
	Charging modes	Multi-stage, including float, boost, HELIX and commissioning charge modes
	Current limit	100% current capability subject to temperature limits and AC voltage limits; field adjustable to max rated current.
	Charging characteristic	Constant voltage, current limited; patented Dynamic Boost and HELIX control
	Line & load regulation	±0.5%

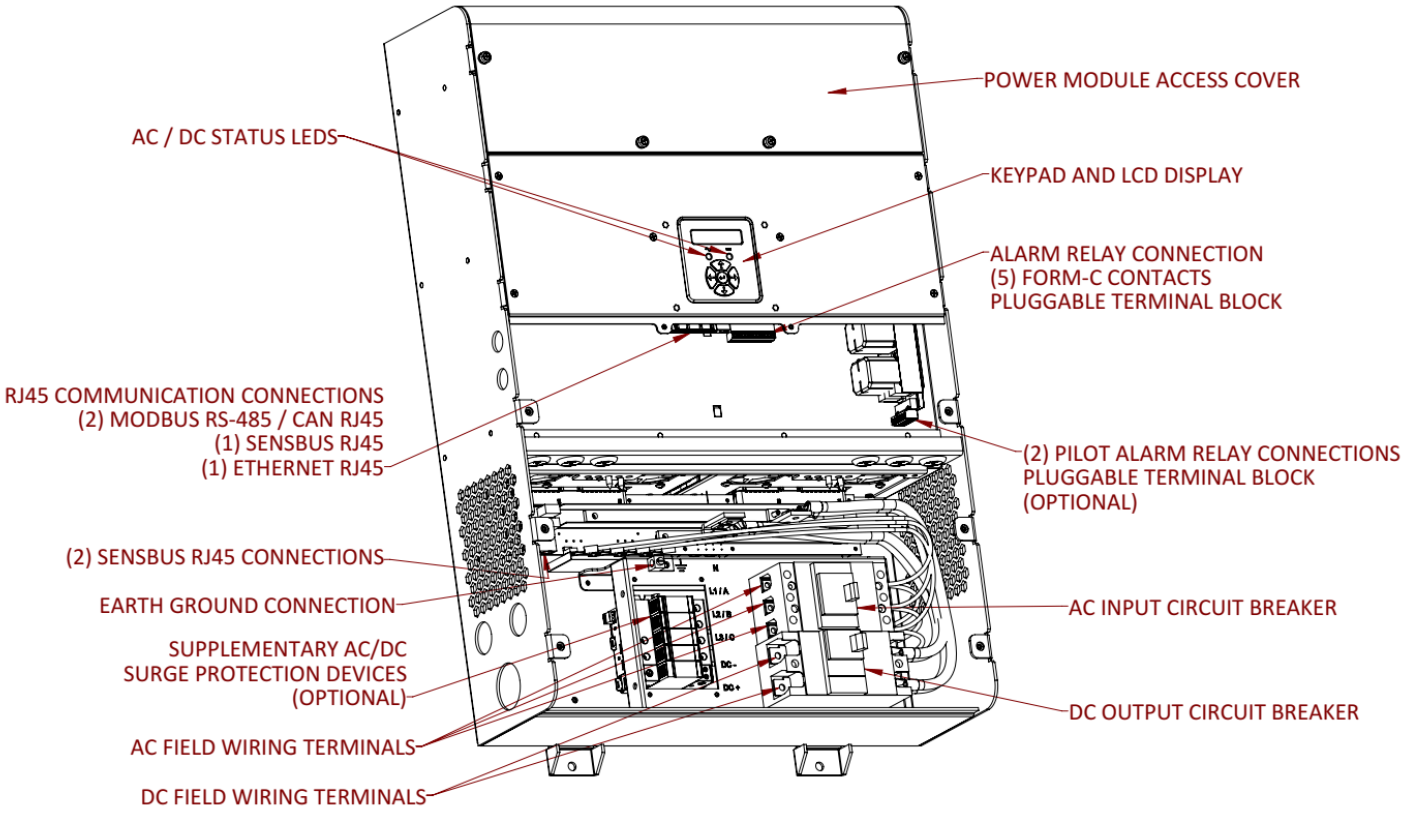
<table>
<tr><td></td><td>Output Ripple</td><td>< 30mV with battery, <100mV off-battery for 120VDC, <200mV off-battery for 240VDC. Delivers fast-responding, stable, well-filtered DC without battery.</td></tr>
<tr><td></td><td>Step response</td><td>8ms typical without battery, to recover within 1% of rated output voltage from load step change of 50% rated output current</td></tr>
<tr><td></td><td>Output protection</td><td>Electronic current limit. 2-pole UL 489 listed circuit breaker.</td></tr>
<tr><td></td><td></td><td>10 kAIC standard, 25 kAIC optional, lockable</td></tr>
<tr><td></td><td>DC surge protection</td><td>Layered electrical transient defenses. Optional UL1449 Open Type 2 Listed supplemental surge protection, alarmed and with field replaceable elements, surge capacity rated 75kA 8/20 µs; visual and remote indications.</td></tr>
<tr><td></td><td>Battery types</td><td>Flooded lead-acid, AGM, Ni-Cd, VRLA, and lithium</td></tr>
<tr><td></td><td>DC power supply operation</td><td>Delivers fast-responding, stable, well-filtered DC without battery</td></tr>
<tr><td></td><td>Battery temp. compensation</td><td>Standard. On-board sensor modifies output voltage when temperature is between 0°C and+40°C. Slope adjustable, factory set to – 0.18% per degree C. Optional remote battery monitor provides battery temperature probe.</td></tr>
<tr><td></td><td>Dead battery charge</td><td>Starts into and recharges zero-volt battery</td></tr>
<tr><td></td><td>Parallel/load share operation</td><td>Two or more independent chargers actively current share and synchronize all modes for increased current or fault tolerance, requires load share accessory kit (SENS p/n 209069)</td></tr>
<tr><td></td><td>Output blocking protection</td><td>Prevents sparking during battery connection or during hot swap operation</td></tr>
<tr><td></td><td>Output Derating</td><td>
<table>
<tr><th rowspan="2">Input Voltage/# Phases</th><th rowspan="2">% Output Power Available</th><th colspan="3">Max. Available Output Current Per Module*</th></tr>
<tr><th>140VDC</th><th>60VDC</th><th>30VDC</th></tr>
<tr><td>400-480VAC/3-ph</td><td>Full Rating (7kW)</td><td>50A</td><td>50A</td><td>50A</td></tr>
<tr><td>400-480VAC/1-ph</td><td>50% (3.5kW)</td><td>25A</td><td>50A</td><td>50A</td></tr>
<tr><td>208-240VAC/3-ph</td><td>50% (3.5kW)</td><td>25A</td><td>50A</td><td>50A</td></tr>
<tr><td>208-277VAC/1-ph</td><td>25% (1.75kW)</td><td>12.5A</td><td>29A</td><td>50A</td></tr>
</table>
*120V-50A shown, divide current values in half for 240V-25A modules</td></tr>
<tr><td>Adjustment & Controls</td><td>Charge mode control</td><td>Fully automatic patented Dynamic Boost system. Manual boost, timed boost & battery commissioning charging options are available from front panel control</td></tr>
<tr><td></td><td>Front panel control</td><td>Change all parameters including voltages, current limits, alarm parameters, relay assignments, network configurations, time-outs, and more</td></tr>
<tr><td></td><td>Local computer</td><td>Change all parameters, troubleshoot, create/save configuration files for quick download to chargers using network connection and SENS Setup Utility software available at www.sens-usa.com</td></tr>
<tr><td>Status reporting</td><td>LEDs</td><td>Two multi-color front panel status LEDs</td></tr>
<tr><td></td><td>Metering</td><td>AC/DC Voltmeter accurate to ±1%; AC/DC ammeter to ±1%; AC frequency meter to ±1.5%; DC Output Watts; DC Output as a percent of maximum rated output</td></tr>
<tr><td></td><td>Status display</td><td>20-character display of status & alarm messages.</td></tr>
<tr><td></td><td>Data logging</td><td>Data logging to internal nonvolatile memory, based on events and at fixed times. Logs retrieved using computer network connection.</td></tr>
</table>

Alarms	Alarm Outputs	Factory set, field reconfigurable, latching and non-latching. Alarms available via communication port, alarm relays, and on LCD.
	Alarm Inputs	Two optional input contacts (via optional battery monitor) to monitor status of, and modify charger operation based on, external devices such as battery room fan or hydrogen monitor.
	Alarm Form C contacts	Five Form C contacts, rated 30V, 2A resistive, assignable. Two optional 120VAC, 5A, resistive or 150VDC, 3A / 240VAC, 10A assignable
	Pilot relay functions	Form C contacts configurable as pilot relays to switch external loads based on user-configurable conditions
Networking	Modbus	Optional Modbus RS-485 or TCP/IP on RJ-45 port
	DNP3	Optional DNP3 RS-485 or TCP/IP on RJ-45 port
	SENSbus	Proprietary bus for connection of paralleled chargers and SENS accessories
Environmental	Operating temperature	-40C to +70C; full spec from -40C to +50C. Display may be unreadable and suffer reduced life above 65°C. Cold starts down to -40°C.
	Ingress protection	IP 20; NEMA 1
	Humidity	5% to 95%, non-condensing
	Altitude	0-6,500 ft (2,000 meters). Above this altitude, output is derated 0.012% per additional meter at rated ambient temperature.
	Vibration & shock resistance	EN60068-2-6, EN 60068-2-64 & EN 60068-2-27
	Electrical transient	ANSI/IEEE C62.41, EN 61000-4-12 on power terminals, IEC 61000-6-5 and ANSI/IEEE C37.90
Abuse protection	Reverse polarity	Charger self-protects without output protective device clearing. Indication via LED & LCD.
	Wrong voltage battery	Charger-battery voltage mismatch shuts down charger after 5 minutes. Indication via LED & LCD.
	Overvoltage shutdown	Selective; shutdown only operates the overvoltage shutdown is caused by the charger itself
	Overtemperature protection	Gradual output power reduction if heatsink temperature becomes excessive; recovery is automatic.
Regulatory Compliance	North America	C-UL Listed for US & Canada: CSA 22.2, No. 107.2, UL 1012, UL 508A
		NFPA-70, NEMA PE-5, PIP (optional)
		FCC Part 15, Class A commercial use and ICES-003 (Canada)
	European Union (CE)	EMC: 2014/30/EU (EN 61000-6-2 & EN 61000-6-4)
		LVD: 2014/35/EU (EN 60335-1 & EN 60335-2-29)
		RoHS 2: 2017/2102/EU (EN 50581)
Construction	Housing	Wall mount
	Housing material	Aluminum with powder coated finish
	Weight	85 lbs (38.6kg) maximum
	Cable entry	Side entry with one 1-1/2 inch NPT opening for DC and two 1 inch NPT openings for AC and two 1/0 inch NPT for alarms/comms
	Network/Alarm connections	Modbus: RJ-45 or terminal blocks 28 to 16 AWG. Form C alarms: 28 to 16 AWG.
	Power connections	AC breaker: 14 – 1/0AWG, DC breaker: 1AWG – 350kcmil

4 SYSTEM OVERVIEW

4.1. Physical Overview

Figure 1 – EnerGenius DC Wallbox Overview

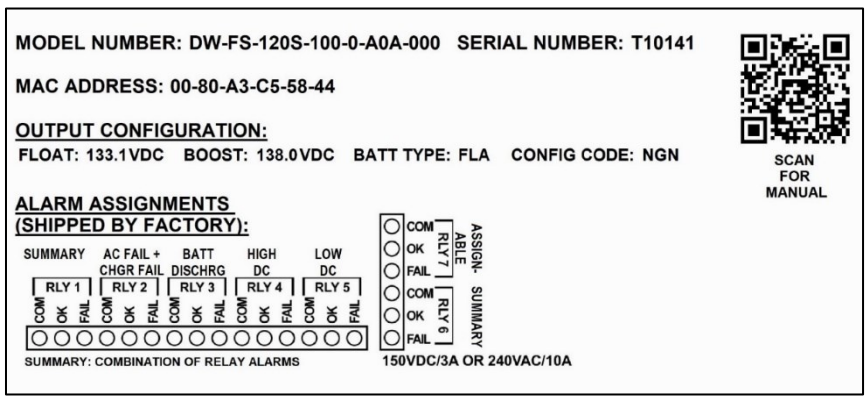


4.2. Functional Overview

4.2.1. Configuration

Each EnerGenius DC Wallbox System comes factory configured for its application from the factory. Configuration details are given on the configuration label (see Figure 2). These values are assigned according to the profile configuration selected during the customer order. Profiles are available for various battery types and applications. Some of the available configuration options may not be applicable to a given installation. Adjustments to settings can be made via the front panel keypad or the SENS Setup Utility software via ethernet connection of the EnerGenius DC Wallbox unit to a computer.

Figure 2 –Configuration Label (on inside lower cover)



4.2.2. Standard Items

4.2.2.1. AC Input Breaker, UL 489 listed. The breaker is lockable in the OFF position.

4.2.2.2. DC Output Breaker, UL 489 listed. The breaker is lockable in the OFF position.

4.2.2.3. Five Form C Relays Contacts for Alarm Relays

4.2.2.4. Ethernet communications

4.2.2.5. SENSbus communications

4.2.3. Factory Optional Items

4.2.3.1. Supplementary Surge Protectors

Supplementary Surge Protectors provide additional AC and DC protection in surge intensive environments. These protectors are equipped with field-replaceable modules that can be replaced when the surge protective device needs replacement. Alarm and status information of the surge protective devices is included.

4.2.3.2. High Current Relays

Two high current Form C relay contacts available for alarms. Configurable using the SENS Setup Utility.

4.2.3.3. High Interrupt AC and DC Breakers

Optional high interrupt AC and DC breakers provide higher short circuit current ratings.

4.2.3.4. Shunt Trip AC Breaker

Optional Shunt trip AC Breaker provides overvoltage input overvoltage protection by turning off the AC input breaker when the input voltage reaches a certain adjustable level.

4.2.3.5. Breaker Status

Breaker Status provides indication and alarms when the AC and DC breakers are in open or tripped positions.

