Document: **PRODSPEC-135, Revision R**
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DCN No. **DCN 107186**
Date: **01/16/2017**
Product: **EnerGenius IQ Utility Grade Charger & Battery Check System**
PATENTED U.S. 9,270,140; 9,385,556; 9,413,186; 9,509,164
MADE IN U.S.A.

1. INTRODUCTION

1.1 General product description

Dual microprocessor controlled stationary AC-DC power supply/battery charger with built-in battery health assessment system and data logger. SCR type power train with single-phase input, full-wave rectification and filtered output. Designed for permanent installation and operation in utility substation, oil & gas, marine, engine starting and similar mission-critical applications.

1.2 Product mission

To cost-effectively maximize reliability of critical DC-driven loads by providing:

- Well-filtered DC
- Maintaining parallel-connected system batteries in peak condition
- Automatically performing battery system checks, and
- Logging all relevant data to enable early warning of problems and perform root cause analysis of system faults

1.2.1 Battery charger/power supply function

Delivers filtered DC to simultaneously power DC loads while accurately recharging and maintaining a parallel-connected system battery in peak condition. Designed to deliver high reliability under harsh conditions for a useful lifetime up to 30 years.

1.2.2 Battery health check function

Built-in check system assesses battery function by periodically reducing charger output voltage to near nominal to evaluate the battery's ability to carry the connected system load. Charger remains ready at all times to carry the system load should the battery fail during check. Check can be user programmed for frequency and duration of automatic checks, and can be initiated manually using a button on the charger's front panel.

1.2.3 Data logging function

A "black box" data logger captures and records information relevant to charger function, battery function and the system environment. Data can be analyzed using SENS Insight PC-based software to help predict system problems, or discover root cause problems in case of system breakdown.

1.3 Unit output ratings and designator

Nominal Voltage	Amps	Model number	Standard 60 Hz AC supply	Optional 60 Hz input	Standard 50/60 Hz input	Optional 50/60 Hz input
12	12	Q012-012	120/208/240 V	480 V	120/208/230 V	--
12	25	Q012-025	120/208/240 V	480 V	120/208/230 V	--
12	50	Q012-050	120/208/240 V	480 V	120/208/230 V	--
12	75	Q012-075	120/208/240 V	480 V	120/208/230 V	--
12	100	Q012-100	120/208/240 V	480 V	120/208/230 V	--
12	150	Q012-150	120/208/240 V	480 V	120/208/230 V	--
24	6	Q024-006	120/208/240 V	480 V	120/208/230 V	--
24	12	Q024-012	120/208/240 V	480 V	120/208/230 V	--
24	16	Q024-016	120/208/240 V	480 V	120/208/230 V	--
24	25	Q024-025	120/208/240 V	480 V	120/208/230 V	--
24	35	Q024-035	120/208/240 V	480 V	120/208/230 V	--
24	50	Q024-050	120/208/240 V	480 V	120/208/230 V	--
24	75	Q024-075	120/208/240 V	480 V	120/208/230 V	--
24	100	Q024-100	120/208/240 V	480 V	120/208/230 V	--
24	150	Q024-150	208/240 V	208, 240, 480 V	230 V	400 V
48	6	Q048-006	120/208/240 V	480 V	120/208/230 V	--
48	12	Q048-012	120/208/240 V	480 V	120/208/230 V	--
48	16	Q048-016	120/208/240 V	480 V	120/208/230 V	--
48	25	Q048-025	120/208/240 V	480 V	120/208/230 V	--
48	35	Q048-035	120/208/240 V	480 V	120/208/230 V	--
48	50	Q048-050	120/208/240 V	480 V	120/208/230 V	--
48	75	Q048-075	208/240 V	208, 240, 480 V	230 V	400 V
48	100	Q048-100	208/240 V	208, 240, 480 V	230 V	400 V
120	6	Q120-006	120/208/240 V	480 V	120/208/230 V	--
120	12	Q120-012	120/208/240 V	480 V	120/208/230 V	--
120	16	Q120-016	120/208/240 V	480 V	120/208/230 V	--
120	25	Q120-025	120/208/240 V	480 V	120/208/230 V	--
120	35	Q120-035	208/240 V	208, 240, 480 V	230 V	400 V
120	50	Q120-050	208/240 V	208, 240, 480 V	230 V	400 V
240	6	Q240-006	120/208/240 V	480 V	120/208/230 V	--
240	12	Q240-012	120/208/240 V	480 V	120/208/230 V	--
240	16	Q240-016	208/240 V	208, 240, 480 V	230 V	400 V
240	25	Q240-025	208/240 V	208, 240, 480 V	230 V	400 V

2 AGENCY STANDARDS AND CERTIFICATIONS

2.1 Safety agency standards
UL 1012, CSA 22.2 No. 107.2, EN 60335-1, EN 60335-2-29 and best commercial practice for utility and industrial-grade charger/power supplies.

2.1.1 Agency markings

- 50 / 60 Hz units: UL and C-UL listed marks to UL 1012 and CSA 22.2 No. 107.2. Listing to UL 1236 is special order option for 12 and 24 volt chargers.
- 50 Hz units: CE mark; DOC to EN 60335-2-29, EN 50081-2 and EN 50082-2

2.2 EMC standards: emissions
- FCC Part 15 Class B
- EN 61000-6-4 and EN 55022, Class A

2.3 EMC standards: immunity
- ANSI/IEEE C62.41 Category B
- IEC 61000-6-2 (heavy industrial), including: IEC 61000-4-2, 61000-4-3, 61000-4-4, 61000-4-5, 61000-4-6 and 61000-4-11
- ANSI C37.90a

2.4 Industry performance standards
- Charging performance: NEMA PE-5
- Electrical transient:
    - ANSI/IEEE C62.41 Category B – 6kV AC
    - ANSI C37.90a - AC, DC & signal ports; electrical fast transient (4 kV) and oscillatory waveform (2.5kV)

2.5 Seismic standards
- IBC 2006-2012. Tested, verified and labeled under authorization of a competent body. Seismically certified to an S_{ds} value of 2.50 g and in accordance with IBC 2000 – referencing ASCE 7-98 and ICC AC-156, IBC 2003 – referencing ASCE 7-02 and ICC AC-156, IBC 2006 – referencing ASCE 7-05 and ICC AC-156, IBC 2012 – referencing ASCE 7-10 and ICC AC-156. Optionally certified to OSHPD California Building Code Requirements, OSHPD Special Seismic Pre-Approval #OSP-0131-10. Seismic Performance Characteristics are S_{DS} (g) = 2.28, z/h= 1.0, l_P = 1.5.
- *Rack-mount models are not certified for IBC Seismic or OSHPD*

2.6 American Bureau of Shipping (ABS) standards
- ABS Type Approved per Rules 1-1-4 and 4-8-3, Certificate Number: 13-HS1014518-1-PDA
- Meets U.S. Coast Guard (USCG) requirements when installed with IP22 drip shield

3. AC MAINS SUPPLY

3.1 Input supply: Units rated up to 3KW DC output (120V 25A)
115-120/208/230-240 volts, 60 Hz standard
Optional:
115-120/208/230-240 VAC, 50/60 Hz
480 VAC, 60 Hz
400-415 VAC, 50/60 Hz

3.2 Input supply: Units rated over 3KW DC output
208/230-240 volts, 60 Hz standard
Optional:
208 VAC, 60 Hz
230-240 VAC, 60 Hz
480 VAC, 60 Hz
230-240 VAC, 50/60 Hz
400-415 VAC, 50/60 Hz

3.3 Input supply tolerances
60 Hz: -12%, +6%, based on standard North American line voltages of 120V, 208V, 240V, and 480V.
50/60 Hz: ±10%, based on standard European line voltages of 230V and 400V.
Rated input frequency all units: ±5%

Input	208V 60Hz	230-240V 50/60 Hz	480V 60Hz	115-120/208/ 230-240V 50/60Hz	230-240V 60 Hz	115-120/208/ 230-240V 60 Hz	400V 50/60HZ	230/240V 60 Hz
Nominal Voltage	208V	230V	480V	240V	240V	240V	400V	240V
High Line at 50 Hz	N/A	253V	N/A	253V	N/A	N/A	440V	N/A
High Line at 60 Hz	220V	254V	508V	254V	254V	254V	424V	254V
Low Line	184V	207V	424V	207V	207V	207V	360V	207V

Charger survives and operates in a predictable manner on any input voltage from zero up to the maximum rating. During brownout conditions the charger continues to operate, at reduced output capability, until AC input drops below the voltage required for safe operation, approximately 75% of nominal, at which point the power train shuts down. Power train automatically restarts after AC voltage reaches the normal range. The charger shuts down to protect itself if input voltage is excessive, and restarts automatically once input voltage returns to normal range.