4.2.3.6. Software

Optional communication protocols include Modbus (TCP/IP and RS-485) and DNP3 (TCP/IP and RS-485).

4.2.3.7. Module Redundancy

The EnerGenius DC Wallbox can be factory ordered with N+1 redundancy. This provides an additional power module than is required to meet the rated output. The modules will actively share the load up to the rated current of the unit. Should a power module fail, the remaining module will support the connected system load and battery recharge demand.

4.2.4. Channelization

EnerGenius DC Wallbox units are equipped with a feature called channelization. Channelization allows for multiple chargers to be assigned to different output channels called A, B, C, or D. Multiple units can be assigned to a common load or units can be allocated to separate outputs for multiple unique loads. All of the channelized EnerGenius DC Wallbox units on a common communication bus can be controlled / monitored from a single point. Each unique load should be assigned to a unique channel.

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

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

5.1.1. Charger is rated IP20.

5.1.2. Charger will operate at full specification when located where temperatures are within -40°C (-40°F) to +50°C (122°F). Output power is gradually reduced at higher temperatures.

5.1.3. Leave clear space for ventilation all around the charger: at least 17.5 inches (44.5 cm) at the top; at least 4 inches (10.16 cm) at the bottom; at least 4 inches (10.16 cm) on each side. Operating temperature ranges stated above assume stated clearances.

5.1.4. Mount to a wall or other vertical support. The mounting surface must safely support the weight of the charger and the fixed wiring. Charger weighs 87 lbs (39.5 Kg).

5.1.5. Allow sufficient room for routing the fixed wiring to the charger. All field connections enter the charger from the side. See diagrams at back of manual for further information.

5.1.6. Do not mount the charger above any heat generating equipment or where it could get wet.

5.2. Mounting Instructions

5.2.1. It is recommended to keep the modules installed for ease of installation. However, if desired for lighter lifting, remove the power modules (see section 10.2) before installing the wallbox. These modules can be accessed by removing the module access cover on the top of the unit (see Figure 1). To remove a module first unlock the module by moving the cam latch to the unlock position. Then pull the module upwards to remove. Each module weighs 23 pounds, so it may require significant force to remove the module after it is in the unlocked position.

5.2.2. Drill four wall mounting holes using dimensions provided on diagrams at back of manual.

> **WARNING:**
> **PROTECT UNIT FROM ALL DRILL SHAVINGS AND DEBRIS!**
> **IF INSTALLING UNIT WITHOUT POWER MODULES INSERTED, USE A FLASHLIGHT TO VISUALLY INSPECT AND REMOVE CONSTRUCTION DEBRIS CONTAMINATION FROM POWER MODULE CONNECTORS PRIOR TO INSERTION OF POWER MODULES.**

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 3/8 inch (M10) screws with standard flat washers. Mounting hardware is not included with the charger and must be provided by the installer.

5.2.5. Use keyhole feature of the upper mounting holes to hang the wallbox in its location.

5.2.6. Inspect the connections, busbars, and wiring for any loose debris or damage from installation.

5.2.7. Re-install any removed power modules at this time. Note – if the wallbox contains only one power module, the blank module cover must remain in place to ensure adequate cooling of the unit.

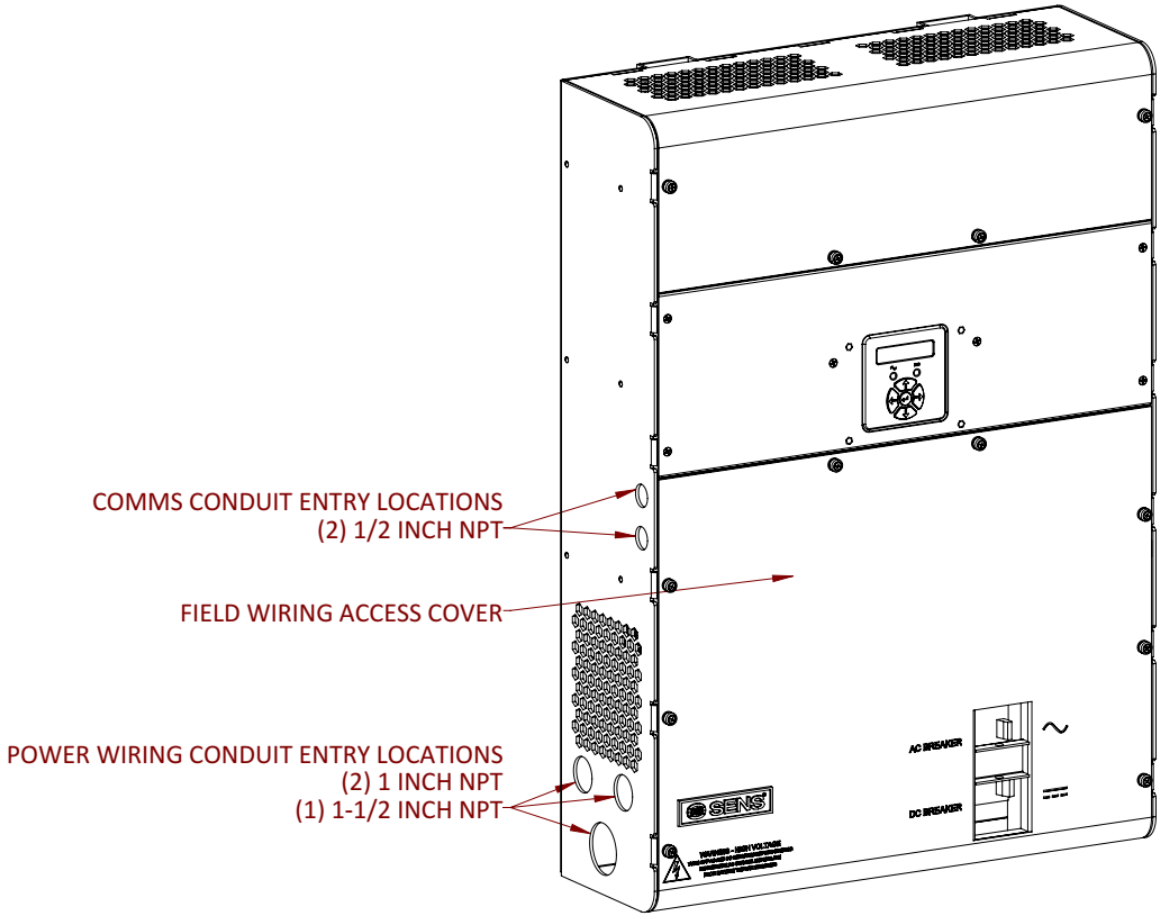
5.2.8. Ensure all ventilation openings are clear and unobstructed.

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. The field wiring area is accessed by removing the field wiring access cover by loosening the three captive Philips #2 screws. Use conduit entry holes as shown in Figure 3.

Figure 3 – EnerGenius DC Wallbox Conduit Openings



WARNING:
ENSURE THAT AC POWER IS DISCONNECTED AT THE MAINS 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 600V 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 feeder 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 (see section 9.12) is highly recommended for best charging performance.

Table 2 – 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		120V	240V
25	14	2.1	2.50	38	76
	12	3.3	1.60	60	120
	10	5.3	1.00	96	192
	8	8.4	0.63	152	304
	6	13.3	0.40	240	480
35	14	2.1	2.50	NEC - not allowed	
	12	3.3	1.60	NEC - not allowed	
	10	5.3	1.00	69	138
	8	8.4	0.63	109	218
	6	13.3	0.40	171	342
	4	21.2	0.25	274	548
	2	33.6	0.16	429	858
50	14	2.1	2.50	NEC - not allowed	
	12	3.3	1.60	NEC - not allowed	
	10	5.3	1.00	NEC - not allowed	
	8	8.4	0.63	76	152
	6	13.3	0.40	120	240
	4	21.2	0.25	192	384
	2	33.6	0.16	300	600
75	10	5.3	1.00	NEC - not allowed	
	8	8.4	0.63	NEC - not allowed	
	6	13.3	0.40	80	160
	4	21.2	0.25	128	256
	2	33.6	0.16	200	400
	1/0	53.5	0.10	327	654
	2/0	67.4	0.08	410	820
100	10	5.3	1.00	NEC - not allowed	
	8	8.4	0.63	NEC - not allowed	
	6	13.3	0.40	NEC - not allowed	
	4	21.2	0.25	NEC - not allowed	
	2	33.6	0.16	150	300
	1/0	53.5	0.10	245	490
	2/0	67.4	0.08	308	616

The above lengths consider the resistance of the battery and cables only and do not take into account any additional interconnects. The above lengths factor in a maximum voltage drop of 2% of the nominal voltage. The above lengths are for operation at 25°C/77°F. For high temperature installations (50°C/122°F) increase wire gauge by 20%.

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 (see Figure 1). This lug is marked with the ground symbol. This should always be the first wire connected and the last wire disconnected. Tighten connections to torque specified in Table 3.

Table 3 – Ground Allowed Wire Gauge and Torque Requirements

Ground Connection Type	Allowed Wire Gauge	Required Torque	Tool
Terminal Block	14-4 AWG (2.5-25 mm^2)	50.0 In-Lb (5.65 Nm)	Flat Screwdriver

6.3. DC Connection

Ensure that any battery disconnect devices in the system, if used, are opened (battery disconnected from DC bus). Connect the DC output conductors to the DC output terminal block/breaker in the charger (see Figures 1-3). 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 Table 4. Route DC wiring at least ¼ inch (6 mm) away from AC wiring, alarm wiring, and the circuit board.

Table 4 – DC Allowed Wire Gauge and Torque Requirements

DC Connection Type	DC Connection Type	Allowed Wire Gauge	Required Torque	Tool
120VDC	Single Box Lug on Breaker Terminal	1 AWG – 300 kcmil (50-150 mm^2)	135 in-lb (15.25 Nm)	M8 hex
240VDC	Single Box Lug on Breaker Terminal	14 – 2 AWG 2.5-35mm^2	14-10AWG: 20 in-lb (2.26 Nm) 8AWG: 35 in-lb (3.95 Nm) 6-2AWG: 75 in-lb (8.47 Nm)	M6 hex

Table 5 – DC Output Breaker Rating

Charger Nominal Output Voltage (VDC)	DC Breaker Rating (Amps)	DC Breaker Interrupt Standard Rating (KAIC)	DC Breaker Interrupt Optional Rating (KAIC)
120	150	10	25
240	70	10	-

6.4. AC Connection

This unit is to be permanently connected to the AC circuit and to the battery. The charger is rated to operate at full power on any AC input within the range of 358-528VAC, 47-63Hz. The unit is rated to operate at 50% power from 188-357VAC, 47-63Hz.

Ensure that the AC input supply is de-energized. Connect the AC line conductors to the AC input terminal block/breaker in the charger (see Figure 1). Tighten connections to torque specified in Table 6. Route AC wiring at least ¼ inch (6 mm) away from DC wiring, alarm wiring, and the circuit board.

Table 6 – AC Allowed Wire Gauge and Torque Requirements

AC Connection Type	Allowed Wire Gauge	Required Torque	Tool
Single Box Lug on Breaker Terminal	14-1/0 AWG (2.5-55.0 mm^2)	62.0 In-Lb (7.0 Nm)	M4 hex

Table 7 – AC Input Current and Breaker Rating

Charger Nominal Output Voltage (VDC)	Charger Rated Output Current (Amps)	AC Rated Input Current Maximum per phase (Amps)	AC Breaker Rating (Amps)	AC Breaker Interrupt Standard Rating (KAIC)	AC Breaker Interrupt Optional Rating (KAIC)
120	50	21.6	30	25	65
120	75	21.6	30	25	65
120	100	21.6	30	25	65
240	25	21.6	30	25	65
240	35	21.6	30	25	65
240	50	21.6	30	25	65

6.5. Standard Alarm Connections

See charger inside cover label for original factory alarm relay assignments (see Figure 2). Alarm relay assignments are custom configurable using the SENS Setup Utility. Alarm circuits are rated 2A at 30V AC or DC. Connect alarm wiring to the respective terminals on the pluggable terminal block in the charger (see Figure 4 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 (see Table 8). Connect alarm terminals only to low voltage, limited energy (“Class 2”) circuits. 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.

Figure 4 – Standard Alarm Connections
(TB1 - pins 1-15 shown)

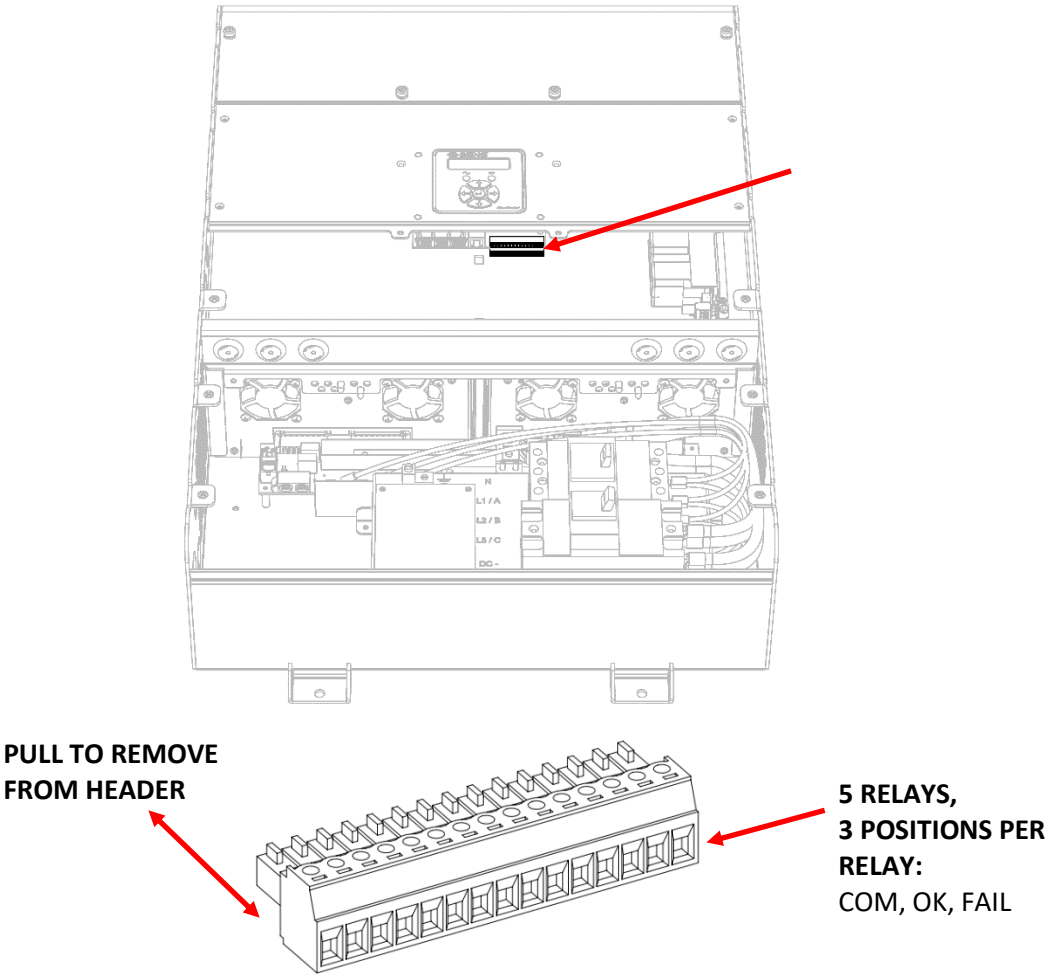


Table 8 – Alarm Relay Contact Wiring for Stationary Power Configuration
Wire from COM to OK for alarm present on open circuit or from COM to FAIL for present on closed circuit.