3.4 Input inrush limiting
An active AC inrush limiter is provided in “Extreme” configurations, along with a high interrupt rated AC circuit breaker.

4 EFFICIENCY & POWER FACTOR

4.1 Typical efficiency
12V: 75%, 24V: 80%, 48V: 85%, 120V: 90%, 240V: 92%, at nominal AC input voltage, maximum rated load current, and equalize charge voltage setting for the usual number of lead-acid cells (rated output voltage divided by 2V/cell).

4.2 Power factor
0.75 typical at nominal line, maximum rated load current, and equalize charge voltage setting for the typical lead-acid battery configuration.

5 OUTPUT

5.1 Output voltages and adjustment ranges

Per table, with possible adjustment ranges meeting or exceeding NEMA PE-5. Float and equalize voltage adjustments are independent of each other. Equalize voltage adjustment may be set the same as float, but not lower. Output voltage is restricted by adjustment ranges and absolute maximums stated below as well as allowed number of battery cells per 5.1.2.

Adj. range VPC	Lead acid	VRLA	NEMA PE-5 NiCd	Extended range NiCd
Float	2.00-2.45	2.00-2.45	1.20-1.60	1.20-1.60
Equalize	2.00-2.45	2.00-2.45	1.20-1.60	1.20-1.55
Overvolt shutdown	2.20-2.60	2.20-2.60	1.50-1.75	1.50-1.75
Commissioning	2.000-2.585	N/A	1.50-1.65	1.20-1.60

Absolute maximum settings for NiCd float and equalize: 16.0V for 6-10 cells, 32.0V for 12-20 cells, 60.0V for 25-40 cells, 149V for 64-96 cells, and 298V for 128-192 cells. Float and equalize voltages are guaranteed at low line and rated load per NEMA PE-5 (without output blocking diodes) for all lead-acid configurations and "NEMA NiCd" configurations. Note that maximum available equalize voltage when using the maximum number of cells under "Extended range NiCd" may be lower than maximum equalize under "NEMA NiCd" category.

5.1.2 Battery compatibility

Rated Volts DC	Lead Acid	Nickel-Cadmium	
		NEMA PE-5	Extended
12	4-6	6-10	6-10
24	8-12	12-20	12-20
48	16-24	25-38	25-40
120	40-60	64-93	64-96
240	80-120	128-185	128-192

Lead-acid specifications include both flooded and valve-regulated types.
120V models will support 110V nominal, and 240V will support 220V nominal applications without modification.

5.2 Battery Commissioning

Initially charge/commission new batteries or recommission batteries from storage. Control is via the front panel keypad. Commissioning is timed and uses configurable voltage and current settings. Commissioning is not available for VRLA batteries.

5.3 Operating modes

Charger output characteristic is the constant voltage, current limited type. The charger operates either in current limit or, if not in current limit, in one of the following voltage control modes:

5.3.1 Float voltage mode: Constant voltage, single rate charging designed to maintain a charged battery, or recharge and maintain a VRLA battery.

5.3.2 Equalize voltage mode: Manually initiated higher voltage limit that is time limited. Purpose of equalize charging is to reduce charge time and reduce voltage discrepancies between cells of a battery.

5.3.3 Standard current-controlled automatic equalize: Charger automatically enters and exits equalize mode depending on current demanded of the charger. Entry into equalize mode is at 95% of the

current limit setpoint. Return to float mode is at 75% of output current limit setpoint. Automatic equalize ends either after the charger drops below the exit threshold value, or after the pre-set equalize time expires. This mode can be user enabled or disabled. Purpose of current-controlled auto equalize charging is to reduce the need for user intervention to start the equalize charge mode.

5.3.4 Dynamic current-controlled automatic equalize: Operates in the same manner as described above for Standard automatic equalize, however the charger automatically adapts to each application in real time by compensating for depth of discharge, varying load, battery age and other variables. This Dynamic Equalize™ mode safely maximizes recharge performance while cutting risk of overcharge that is associated with prolonged fixed charge cycles or excessive Equalize settings. This mode is preferable to the standard method due to overall better recharge performance.