	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 and Charger Fail**	**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.
Functions and operation assigned to each relay are typical. Different functions and assignments are available both from the factory and by reassignment using the SENS Setup Utility.

6.6. Optional High Current Relay Connections

Optional high current relay assignments are custom configurable using the SENS Setup Utility. There are two options of high current alarm relays available from the factory. The first variant of alarm circuits (2) is rated 5A at 120VAC. The second variant of alarm circuits (2) is rated 3A at 150VDC and 10A at 240VAC. Connect optional alarm wiring to the respective terminals on the pluggable terminal block in the charger (see Figure 5 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 (See Table 9). The terminals accept 26-12 AWG (0.14-4.0 mm^2) conductors. Tighten connections to 5.5 Lb-In (0.62 Nm) using a small slotted driver. Route alarm wiring at least ¼ inch (6 mm) away from DC wiring, AC wiring, low voltage wiring, and the circuit board.

Figure 5 – Optional High Current Relay Connections

(TB1 - pins 1-6 shown)

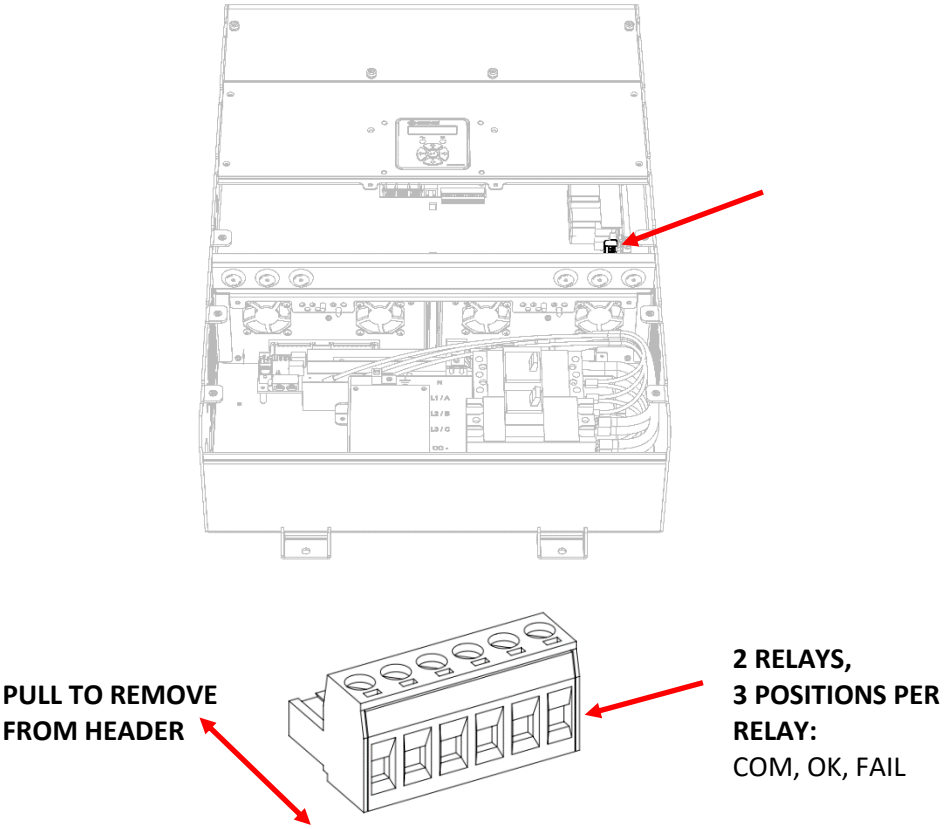


Table 9 – Optional High Current Relay Connections

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

	RELAY 1 Non-latching Coil	**RELAY 2** Non-latching Coil
Relay Contacts	**Assignable**	**Assignable**
Open on alarm	OK (TB1-1)	OK (TB1-4)
Close on alarm Defaults to FAIL with no AC and DC power (normally closed)	FAIL (TB1-2)	FAIL (TB1-5)
Common	COM (TB1-3)	COM (TB1-6)

6.7. CANbus and RS-485 Connections

Every charger includes CANbus and RS-485 communications via two RJ-45 jacks.

6.7.1. CANbus

The unit is equipped with CANbus communications support via the RJ45 ports. This interface is intended for communication with customer devices including battery monitoring systems, user interfaces, and customer-specific CAN protocol communications. Consult the factory for configuration and setup.

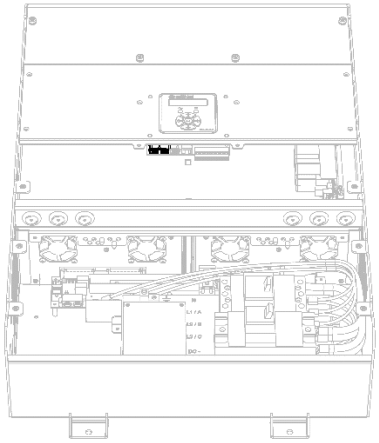
6.7.2. RS-485

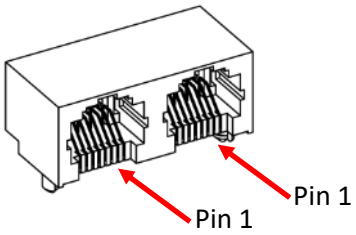
The unit is equipped with serial RS-485 communications support via the RJ45 ports. This interface is intended for monitoring and communicating with the charger. Available protocols include Modbus and DNP3. See manual sections on specific protocols for more information.

6.7.3. Connection

Connect communications using a twisted pair cable at the RJ-45 connector on the alarm/communications circuit board located on the inside front cover (see Figure 6 for detail). Two RJ-45 ports are provided. The ports are in parallel and either port may be used. See Table 10 for connector pinout. Communications are isolated. 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 Figure 7).

Figure 6 – CANbus and RS-485 RJ-45 Connections





TWO PORTS:

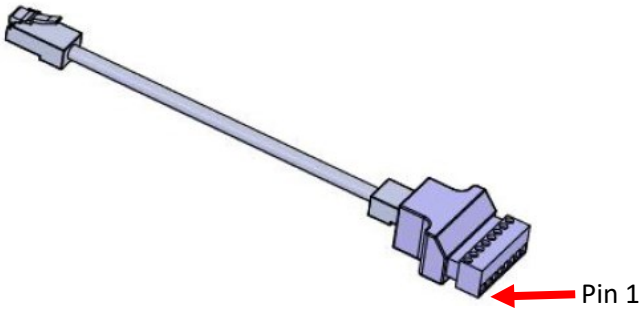
Connect CANbus and/or Modbus to one or both ports

Table 10 – Connector Pinout

Pin #	Purpose
1	CANbus
2	CANbus
3	No connect pass-through
4	Modbus –D0 (B)
5	Modbus +D1 (A)
6	No connect pass-through
7	Power*
8	Common (isolated)

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

Figure 7 – RJ-45 to Terminal Block Adapter — Optional

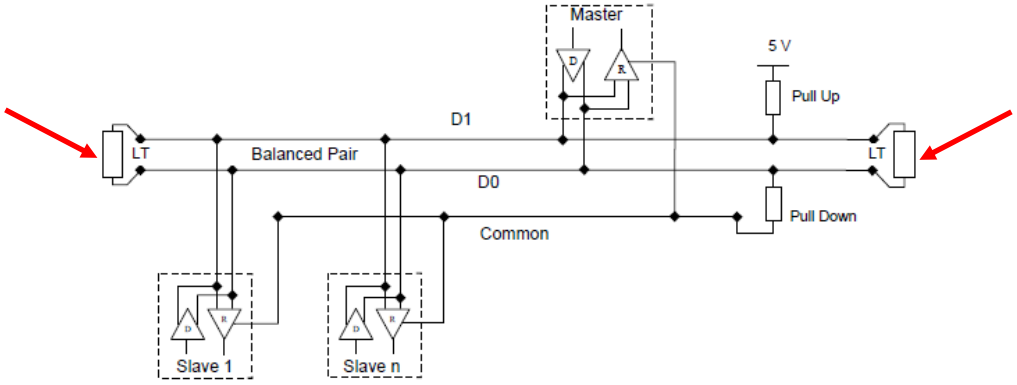


6.7.4. Termination

For proper operation, a 120-ohm terminator is required at the ends of the CAN and/or RS-485 bus. If multiple devices are on the bus, only the devices on the ends of the network bus need termination resistors. Figure 8 shows an example of how to terminate the network. 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).

SENS chargers are slave devices. Pull-up and pull-down resistors are optional per Modbus specifications.

Figure 8 – Typical RS-485 Termination

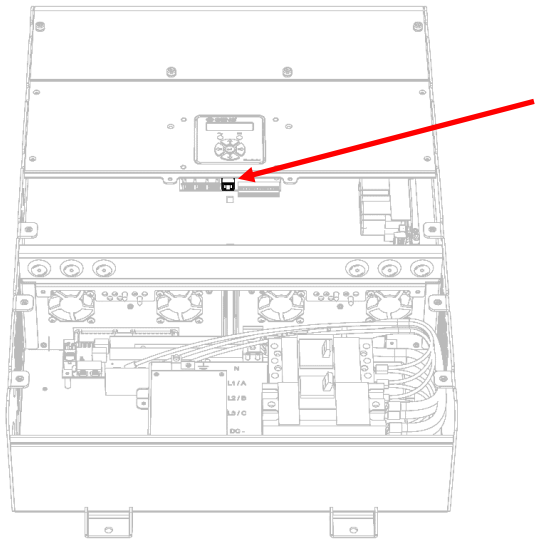


LT = Line Termination 120-ohm resistor

6.8. Ethernet

The unit is equipped with an ethernet RJ45 port (see Figure 9). Connect Cat5 or better ethernet cable. This provides a 10/100 ethernet connection. Ethernet communication includes ethernet connectivity to the charger for monitoring and configuration via the SENS Setup Utility, Modbus TCP/IP (optional) and DNP3 (optional).

Figure 9 – Ethernet Connection



6.8.1. Configure TCP/IP Address

Configure TCP/IP settings using the SENS Setup Utility or the keypad. To adjust settings using the keypad, ensure the access level is set to allow adjustments. 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.

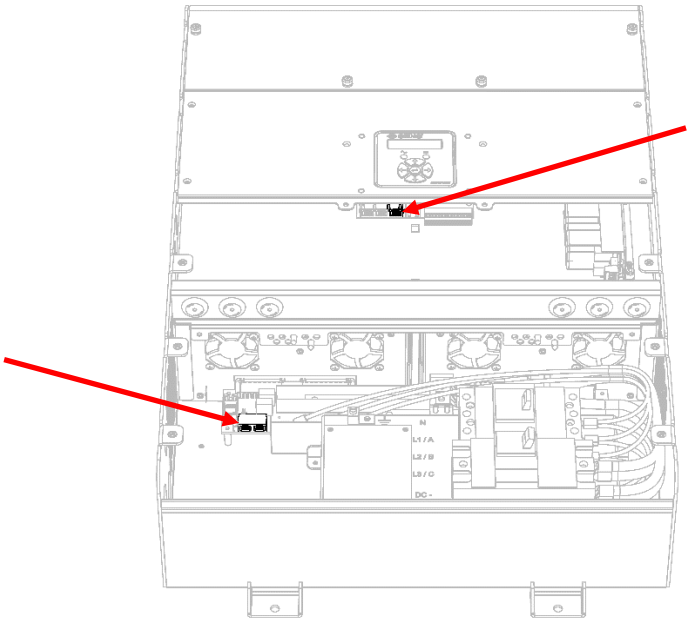
6.9. SENSbus Connection

The unit is equipped with three SENSbus RJ45 ports (see Figure 10). This connection is used to interconnect SENS specific devices.

WARNING:
DO NOT PLUG ETHERNET INTO THIS CONNECTION

A 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.

Figure 10 – SENSbus Connection



6.9.1. 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 port on each charger to automatically initiate load sharing (see Figure 10). 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.

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. No additional user setup is required to enable active current sharing. Two or more chargers automatically negotiate with each other to determine which charger is designated as the master unit.

6.9.2. Remote Battery Monitor—*Optional*

The optional remote battery monitor accessory provides the ability to monitor battery temperature and ambient temperature. Future options include battery voltage, battery current, battery float current, 5V logic inputs and other parameters

Connect the remote battery monitor to the charger using a network cable connected to the SENSbus RJ-45 port. Remove a factory installed 120-ohm terminator from the SENSbus RJ-45 port to connect the network cable from the remote battery monitor. Ensure a terminator remains in another SENSbus RJ-45 port on the charger. Place a 120-ohm terminator in the open RJ-45 SENSbus port on the remote battery monitor to ensure a terminator is located at both ends of the communications bus.

6.9.3. 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.