5.3.5 Periodic automatic equalize: Charger enters equalize mode periodically for a user-adjustable duration, at a user-adjustable frequency. This mode can be user enabled or disabled. Purpose for this mode is to reduce the need for user intervention to start the equalize charge mode.

5.3.6 Battery check mode: Battery check mode causes the charger's output voltage to drop to a user-adjustable value, permitting a healthy parallel-connected battery to support the connected DC load. During the test the charger assesses whether the battery is capable of supporting the load. Should the battery fail to support the connected load the charger will continue powering the load without interruption, terminate the test and issue an alarm. Battery check mode is initiated either manually with the front panel BATT CHCK button, or automatically. Duration of battery check is user adjustable, as is frequency of the automatic check. The automatic check mode and BATT CHCK button can be user enabled or disabled.

5.4 Equalize charging time limits
User selectable in one-hour increments from 1 to 255 hours.

5.4 Output current limit and adjustment
Electronic regulation is factory set at 100%, user adjustable from 33% to 110% of the charger's rated output current

5.5 Output regulation
Combined line and load regulation, including electronics warm-up drift, is better than ±0.5% at the charger's output terminals under all combinations of rated load, input voltage and input frequency. Output regulation with the optional blocking diode is equally good except at extreme low-line conditions.

5.5.1 Dynamic response
With the standard filter and when connected to a battery having rated A-H capacity greater than 4 times rated output current of the charger, output voltage will not deviate beyond 5% of the initial steady state output voltage when subjected to load current changes between 20 to 100% and 100 to 20% of full rated load current. Recovery to within 1% of steady state voltage is within 200 milliseconds. Response time is slower when charger is fitted with the optional 30 mV output filter.

5.5.2 Turn-on overshoot
DC output overshoot at turn on, with or without battery, is limited to less than 5% of the adjusted float or equalize voltage (whichever applies) for any output load between 0 and 100% of full rated load.

5.6 Battery temperature compensation

Local temperature compensation (TC) is standard, with standard sensor located near the charger's AC and DC breakers. TC slope is user programmable, and can be enabled or disabled by the user through the charger's keypad. Slope setting range is -1.0 to -5.5mV/°C/cell for lead-acid battery and -0.75 to -4.0mV/°C/cell for nickel-cadmium battery. Factory defaults are -4.0mV/°C/cell for lead-acid battery and -2.5mV/°C/cell for nickel-cadmium battery. Remote temperature sensing is available when an optional CommsGenius communications board is included.

5.7 Output stability

The charger operates in a stable fashion when driving DC loads either with a parallel-connected battery or without battery. SENS recommends that the system battery remain connected to minimize voltage deviations when there are large load steps.

5.8 Output ripple

Specifications "with battery attached" are based on a lead-acid battery with capacity at least four times the charger's rated output current.

5.8.1 12V models

Standard filter: Less than 30mV rms with attached, and less than 480mV rms without battery.

Optional filter: Less than 30mV rms with battery attached, and less than 100mV rms without battery.

5.8.2 24V models

Standard filter: Less than 30mV rms with battery attached, and less than 480mV rms without battery.

Optional filter: Less than 30mV rms with battery attached, and less than 100mV rms without battery.

5.8.3 48V models

Standard filter: Less than 30mV rms with battery attached, and less than 480mV rms without battery.

Optional filter: Less than 30mV rms with battery attached, and less than 30mV rms without battery.

5.8.4 120V model

Standard filter: Less than 100mV rms with battery attached, and less than 2% without battery.

Optional filter: Less than 30 mV rms with battery attached, and less than 100mV rms without battery.

5.8.5 240V model

Standard filter: Less than 200mV rms with battery attached, and less than 2% without battery.

Optional filter: Less than 30 mV rms with battery attached, and less than 200mV rms without battery.

6 PROTECTION

6.1 Soft Start (walk-in)
After completion of microprocessor self-checks, the power train output increases over ~ 5 seconds to full power, or to a lesser amount as demanded by the load.