Remove a factory installed 120-ohm terminator from the SENSbus RJ-45 port on the charger to connect the network cable from the remote panel. Ensure a terminator remains in another SENSbus RJ-45 port on the charger. Connect a straight-thru splitter to the RJ-45 SENSbus port on the remote panel. Place a 120-ohm terminator in one of the positions on the remote panel splitter to ensure a terminator is located at both ends of the communications bus. Connect the remote panel to the charger using a network cable from the SENSbus RJ-45 port on the charger to the remote panel splitter.

6.10. Verify Connections

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

6.10.2. 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. Close any system battery disconnect, if used, and the charger DC circuit breaker to connect battery 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 Figure 2). 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. Ensure the keypad access level is set to allow adjustments.

7.2.2.1. FLA

This setting is ideal for flooded lead-acid batteries. The charging algorithm options 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. This charging mode should not be used with switchgear or other industrial type batteries. For AGM type batteries employed in switchgear or other industrial applications please see the “VRLA” battery type below.

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 switchgear and other industrial applications. The charging algorithm for valve-regulated lead-acid batteries includes Float mode only (see section 9.2).

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. Configuration types include:

7.2.3.1. GENSET (GEN)

This configuration code is intended for standard engine start applications and is not employed in the EnerGenius DC product family.

7.2.3.2. MARINE (MAR)

This configuration code is intended for standard marine applications.

7.2.3.3. Industrial / Utility (NGN)

This configuration code is intended for standard industrial and utility applications and is the typical factory-supplied configuration code for EnerGenius DC.

7.2.3.4. Power Supply (PSP)

This configuration code is intended for standard power supply applications where a storage battery is not connected.

7.3. Apply AC Input Voltage

Verify the AC input is the correct value (188-528 VAC, 47-63 Hz) and apply AC to charger by closing the charger AC circuit breaker.

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 will taper to a value below the current limit setpoint of the charger, and the charger will revert to constant voltage output. Chargers configured to use Autoboost will operate in the boost mode for variable time ranging from a few minutes to several hours depending on state of charge of the batteries. When in the Autoboost mode the charger will automatically revert from boost to float mode if Autoboost system has not automatically reverted to float prior to 24 hours. This is a safety feature which, if it activates, should be investigated.

7.4. Power Off

Power charger off as necessary by shutting off both AC and DC breakers 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 and the front panel LCD will indicate the alarm(s).

Table 11 – 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 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 YELLOW	AC good, Incompatible Battery error (charger disabled)
SOLID GREEN	FLASHING GREEN/YELLOW	AC good, output limited by high temperature
SOLID GREEN	DOUBLE FLASH YELLOW	AC good, load share fail
SOLID GREEN	DOUBLE FLASH RED	AC good, load sharing DC negative connection open or load sharing charger address fault
SOLID YELLOW	SOLID GREEN	AC voltage/frequency out of range or AC phase missing, DC voltage good
SOLID RED	SOLID GREEN	AC fail or over max voltage, DC voltage good
SOLID RED	SOLID YELLOW	AC fail, high or low DC voltage (above/below alarm setpoint)
SOLID RED	SOLID RED	AC fail, charger fail or overvoltage shutdown (charger disabled)
SOLID RED	FLASHING YELLOW	AC fail, Incompatible Battery error (charger disabled)
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

8.2. Individual Alarm Relay Contacts

The standard 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. See Table 8 for typical alarm relay assignments. The relays can be configured to be latching or non-latching with adjustable delays using the SENS Setup Utility.

By default, the relay contacts change state 30 seconds after the onset of a fault. The relay delay is configurable using the front panel keypad (see section 9.10) 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 AC and DC ammeters and voltmeters as well as information about input, output, charging status and alarms. The voltmeters are accurate to ±1% and the ammeters are accurate to ±1%. The display is readable with or without ambient lighting and operates automatically, requiring no operator intervention.

The LCD is fully operational from -20°C to +50°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.

8.1. 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.

8.2. Alarm Definitions

See Table 11 for a description of LED indicator activity. Unless noted otherwise, the following alarms are displayed on the LCD panel.

8.2.1. AC Line Failure

Indicates AC input voltage is not detected or is outside of the allowed 188-528VAC range. Activates solid red AC LED. When this alarm is assigned to a relay contact AC LINE FAIL will cause the assigned relay to change to the Failed state after the time delay.

8.2.2. High DC Voltage

Indicates DC output voltage is above the High DC Voltage factory alarm setpoint (see Table 12) or the configured level if setpoint is adjusted using keypad or SENS Setup Utility. Activates solid yellow DC LED. When this alarm is assigned to a relay contact HIGH DC VOLTAGE will cause the assigned relay to change to the Failed state after the time delay.

Table 12 – Factory High DC Setpoints

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

*Configuration Code displayed on charger label

8.2.3. Battery on Discharge

Indicates battery is beginning to discharge and DC output voltage is below Battery Discharge Voltage factory alarm setpoint (see Table 13) 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. When this alarm is assigned to a relay contact BATTERY DISCHARGING will cause the assigned relay to change to the Failed state after the time delay.

Table 13 – Factory Battery Discharging Setpoints

Configuration Code*	Battery Type	Battery Discharging Setpoint (V / Cell)
GEN	AGM	2.083
	FLA	2.083
	NCD	1.250
	HCB	2.083
MAR	VRLA	2.000
	AGM/FLA	2.000
	NCD	1.200
NGN	VRLA	2.000
	AGM/FLA	2.000
	NCD	1.200
PSP	N/A	1.700

*Configuration Code displayed on charger label.

8.2.4. Low DC Voltage

Indicates battery has discharged and DC output voltage is below Low DC Voltage factory alarm setpoint (see Table 14) 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. When this alarm is assigned to a relay contact LOW DC VOLTAGE will cause the assigned relay to change to the Failed state after the time delay.

Table 14 – Factory Low DC Setpoints

Configuration Code*	Battery Type	Low DC Setpoint (V / Cell)
GEN	AGM	2.017
	FLA	2.017
	NCD	1.210
	HCB	2.017
MAR	VRLA	1.833
	AGM/FLA	1.833
	NCD	1.100
NGN	VRLA	1.833
	AGM/FLA	1.833
	NCD	1.100
PSP	N/A	1.700

*Configuration Code displayed on charger label.

8.2.5. Battery End of Discharge

Indicates DC output voltage is below Battery End Discharge factory alarm setpoint (see Table 15) 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. When this alarm is assigned to a relay contact BATTERY END OF DISCHARGE will cause the assigned relay to change to the Failed state after the time delay.

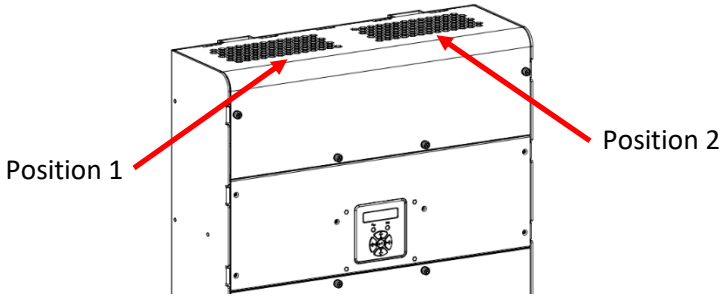
Table 15 – Factory Battery End of Discharge Setpoints

Configuration Code*	Battery Type	Battery End of Discharge Setpoints (V / Cell)
GEN	AGM	1.750
	FLA	1.750
	NCD	1.050
	HCB	1.750
MAR	VRLA	1.750
	AGM/FLA	1.750
	NCD	1.050
NGN	VRLA	1.750
	AGM/FLA	1.750
	NCD	1.050
PSP	N/A	1.700

*Configuration Code displayed on charger label.

8.2.6. Charger Module Fault

Indicates one or more individual module(s) in a system are in an alarm state. Activates flashing green/red DC LED. When this alarm is assigned to a relay contact INDIVIDUAL MODULE FAULT will cause the assigned relay to change to the Failed state after the time delay. The alarming module is indicated by position number in the alarm message on the LCD. Charger module position numbers are assigned as shown below.



8.2.7. Charger Failure

Indicates a power module within the charger has failed. One or more power modules 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 alarm is typically caused by a module internal component failure. This alarm does not occur during AC power failures. Activates solid red DC LED. When this alarm is assigned to a relay contact CHARGER FAIL will cause the assigned relay to change to the Failed state after the time delay.

8.2.8. Over Voltage Shutdown

Indicates that the charger has executed a high voltage shutdown and DC output voltage is above Over Voltage Shutdown factory alarm setpoint (see Table 16) 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 including a parallel connected charger of any type. Activates solid red DC LED. When this alarm is assigned to a relay contact OVERVOLTAGE SHUTDOWN will cause the assigned relay to change to the Failed state after the time delay.

Table 16 – Factory Overvoltage Shutdown Setpoints

Configuration Code*	Battery Type	Overvoltage Shutdown Setpoint (V / Cell)
GEN	AGM	2.834
	FLA	2.834
	NCD	1.700
	HCB	2.834
MAR	VRLA	2.530
	AGM/FLA	2.568
	NCD	1.700
NGN	VRLA	2.530
	AGM/FLA	2.568
	NCD	1.700
PSP	N/A	2.200

*Configuration Code displayed on charger label.

8.2.9. Reverse Polarity

Indicates battery is connected backwards. Charger output is disabled until the condition is corrected. Activates flashing red/yellow DC LED. When this alarm is assigned to a relay contact REVERSE POLARITY will cause the assigned relay to change to the Failed state after the time delay.

8.2.10. Incompatible Battery

Indicates charger is connected to an incompatible battery. 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 yellow DC LED. When this alarm is assigned to a relay contact INCOMPATIBLE BATTERY will cause the assigned relay to change to the Failed state after the time delay. After correcting mismatched condition cycle power to reset the charger and begin operation. See section 9.5 for charging a very low or zero-volt battery, when this safety feature would be a nuisance.

8.2.11. Invalid Settings

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

8.2.12. Fan Fail

Indicates a problem with one of more of the fans in a module. When this alarm is assigned to a relay contact FAN FAIL will cause the assigned relay to change to the Failed state after the time delay.

8.2.13. SENSbus Inactive

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

to the Failed state after the time delay.

8.2.14. Thermal Fold Back

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

8.2.15. No Remote Temp Sense

Indicates disabled or failed remote temperature sensor. This alarm is only available when a remote battery temperature sensor is installed with the optional remote battery monitor. When the temperature probe sensor is shorted temperature compensation is turned OFF. When this alarm is assigned to a relay contact TEMPERATURE PROBE FAULT will cause the assigned relay to change to the Failed state after the time delay.

8.2.16. Current Limiting

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

8.2.17. Ground Fault Positive

Indicates a short circuit or high impedance leakage current (greater than 500uA) exists from the charger positive to ground. Chargers intended for Marine and Utility/Industrial applications are shipped with this alarm enabled. Ground fault settings can be adjusted using the front panel keypad. Adjustments include ground fault polarity and sensitivity. The sensitivity adjustment range is from 0 (OFF) to 5,000µA in 100µA increments. A Setup Error code will alert user if this is adjusted beyond the charger capability. When this alarm is assigned to a relay contact GROUND FAULT POSITIVE will cause the assigned relay to change to the Failed state after the time delay.

8.2.18. Ground Fault Negative

Indicates a short circuit or high impedance leakage current (greater than 500uA) exists from the charger negative 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. Ground fault settings can be adjusted using the front panel keypad. Adjustments include ground fault polarity and sensitivity. The sensitivity adjustment range is from 0 (OFF) to 5,000µA in 100µA increments. A Setup Error code will alert user if this is adjusted beyond the charger capability. When this alarm is assigned to a relay contact GROUND FAULT NEGATIVE will cause the assigned relay to change to the Failed state after the time delay.

8.2.19. Low Current

Indicates current from the charger is below the Low Current Alarm setpoint. Unless specified by customer order, chargers are shipped with the low current alarm disabled. When this alarm is assigned to a relay contact LOW CURRENT will cause the assigned relay to change to the Failed state after the time delay.

8.2.20. Load Share Fail

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

8.2.21. 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. The Boost time limit is set to 24 hours by default. When this alarm is assigned to a relay

contact AUTOBOOST LOCKOUT ACTIVE will cause the assigned relay to change to the Failed state after the time delay.

8.2.22. 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.

8.2.23. 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.

8.2.24. Check Filter

Indicates charger has experienced a thermal roll back which might be caused by a clogged input air filter. Check module input air filter and clean if needed. When this alarm is assigned to a relay contact CHECK FILTER will cause the assigned relay to change to the Failed state after the time delay.

8.2.25. Thermal Fault

Indicates module has faulted because it over heated and thermal fold-back has reached zero watts. Module output has been disabled. Recycle AC and DC power for re-initiation. This can be environmental or a sign that a fan is not working properly. 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.

8.2.26. 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 with the optional remote battery monitor. 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.

8.2.27. High Battery Temperature Shutdown

Indicates battery temperature is high enough that the charger has shut off as a safety concern. This alarm is only available when a remote battery temperature sensor is installed with the optional remote battery monitor. 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.

8.2.28. High Battery Room Temperature

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

8.2.29. 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.

8.2.30. 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 with the optional remote battery

monitor. 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.

8.2.31. AC Phase Missing

Indicates an AC phase is missing or out of range. Activates solid yellow AC LED. When this alarm is assigned to a relay contact AC PHASE MISSING will cause the assigned relay to change to the Failed state after the time delay.

8.2.32. AC Voltage Over Maximum

Indicates AC Voltage has gone above maximum allowed by the charger on any phase. 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.

8.2.33. 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.

8.2.34. AC Frequency Out of Range

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

8.2.35. 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.

8.2.36. AC SPD

Indicates supplementary AC surge protective device has expired and needs to be replaced. Only active with optional supplementary surge protector options. When this alarm is assigned to a relay contact AC SPD will cause the assigned relay to change to the Failed state after the time delay.

8.2.37. DC SPD

Indicates supplementary DC surge protective device has expired and needs to be replaced. Only active with optional supplementary surge protector options. When this alarm is assigned to a relay contact DC SPD will cause the assigned relay to change to the Failed state after the time delay.

8.2.38. AC Breaker

Indicates that AC breaker is OPEN or has tripped. Only active with Breaker Status option. Alarm/communications circuit board AC BREAKER relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

8.2.39. DC Breaker

Indicates that DC breaker is OPEN or has tripped. Only active with Breaker Status option. Alarm/communications circuit board DC BREAKER relay contacts change to Fail state after delay when alarm is assigned to relay contacts.

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 Table 17. See following sections for descriptions of each charging mode.

Table 17 – Charging Algorithms

Battery Type	Charging Algorithm		
	Float Mode	Dynamic Boost Mode	HELIX Mode
FLA	✓	✓	
NCD	✓	✓	
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 HELIX mode is enabled the charger will enter HELIX mode after operating in Float for a short time.

9.2. Float Mode

Float mode is used to maintain stationary 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.

Table 18 – Factory Float Voltage Settings

Configuration Code*	Battery Type	Float Voltage (V / Cell)
GEN	AGM	2.27
	FLA	2.22
	NCD	1.43
	HCB	2.23
MAR	VRLA	2.27
	AGM/FLA	2.22
	NCD	1.43
NGN	VRLA	2.27
	AGM/FLA	2.22
	NCD	1.43
PSP	N/A	2.00

*Configuration Code displayed on charger label.

9.3. Dynamic Boost™ Mode

Dynamic Boost is an advanced method of boost charging that automatically computes during each recharge the optimal time for the charger to remain at the boost voltage, before transitioning back to the float charge mode. Dynamic Boost automatically adjusts for 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 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. The above descriptions are the default values, and Dynamic Boost can be enabled or disabled by the user at any time.

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.

Table 19 – Factory Boost Voltage Settings

Configuration Code*	Battery Type	Boost Voltage (V / Cell)
GEN	AGM	2.39
	FLA	2.36
	NICD	1.52
	HCB	2.40
MAR	VRLA	Disabled
	AGM/FLA	2.30
	NCD	1.52
NGN	VRLA	Disabled
	AGM/FLA	2.30
	NCD	1.52
PSP	N/A	Disabled

*Configuration Code displayed on charger label.

9.4. HELIX Mode

HELIX (High Efficiency, LIfe-eXtending) mode is a type of intermittent charging that can increase the life of some types of batteries. 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. Charging Low or Zero-volt Batteries

The charger includes a safety start-up voltage feature designed to prevent long-term overcharge of a battery in the event of a mismatched battery (e.g. a 120V battery is connected to a 240V charger). The default startup voltage level is factory configured to 50% of the float voltage, meaning that the charger must detect at least 50% of nominal voltage before starting. If battery voltage remains below the low battery error threshold for more than 5 minutes, the charger will alarm “Incompatible Battery” and shut down. If DC voltage rises properly the charger will continue to charge the battery normally using

standard output settings (see section 9.6 if alternate output settings are required). After correcting a mismatched condition, cycle AC and DC power to reset the charger and resume charging.

This safety feature can be temporarily defeated from the keypad or the SENS Setup Utility in order to charge/commission a zero-volt or fully discharged battery. Use the keypad or SENS Setup Utility to set the desired minimum startup voltage level and initiate a forced startup.

If the startup voltage level is set to zero, initiation of the startup charge will occur automatically.

9.6. Commissioning Batteries

Some batteries require an initial "commissioning" charge that typically employs different charging voltage and current limit values than the normal charger operating values. Set the commissioning charging voltage and current limit values using the SENS Setup Utility or charger keypad. Commissioning is not available for VRLA and power supply battery types. During commissioning the Over Voltage Shutdown trip point is automatically adjusted upward to approximately 102% of the commissioning charge voltage and the temperature compensation system is deactivated. After commissioning completes, the charger automatically reverts to the settings configured for normal charging, including temperature compensation and the Over Voltage Shutdown trip point.

9.7. Battery Check

Battery Check determines if the system battery can support a parallel connected DC load. Battery Check reduces charger output voltage to a configurable backstop level to permit the battery to support the load. Once Battery Check is activated by the user it can be run either manually or scheduled to run periodically. Manually activate a Battery Check, schedule a Battery Check to run automatically and configure minimum voltage and duration using the keypad or SENS Setup Utility. Upon completion of the test, the LCD displays whether the test passed or failed for ten seconds or until the "Enter" key is pressed. An in-progress Battery Check activates a fast flashing green DC LED. Battery Check failure activates a fast flashing yellow DC LED. When this alarm is assigned to relay contacts BATTERY CHECK relay contacts change to Fail state after delay. The BATTERY CHECK alarm latches by default. Clear a latched Battery Check alarm using the keypad or SENS Setup Utility.

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 about 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 recharge switchgear relays for chargers in switchgear applications without a continuous current load.

9.8. Shunt Trip AC Breaker - optional

Models may be equipped with a factory ordered optional shunt trip AC breaker. This feature allows for the AC breaker to automatically trip when the AC input voltage reaches a certain level. The setting for this feature is AC Over Max Voltage. The factory setting for this feature is 550VAC with a 3 second delay. This feature may be used to protect the charger from failure due to sudden increases in AC voltage. Note – should the shunt trip be triggered, the AC breaker must be manually switched back to the ON position.

9.9. Restore Factory Defaults

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

- Battery type
- Cell count
- Float Voltage
- Boost Voltage
- Battery Discharge Voltage
- Low DC Voltage
- Temperature Compensation Slope
- Auto Boost Time Limit
- Periodic Scheduled Boost Interval
- Periodic Scheduled Boost Duration
- Low Current Alarm
- Battery Check Interval

- Battery End of Discharge Voltage
- High DC Voltage
- Battery Check Voltage
- Over Voltage Shutdown
- 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 using the front panel keypad. 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 Table 20). 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.

Table 20 – 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.

Main Menus *(Press up and down arrows to scroll through Main Menu options)*		**Configurable/Viewable** *(Press left and right arrows to scroll through choices within each menu option)*	**Parameter Descriptions**
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
	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 for EDC units
		DC Output #B	Disable for EDC units
		DC Output #C	Disable for EDC units
		DC Output #D	Disable for EDC units
AC	Meters	AC Input	AC input voltage and frequency
	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 EDC units
		AC Input #B	Disable for EDC 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		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.
		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
		Soft Reset All	Press UP arrow to reset all devices in the unit/system
		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%
		Relay Test	Press UP arrow to set all alarm relays and DOWN arrow to clear all relays
		Display Test	Press UP arrow to set all LCD segments black and DOWN arrow to clear all LCD segments
		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 slave 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 slave 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.
	User CAN	User CAN Mode	Enable or disable User CAN Mode
Alarm Relays		Relay Delay Time AC	Adjust amount of time to delay activation of alarm relays after an AC alarm event takes place from 5 to 60 seconds. Alarm/comms circuit board alarm relay contacts and alarms on communications ports are delayed; LED alarm indication is not delayed.
		Relay Delay Time DC	Adjust amount of time to delay activation of alarm relays after a DC alarm event takes place from 5 to 60 seconds. Alarm/comms circuit board alarm relay contacts and alarms on communications ports are delayed; LED alarm indication is not delayed.
		Relay Test	Press UP arrow to set all alarm relays and DOWN arrow to clear all relays
Unit Information		Serial No.	Charger serial number
		Display Revision	Software revision currently loaded on alarms/comms circuit board
		Copyright	SENS copyright year

	Charger Revision	Software revision currently loaded on charging devices

9.11. 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 6.8 and 9.12). Communication between a computer and the charger using the SENS Setup Utility requires connection of a Cat5 minimum RJ45 cable between the ethernet port on the charger and the ethernet port on the computer (see section 6.8). Connect using the "SENSnet" option in the SENS Setup Utility. See the SENS Setup Utility user manual for information on connecting to and communicating with the charger.

9.12. Protocol Communications Circuit Board

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 6.8).

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

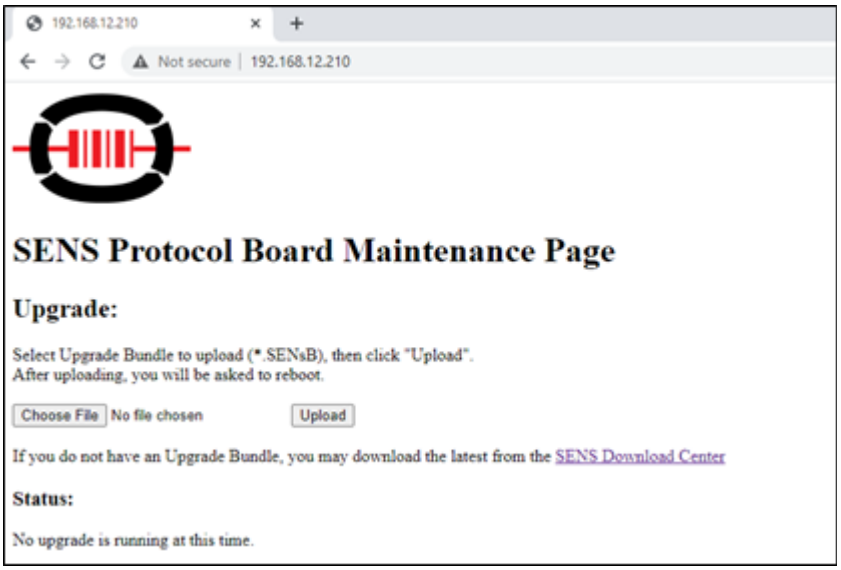
Connect a network cable from the ethernet port on the protocol communications circuit board in the charger to the building network (typically at a router). Allow charger to obtain an IP address dynamically or set a static IP.

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 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 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 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 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.

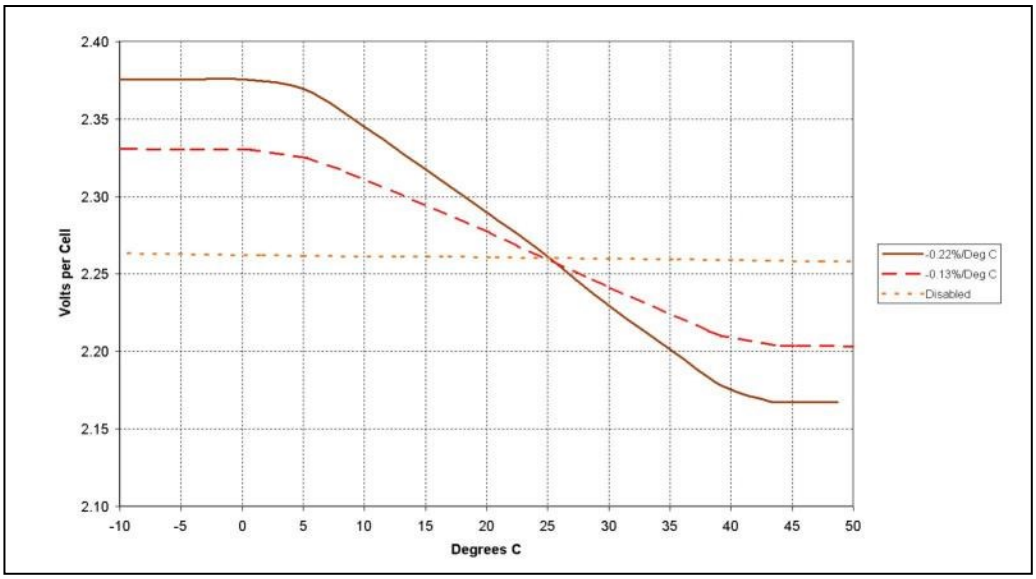
9.12.3.5. View update progress on the charger LCD and the protocol communications board webpage. The protocol communications circuit board will restart multiple times. Verify update is complete by confirming the new bundle version stated on the webpage.

9.13. Temperature Compensation

The charger is temperature compensated to match the negative temperature coefficient of the battery. A SENS remote battery monitor is required for this functionality. 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 Figure 11).

The charger automatically includes local temperature compensation using internal on-board sensors. Remote temperature compensation is enabled when the external sensor is located at the batteries and connected via the optional SENS remote battery monitor. Remote temperature compensation 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. Temperature compensation is disabled by setting the temperature compensation slope to zero using the keypad or 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.

Figure 11 – 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 the load share accessory between chargers using the SENSbus RJ-45 connectors (see section 6.9) automatically initiates load sharing and synchronization of all 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 SENSbus. Chargers intended for load sharing must be configured with the same output settings in order to load share properly. 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 its 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 (120V or 240V) 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

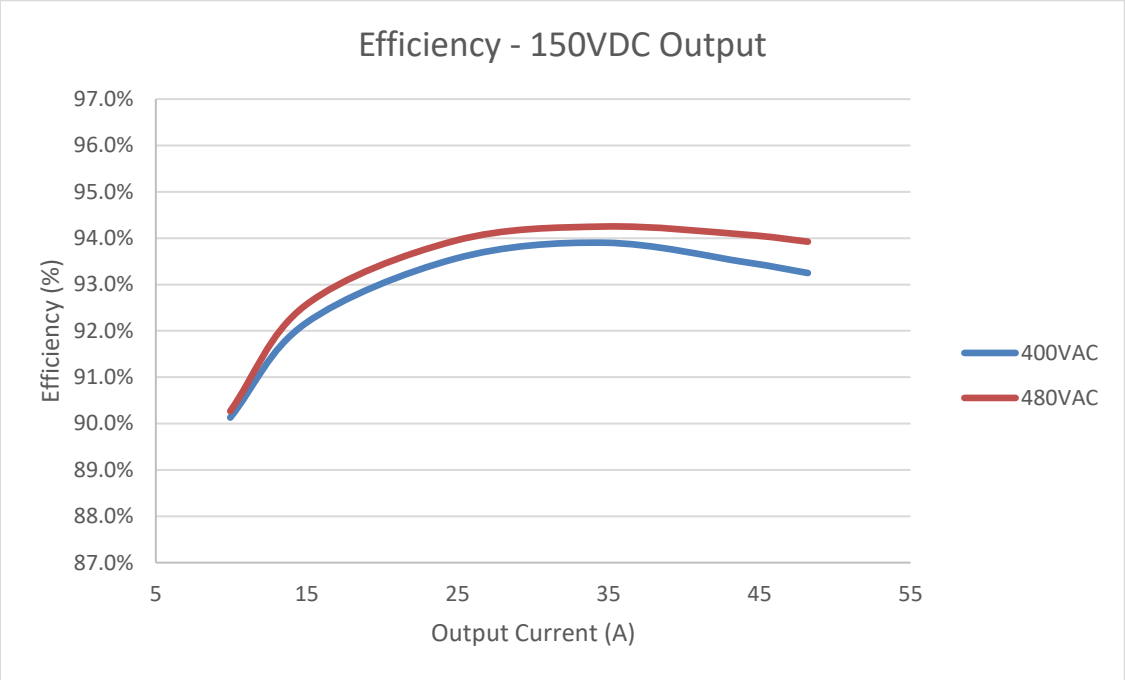
The optional remote alarm/communications panel accessory provides additional alarm relay contacts and the ability to adjust and communicate with multiple chargers using one external device. Connection of a network cable between the accessory and charger(s) using the SENSbus RJ-45 connectors (see section 6.9) 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 9.9 for keypad operation.

9.16. Efficiency

Figure 12 shows the efficiency of the charger at a given input voltage for a single 120VDC 50A module at 150VDC output voltage.

Figure 12 – Efficiency



10 SERVICE AND MAINTENANCE

10.1. Recommended Annual Maintenance

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

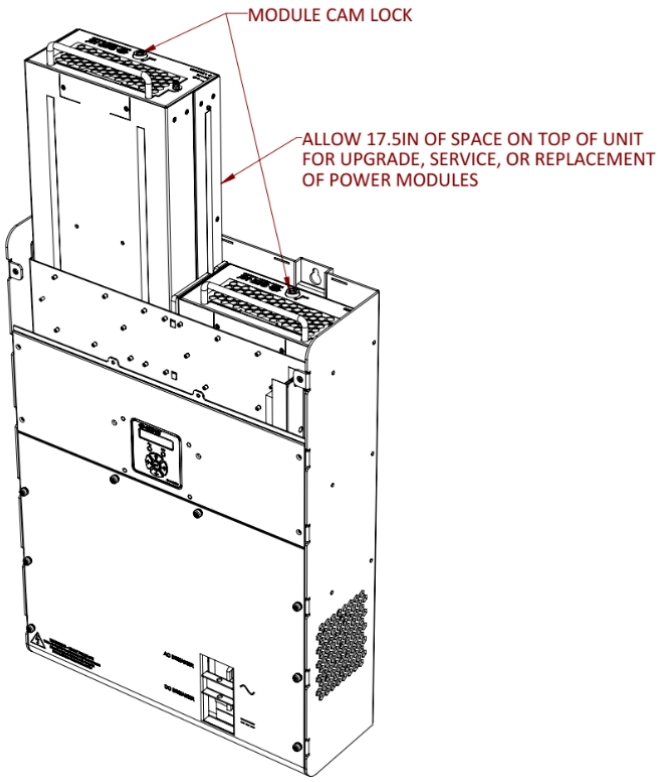
Verify that convection cooling vents are not blocked or clogged.

Ensure that air filter is clean and free from debris (see section 10.2).

10.2. Power Module Access

The EnerGenius DC Wallbox is powered by up to two EnerGenius DC power modules. These modules can be accessed by removing the module access cover on the top of the unit (see Figure 13). To remove a module first unlock the module by moving the cam latch to the unlock position. Then pull the module upwards to remove. Each module weighs 23 pounds, so it may require significant force to remove the module after it is in the unlocked position.

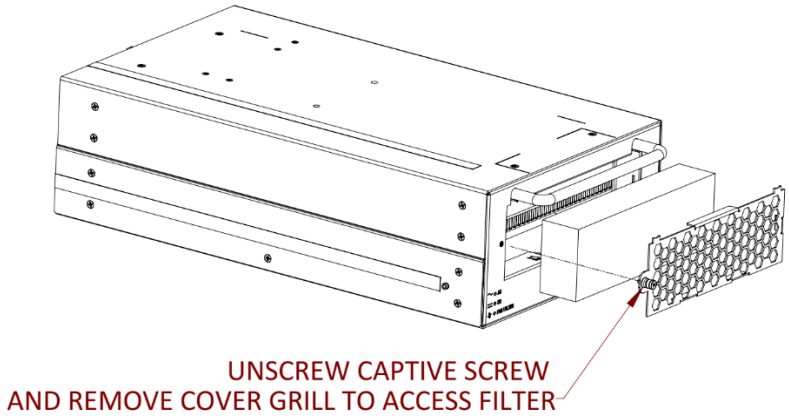
Figure 13 – Module Access



10.3. Air Filter

Each power module is equipped with an air filter accessed by removing the front grill cover (see Figure 14). An alarm will indicate when the filter needs to be serviced. The filter can be cleaned with compressed air and re-installed.

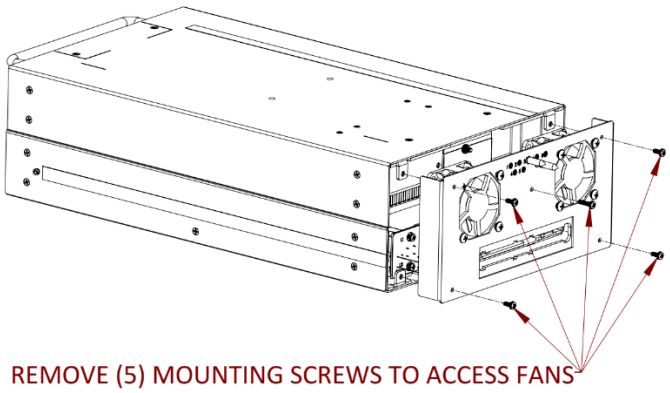
Figure 14 – Filter Servicing



10.4. Fans

Each power module is equipped with two fans on the top side of the unit. The fans act in parallel, so that if a fan failure occurs, the unit can continue to operate, though output power may be reduced depending on continuous loads and ambient temperature. An alarm will indicate if a fan needs to be serviced or replaced. See Figure 15 for fan servicing details. Contact SENS for replacement components and detailed service instructions.

Figure 15 – Fan Servicing



10.5. Supplemental Surge Protectors

If the charger was ordered with the optional supplemental surge protection (see Figure 1), these devices may be need be replaced if operated under extensive surge conditions. Should the device need to be replaced indication will be provided on the LEDs, display, and alarms. Contact SENS for replacement components and detailed service instructions.

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. TCP/IP Modbus—*Optional*

Modbus communications over TCP/IP is optional and requires configuration using the SENS Setup Utility or the keypad. To adjust settings using the keypad, ensure the access level is set to allow adjustments. . 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 Modbus slave address and enable/disable Modbus write access as desired. See section 6.8 for connection information. Both Modbus TCP/IP and DNP3 TCP/IP may be used simultaneously.

Table 21 – TCP/IP Modbus Default Settings

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

11.2. RS-485 Modbus—*Optional*

Serial Modbus communications over RS-485 using RTU mode is optional. Modbus communications settings may be configured using the keypad or SENS Setup Utility prior to executing communications. Configure Modbus slave address, baud rate, parity and enable/disable Modbus write access as desired. See section 6.7 for connection and termination requirements. Only one RS-485 protocol is allowed at a time. Enable/disable either Modbus RS-485 or DNP3 RS-485 using the keypad or SENS Setup Utility.

Table 22 – Modbus RS-485 Default Settings

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

11.3. Modbus Holding Registers

EnerGenius DC products provide an extensive array of Modbus registers. The following are common registers that are applicable to most applications. The entire list of Modbus registers is available from sens-usa.com/support/download-center/.

Address High		Address Low		Name	Description	Units	Scale Factor
Decimal	Hex	Decimal	Hex				
0	0x000	1	0x001	Unit Serial	Serial Number of System the device was built into and shipped part of	Num	1
2	0x002	3	0x003	Program Revision	Version of the main program	Num	1
4	0x004	5	0x005	Bootloader Version	Version of bootloader	Num	1
6	0x006	7	0x007	Type	Device type	Enum	1
8	0x008	9	0x009	Serial	Serial Number of the Device	Num	1
10	0x00A	11	0x00B	Build Date	Year (16bit), month(8bit), day(8bit)	Num	1
12	0x00C	13	0x00D	Model Num 1_4	Model number character	bit	1
14	0x00E	15	0x00F	Model Num 5_8	Model number character	bit	1
16	0x010	17	0x011	Model Num 9_12	Model number character	bit	1
18	0x012	19	0x013	Model Num 13_16	Model number character	bit	1
20	0x014	21	0x015	Model Num 17_20	Model number character	bit	1
22	0x016	23	0x017	Model Num 21_24	Model number character	bit	1
24	0x018	25	0x019	Model Num 25_28	Model number character	bit	1
26	0x01A	27	0x01B	Model Num 29_32	Model number character	bit	1
42	0x02A	43	0x02B	Basic Charging Alarms	Charging Alarm status bits (see section 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
50	0x032	51	0x033	Accessory Channel Alarms	Accessory Channel Alarm status bits (see section 11.8)	Bitfield	1
52	0x034	53	0x035	Accessory System Alarms	Accessory System Alarms status bits (see section 11.9)	Bitfield	1
54	0x036	55	0x037	Accessory Assigned Charger Alarms	Accessory Assigned Charger Alarms status bits (see section 11.10)	Bitfield	1
212	0x0D4	213	0x0D5	Unit Voltage	Voltage currently being supplied by the unit to the battery/loads	V	32768
214	0x0D6	215	0x0D7	Unit Current	Current currently being supplied by the unit to the battery/loads	A	32768
216	0x0D8	217	0x0D9	Unit Power	Power currently being supplied by the unit	W	32768
218	0x0DA	219	0x0DB	Unit Float Voltage	Float Voltage Setting of the unit	V/cell	32768
220	0x0DC	221	0x0DD	Unit Boost Voltage	Boost Voltage Setting of the unit	V/cell	32768
222	0x0DE	223	0x0DF	Unit Battery Temp	Battery temperature	°C	32768
224	0x0E0	225	0x0E1	Unit Internal temp	Internal temperature of the unit	°C	32768
226	0x0E2	227	0x0E3	Unit Boost Timer	Boost timer	Sec	1

228	0x0E4	229	0x0E5	Unit Periodic Boost Countdown	Interval between periodic boost events (0=disabled)	Sec	1
230	0x0E6	231	0x0E7	Unit Line Frequency	AC Line Frequency	Hz	10
232	0x0E8	233	0x0E9	Unit Line Voltage 1	AC Line 1 Voltage	V	32768
234	0x0EA	235	0x0EB	Unit Line Current 1	AC Line 1 Current	A	32768
236	0x0EC	237	0x0ED	Unit Line Voltage 2	AC Line 2 Voltage	V	32768
238	0x0EE	239	0x0EF	Unit Line Current 2	AC Line 2 Current	A	32768
240	0x0F0	241	0x0F1	Unit Line Voltage 3	AC Line 3 Voltage	V	32768
242	0x0F2	243	0x0F3	Unit Line Current 3	AC Line 3 Current	A	32768
244	0x0F4	245	0x0F5	Unit State Timer	Timer for elapsed time with a given state	Sec	1
246	0x0F6	247	0x0F7	Unit Battery Check Due	Time until next Battery Check	Sec	1
248	0x0F8	249	0x0F9	Unit Number of Chargers	Number of modules	Num	1
250	0x0FA	251	0x0FB	Unit Redundancy Level	Number of redundant modules	Num	1

11.4. Basic Charging Alarms Bit Definition

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

15	0x0F	Load Share Fault	Modules or chargers connected for load sharing are not sharing the current load.
16	0x10	AutoBoost Lockout Active	Boost mode time limit has expired and charger has returned to Float mode. Boost mode is disabled until the time limit is reset. The Boost time limit is reset when power is cycled.
17	0x11	Unused	Unused
18	0x12	SENS Bus Inactive	Device is not communicating on SENSbus.
19	0x13	Battery On Discharge	Battery is beginning to discharge and DC output voltage is below Batt Discharge Voltage alarm setpoint.
20	0x14	Battery End Discharge	DC output voltage is below Batt End Discharge Voltage alarm setpoint.
21	0x15	Ground Fault Negative	Ground fault current to the negative output terminal is above the Ground Fault Trip sensitivity setpoint.
22	0x16	DC Negative open	Chargers connected in parallel that suffer a loss of high current negative connection may try to route power through the SENSbus cabling. This alarm shows that a charger has detected the issue and has shut itself off. Please check battery terminal connections
23	0x17	DC Below Startup Voltage	Battery voltage is below the Startup Voltage setpoint. Unit output voltage is disabled. Forced startup feature overrides.
24	0x18	Fan Fail	There is a problem with one or more of the module fans.
27	0x1B	Battery Check	Battery has failed the most recent battery check.

11.5. Charging Status Bit Definition

Bit Address		Name	Description
Decimal	Hex		
0	0x00	Output Idle	Charging status - Output Idle
1	0x01	Slave Mode	Charging status - Slave 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. Charging Alarms Extended Bit Definition

Bit Address		Name	Description
Decimal	Hex		
0	0x00	Check Filter	Module has experienced a thermal roll back which can be caused by a clogged input air filter.
1	0x01	Thermal Fault	Module has faulted because it over-heated and thermal fold-back has reached zero watts. Module output has been disabled.
2	0x02	High Battery Temperature	Battery temperature is above the High Battery Temperature alarm setpoint.
3	0x03	High Battery Temperature Shutdown	Battery temperature is high enough that the unit has shut off for safety precautions. Only available when a remote battery temperature sensor is installed with the optional remote battery monitor.
4	0x04	High AC Ripple Detected on Output	Charger's output ripple is above High AC Ripple Detection alarm setpoint.
5	0x05	DC Output Open	Charger has detected that the output is not connected to anything.
6	0x06	Charger Low Temperature	Unit ambient temperature is below its rated ambient temperature, unit output may be derated.
7	0x07	Battery Low Temperature	Battery temperature is below Battery Low Temperature alarm setpoint. Only available when a remote battery temperature sensor is installed with the optional remote battery monitor.

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. Accessory Channel Alarms Bit Definition

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

11.9. Accessory System Alarms Bit Definition

Bit Address		Name	Description
Decimal	Hex		
0	0x00	Invalid System Config	Configuration of system is conflicted. Charger will continue to operate but may not be fully functional until the issue is resolved.
1	0x01	AC1 SPD	The AC supplementary surge protector has expired and needs replacement.
2	0x02	AC1 Breaker	The AC breaker is OPEN or has tripped. Only available with Breaker Status option.
3	0x03	Unused	Unused
4	0x04	Unused	Unused
5	0x05	DC SPD	The DC supplementary surge protector has expired and needs replacement.
6	0x06	DC Breaker	The DC breaker is OPEN or has tripped. Only available with Breaker Status option.
7	0x07	Unused	Unused
8	0x08	Unused	Unused
9	0x09	Unused	Unused
10	0x0A	Unused	Unused
11	0x0B	System Display Board	This device is configured as a system display board. It will present information for the entire system, even if devices are not in its unit.
12	0x0C	Unused	Unused
13	0x0D	SENSbus Inactive	No other devices are found on SENSbus.
14	0x0E	Unused	Unused
15	0x0F	Unused	Unused
16	0x10	Unused	Unused
17	0x11	Unused	Unused
18	0x12	No Power Board Data	No module power boards are found on SENSbus.

11.10. Accessory Assigned Channel Alarms Bit Definition

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

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

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

12 DNP3 COMMUNICATIONS

DNP3 is a messaging protocol used for client/server communication and is implemented according to IEEE Standard 1815-2012. The EnerGenius DC is compliant with DNP3 Subset Level 2 and supports various features of Level 3 and Level 4. EnerGenius DC 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. TCP/IP DNP3—*Optional*

DNP3 communications over TCP/IP is optional and requires configuration using the SENS Setup Utility or the keypad. To adjust settings using the keypad, ensure the access level is set to allow adjustments. 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.

Table 16 – TCP/IP DNP3 Default Settings

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

12.2. RS-485 DNP3—*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.

Table 17 – DNP3 RS-485 Default Settings

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

12.3. SENS DNP3 Config Tool

The SENS DNP3 Config Tool is a worksheet that allows user configuration of all DNP3 data points. EnerGenius DC 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
104	Charger Module	**Invalid output channel.** Chargers must be set to use a valid output channel setting: either an assigned output channel 1 4 (representing Ch A Ch D, respectively) for channelized systems or 0 for non-channelized operation. Combining channelized chargers with non-channelized chargers in the same unit (or system) is not supported.	- If necessary, enable the channel using the keypad "Enable/Disable DC Output Ch" selection in the "Other Settings" menu or the setup utility. - To select a different output channel, reassign the charger to match its actual output channel connection using the "Set DC Output" setting in the "Other Settings" menu or by using the setup utility. - To operate without channelized outputs, use the keypad "Enable/Disable DC Output Ch" selection in the "Other Settings" menu or the setup utility to disable all output channels for the display board. Then use the "Set DC Output" setting in the "Other Settings" menu or the setup utility to assign all chargers to the default DC output channel (0). For factory default settings install jumpers on the charger in all three Float Voltage positions or two float settings plus one Range jumper. For other standard settings, install three jumpers on the charger to select the Battery Type, Float Voltage, and Range for your battery.
201	Channel	**No chargers assigned to output channel.** Every enabled output channel must have at least one charger assigned to it. When none is found, it is presumed that a charger has failed, has lost SENSbus data communication, or has an incorrect channel setting.	- Check for a charger that has failed (indicated by its LED status). - Check for disconnected or damaged SENSbus data cables. - If the output channel is not to be used, disable it by using the keypad "Enable/Disable DC Output Ch" setting in the "Other Settings" menu or the PC utility.

202	Channel	**Too few chargers operating.** The combined output rating of all chargers operating on this channel is less than the channel's rated output. This can occur because a charger has failed, has an open AC input or DC output connection, has lost SENSbus data communication, is configured for the wrong output channel, etc. Note: the channel output settings are used to determine channel-level output current limit settings for "N+1" and "N+2" redundant configurations; non-redundant systems use channel settings of 0 which allow up to 100% output from every available charger.	- Use the "Set DC Output" setting in the "Other Settings" menu or the setup utility to verify all chargers' output channel settings. Each charger must be set for the output channel corresponding to its electrical DC output connection. - Use the setup utility to verify the channel DC output current and power ratings. For "N+1" or "N+2" redundant operation use the required output rating, i.e. the total for the minimum number of chargers ("N") that will provide the necessary output ratings. Non-redundant systems use 0 settings (which disables this error check). - If necessary, install additional chargers to meet the required output rating (plus the additional chargers needed for "N+1" or "N+2" redundant operation). - Verify that each channel is assigned enough chargers to meet the required DC output rating (plus any extra chargers needed to provide "N+1" or "N+2" redundant operation). - Check for disconnected or damaged SENSbus data cables. - Check for miswired, disconnected, or damaged input and output connections.
203	Channel	**Charger assigned to a disabled channel.** All chargers must either be set for non-channelized operation (0, Default output) or to a valid output channel that is enabled in this unit or system.	- To use this channel, enable it using the keypad "Enable/Disable DC Output Ch" selection in the "Other Settings" menu or the setup utility. Verify that the DC outputs of all chargers assigned to this channel are electrically connected to that output bus. - To select a different output channel, reassign the charger to match its actual output channel connection using the "Set DC Output" setting in the "Other Settings" menu or by using the setup utility. - To operate without channelized outputs, use the keypad "Enable/Disable DC Output Ch" selection in the "Other Settings" menu or the setup utility to disable all output channels for the display board. Then use the "Set DC Output" setting in the "Other Settings" menu or the setup utility to assign all chargers to the default DC output channel (0). For factory default settings install jumpers on the charger in all three Float Voltage positions or two float settings plus one Range jumper. For other standard settings, install three jumpers on the charger

			to select the Battery Type, Float Voltage, and Range for your battery.
301	Unit (or System)	**Missing chargers.** A charger that should be present is missing, has failed, or otherwise not found on the SENSbus network. The number of chargers in this system must not be less than the System Charger Count setting. This setting defines how many chargers should be installed, particularly in "N+1" and "N+2" redundant configurations (where full output is possible without all chargers operating). This setting normally is 0 (Off) for non-redundant systems, which disables this error check.	- Check for a charger that has failed (indicated by its LED status). - Check for disconnected or damaged SENSbus data cables. - Use the "Minimum System Number of Chargers" selection in the "Other Settings" menu or the PC utility to verify the System Charger Count setting. For "N+1" or "N+2" redundant operation this should be the number of charger modules connected to the SENSbus network. Non-redundant systems normally use a 0 setting (which disables this error check) but may be set if error checking is desired.
302	Unit (or System)	**Channel Charger assignments used but not all chargers are set for the DC channel.** If Channel-Charger Assignments are used, ALL installed Charger Ids must be set.	-To correct this, the SENS Setup Utility must be used to assign Charger Ids to a channel.
303	Unit (or System)	**Channel Charger assignments used but not all chargers are set for the AC channel.** If Channel-Charger Assignments are used, ALL installed Charger Ids must be set.	-To correct this, the SENS Setup Utility must be used to assign Charger Ids to a channel.
304	Unit (or System)	**Duplicate Charger Id found in system using Assigned Chargers.** If assigned chargers feature is used, Charger Ids MUST be unique. The system will continue to operate, but this indicates that jumpers need to be adjusted.	Corrective action is to use the SENS Setup Utility to change the Unit Serial number to match the unit the module was installed in.
305	Unit (or System)	**Rogue Module Found.** This can apply to any type of system. It indicates that a charger module was found that has a Unit Serial Number that does not match any display found on the bus. This could	Corrective action is to fix Unit Serial Numbers on all chargers/modules and Accessory boards.

		happen when adding a module from another system.	
401	Hardware	**Optional Hardware Error.** Hardware that may be optional is not working properly.	This could be a bad configuration. Compare Option Select Bits with Hardware Status Bits to determine if perhaps a piece of hardware is configured to be present but doesn't actually exist on this board.
402	Hardware	**Critical Hardware Error.** Critical Hardware is not working properly.	Check Hardware Status Bits to determine the specific hardware that is not behaving. This may require a board replacement.

13.2. Troubleshooting Guide

AC LED	DC LED	Fan / Filter LCD	Symptom	Possible Causes	Recommended Actions
OFF	OFF	-	Display AC and DC LEDs and display are off	1. Proper AC or DC voltages not applied 2. Cable to display board failure or poor connection 3. Display board failure	1. Using a voltmeter, check that AC input voltage and frequency at AC input terminal block/breaker are in the range 188VAC – 528VAC / 47Hz – 63Hz or that >60VDC 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, remove display cover while leaving cables connected and verify the network cable from the SENSbus port at the top of the display board to the breakout board (located above breakers) is tightly connected at both ports. 4. If none of the above steps resolved the issue, display board may need to be replaced. Contact SENS.
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	1. Verify that a terminator is installed as directed in the manual (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 ports as directed in

				settings (baud rate, address)	the manual, in the Modbus connections section. Correct cabling as required. 3. For serial applications, if cable is connected correctly, verify 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. Investigate individual modules for LED errors.
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	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 battery surface charge and any other 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 charger modules 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. Check for obstructions on ventilation openings 2. Ensure that all covers are installed as directed in manual. 3. 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 load share cable from charger.
SOLID GREEN	DOUBLE FLASH RED	-	AC good, output disabled	1. Too many devices on the SENSbus network	1. Ensure that less than max allowed number of devices is on the SENSbus. 2. If step 1 doesn't resolve issue, a failed display board is likely, contact SENS
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 188VAC – 428VAC / 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 188VAC – 428VAC / 47Hz – 63Hz or that > 60VDC 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 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 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 188VAC – 428VAC / 47Hz – 63Hz or that > 60VDC 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 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). 3. 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 188VAC – 428VAC / 47Hz – 63Hz or that > 60VDC 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 1. 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 charge. 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 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 188VAC – 428VAC / 47Hz – 63Hz or that >60VDC 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

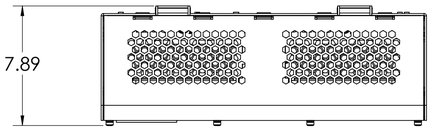
					failure is the likely cause. Replace module. DC LED 1.Check that charger voltage is set correctly for the battery. After making any correction to the setting, remove both AC and DC power for 1 minute, then reapply power.
ALTERNATING FLASHING YELLOW		-	No output	1. Illegal configuration	1. Ensure that charger has been programmed to desired and allowable settings.
SYNCHRONIZED FLASHING YELLOW		-	No output	1. Missing terminator 2. Missing/damaged charger module	1. Verify a terminator is connected in the display board SENSbus port. 2. Ensure all charger modules are securely seated in charger chassis. 3. If steps 1 and 2 don't resolve issue, a charger module failure is the likely cause. Contact SENS or replace charger module.
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.
-	-	YELLOW	Filter Error	Filter Issue	1. Identify module giving error. 2. Clean module filter as directed in manual. 3. Ensure ventilation openings are not obstructed.
-	-	RED	Fan Error	Fan Failure	1. Identify module giving error. 2. Replace module fans as directed in manual.

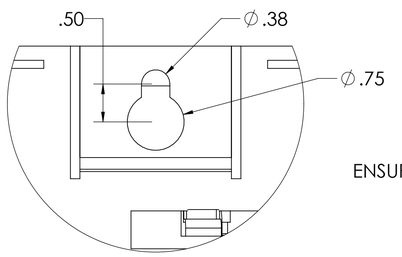
14 GLOSSARY

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, and nickel-cadmium.
Configuration Code	Indicates charger output voltage configuration. Configuration code is included on the inside cover label.
Modbus	Modbus is an application layer messaging protocol provided by Modbus Organization and used for client/server communication. Modbus is provided over RS-485 in RTU mode or over TCP/IP as an option.

NOTES:
1. THIS DRAWING IS FOR REFERENCE ONLY.
2. THE INSTALLATION OF THIS EQUIPMENT SHALL COMPLY WITH ALL LOCAL AUTHORITY AND APPLICABLE BUILDING CODES.
3. CLEARANCES - FOR VENTILATION AND SERVICABILITY PROVIDE A MINIMUM CLEARANCE OF:
   - 17.5 INCHES ON TOP OF THE UNIT.
   - 6 INCHES ON EACH SIDE OF THE UNIT.
4. WEIGHT: 85 LBS MAXIMUM
5. POWER MODULES MAY BE REMOVED FROM UNIT PRIOR TO INSTALLATION FOR EASY OF ASSEMBLY.
6. ***IMPORTANT*** - WHEN INSTALLTING UNIT, ENSURE THAT NO DEBRIS OR PARTICLES FALL INTO UNIT.

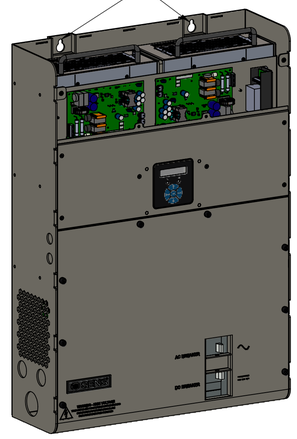
REVISIONS				
DCN	REV	DESCRIPTION	DATE	APPROVED
107772	A	INITIAL RELEASE	12/9/2019	ERS
107839	B	GENERAL UPDATE	4/23/2020	ERS

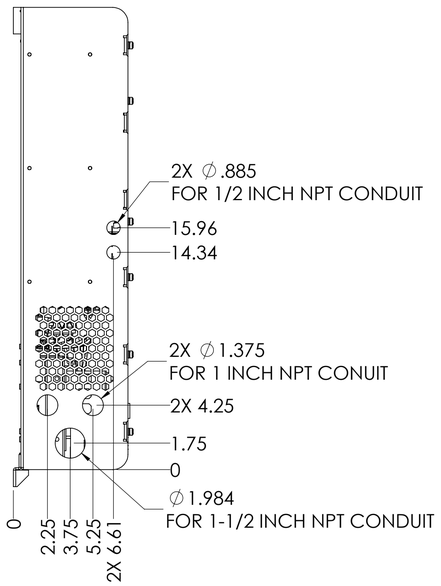


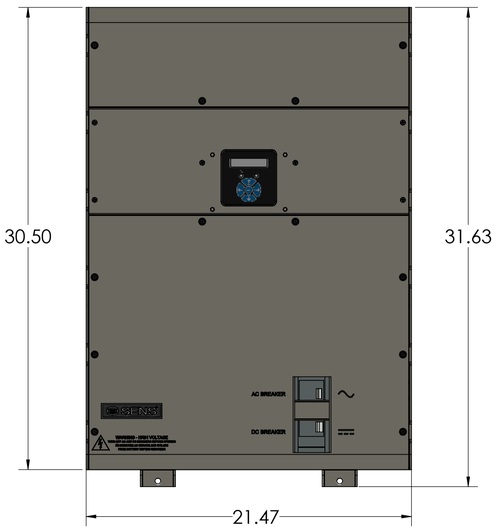


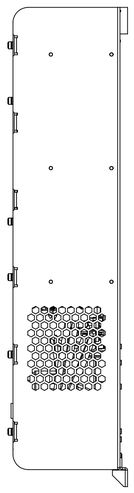
DETAIL A
SCALE 1 : 1
2 LOCATIONS

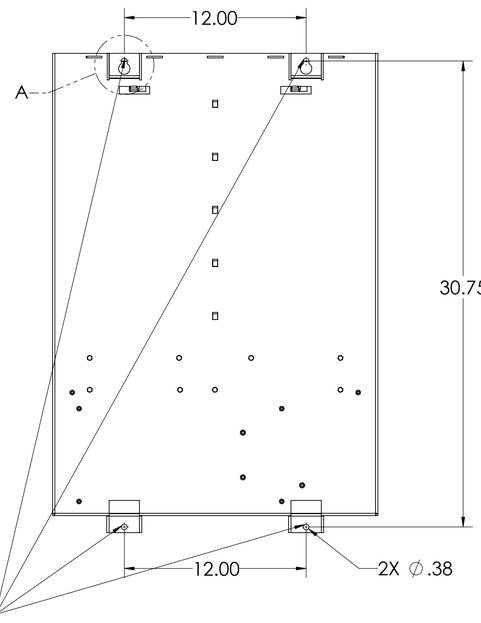
REMOVE TOP COVER TO ACCESS UPPER MOUNTING POINTS
ENSURE NO DEBRIS OR PARTICLES FALL INTO UNIT DURING INSTALLATION

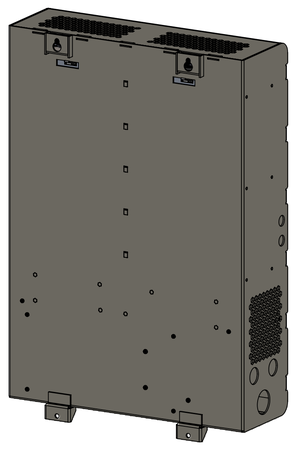


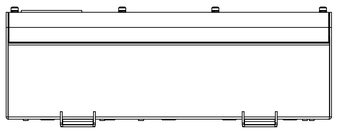












SENS
STORED ENERGY SYSTEMS

1840 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	12/9/2019
CHECKED		

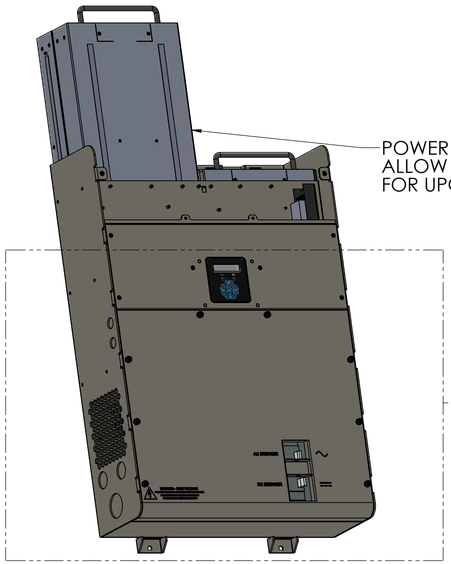
THIRD ANGLE PROJECTION
DIMENSIONS & TOLERANCES PER ASME Y14.5 - 2009

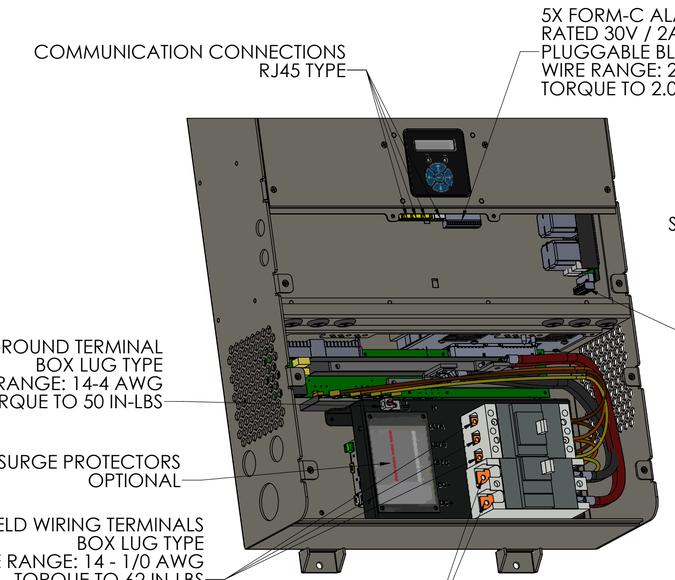
DESCRIPTION: DIAGRAM,ENERGENIUS DC,WALLBOX,INSTALL

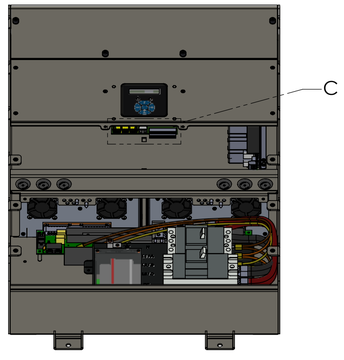
SIZE: D
DOCUMENT NUMBER: DIA\00646
REV: B
SHEET 1 OF 2

REVISIONS				
DCN	REV	DESCRIPTION	DATE	APPROVED
-	-	SEE SHEET ONE	-	-

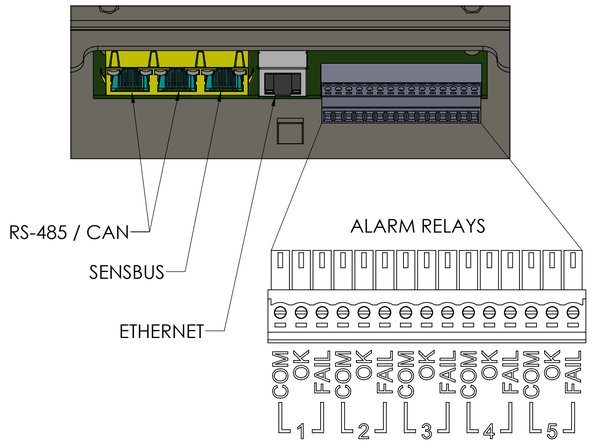
NOTES:
1. WIRE RANGES REFER TO THE PHYSICAL CAPACITY OF THE TERMINALS. IN addition TO PHYSICAL LIMITATIONS, CONDUCTORS MUST BE ELECTRICALLY ADEQUATE PER ALL APPLICABLE ELECTRICAL SAFTEY REGULATIONS, SUCH AS THE NATIONAL ELECTRICAL CODE.







COMMUNICATION CONNECTIONS
DETAIL C
SCALE 1 : 1



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TWO PLACE DECIMAL ± .02
THREE PLACE DECIMAL ± .005
DO NOT SCALE DRAWING

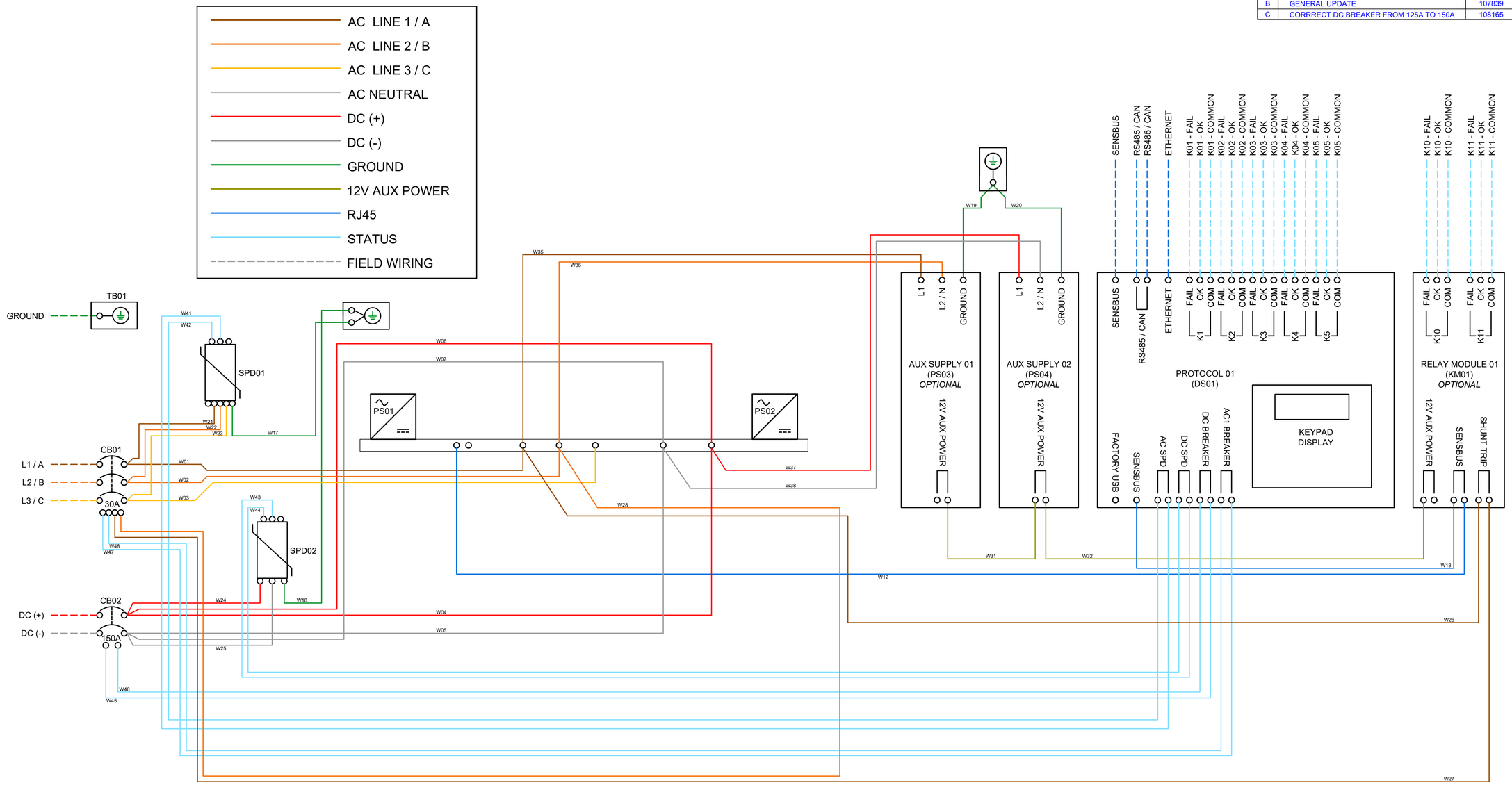
	NAME	DATE
DRAWN	ERS	12/9/2019
CHECKED		

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

DESCRIPTION: DIAGRAM,ENERGENIUS DC,WALLBOX,INSTALL

SIZE D | DOCUMENT NUMBER DIA\00646 | REV B | SHEET 2 OF 2

REVISIONS				
REV	DESCRIPTION	DCN	DATE	APPROVED
A	INITIAL RELEASE	107772	12/19/2019	ERS
B	GENERAL UPDATE	107839	4/16/2020	ERS
C	CORRRECT DC BREAKER FROM 125A TO 150A	108165	12/1/2021	ERS



NOTES:

1. THIS DRAWING REFERS TO A MAXIMUM CONFIGURED 120VDC, 100A OUTPUT MODEL
2. THE FOLLOWING COMPONENTS AND ASSOCIATED WIRING ARE OPTIONAL:
   - AUX SUPPLY 01, AUX SUPPLY 02, AND RELAY MODULE 01
   - SPD01 AND SPD02
   - BREAKER STATUS FEATURE
   - SHUNT TRIP FREATURE
3. THIS DRAWING IS FOR REFERENCE ONLY

DIMENSIONS AND TOLERANCES PER ASME Y14.5- 2009

THIRD ANGLE PROJECTION

ALL DIMS IN INCHES UNLESS OTHERWISE NOTED

TOLERANCES EXCEPT AS NOTED

INCHES
.X ± 0.02
.XX ± 0.02
.XXX ± 0.005

ANGLES ± 1°

MATERIAL
SEE BILL OF MATERIAL

FINISH

DRAWN BY ERS

DATE 11/22/2019

DO NOT SCALE THIS DRAWING

1840 INDUSTRIAL CIRCLE
LONGMONT, CO 80501
303-678-7500
WWW.SENS-USA.COM

SENS

TITLE WIRING DIAGRAM
ENERGENIUS DC,WALLBOX
120VDC 100A

SIZE D

DRAWING NUMBER WD\00706

REV. C

SCALE N.T.S.

SHEET 1 OF 1

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:	EnerGenius DC Battery Charger and Accessories
Model Numbers:	Models DK-*, DS-*, DW-* DM-*, DU-* DR-*, and RM-* where "*" = any series of digits and dashes
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 (EU) 2015/863 (RoHS) EN 63000:2018
Place and date of first issue:	Longmont, CO USA on, April 28, 2020

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

EnerGenius® IQ and EnerGenius DC Battery Chargers

What is covered?
This warranty covers any defect in material and workmanship on EnerGenius IQ and EnerGenius DC model 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, acts of persons not in our control, and acts of God.

For how long:
Five (5) years from date of shipment.

What we will do:
If your battery charger is defective within five years of date of shipment, 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 five-year 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, or if applicable the EnerGenius DC power module, 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 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.