6.2 Surge suppression – AC input
Transformer secondary MOV surge suppression.

6.3 Supplemental surge suppression
A supplemental AC surge protective device to UL 1449, 3rd edition is available as an option for connection direct to the user's electrical panel supplying the charger. Installing this device at the panel offers protection to all other devices powered from the panel.

6.4 Output overload protection
Electronic current limit, UL listed DC circuit breaker

6.5 Input overcurrent protection device
2-pole breaker, 10 K AIC minimum. Medium (18-25 K AIC) and high (65 K AIC) interrupt breakers available as extra cost options as listed in the table below. 65K AIC breaker available only in chargers accommodated in the larger housing size Q2. Input breaker interrupt ratings are shown in Table 6.5.

10 KAIC breakers are suitable for solidly grounded AC sources up to 240Vac, where the phase-to-ground potential is limited to the system's phase-to-neutral voltage (IEC type "TN" and "TT"). Optional 18 KAIC, 25 KAIC, and 65 KAIC circuit breakers are suitable for higher voltages and for impedance grounded systems (IEC type "IT"), ungrounded systems, and grounded delta systems where the phase to ground potential can equal the phase-to-phase voltage

TABLE 6.5 Input Circuit Breaker Interrupt Ratings

Output		Input Circuit Breaker Available KAIC Ratings			
Vdc	Adc	115-240V 50/60Hz (P, 4) [1]	115-240V60Hz (S, T,3,Z) [2]	400-415V 50/60Hz (V) [3]	480V 60Hz (8) [3]
12	12	10, 25	10, 25	18	18
	25				
	50				
	75	10, 25, 65	10, 25, 65	18, 65	18, 65
	100				
	150	25, 65			
24	6	10, 25	10, 25	18	18
	12				
	16				
	25				
	35				
	50				
	75	25, 65	10, 25, 65	18, 65	18, 65
	100				
	150			18, 65	
48	6	10, 25	10, 25	18	18
	12				
	16				
	25				
	35	25			
	50				
	75	25, 65	10, 25, 65	18, 65	18, 65
	100				18, 65
120	6	10, 25	10, 25	18	18
	12				
	16	25			
	25				
	35	25, 65	10, 25, 65	18, 65	18, 65
	50				18, 65
240	6	10, 25	10, 25	18	18
	12	25			
	16	25, 65	10, 25, 65	18, 65	18, 65
	25				18, 65

[1] 10 KAIC breakers for input code "P" may be used only on solidly grounded systems up to 240V phase-to-ground ("TN" or "TT"). Impedance-grounded ("IT") and other systems that could exceed 240V phase to ground should use 25 KAIC or 65 KAIC breakers. Because 240V rated 10 KAIC breakers are limited to 30A and lower, they are not available for higher power models with input code "P" nor any models with input code "4".

[2] 10 KAIC breakers for input codes "S", "T" and "3" may be used only on solidly grounded systems up to 120V phase-to-ground ("TN" or "TT"). Impedance-grounded ("IT") and other systems that could exceed 120V phase to ground should use 25 KAIC or 65 KAIC breakers.

[3] 10 KAIC breakers are not available for input codes "V" and "8".

6.6 Output overcurrent protective device

Two-pole circuit DC-rated breaker 5K AIC minimum. Output breaker interrupt ratings are shown in Table 6.6.

TABLE 6.6 Output Circuit Breaker Interrupt Ratings

Output		Output Circuit Breaker Available KAIC Ratings
Vdc	Adc	
12	12	5
	25	
	50	
	75	
	100	
	150	10
24	6	5
	12	
	16	
	25	
	35	
	50	
	75	
	100	
	150	10
48	6	5
	12	
	16	
	25	
	35	
	50	
	75	
	100	
120	6	10
	12	
	16	
	25	
	35	
	50	
240	6	10
	12	
	16	
	25	

6.7 Selective overvoltage shutdown (OVSD)

In the unlikely event of a control system failure that causes the charger's voltage to become ungoverned, the OVSD shuts down and locks out the SCR drive until manually reset. An anti-false shutdown system prevents spurious operation. Selective operation means that a charger shuts down only if it is causing the overvoltage problem. If another DC source is causing the overvoltage problem the charger not causing the problem does not shut down. A hardware interlock eliminates any possibility of accidental software-initiated change to the over voltage shutdown point. To accommodate the wide range of battery configurations, the over voltage shutdown value is user-configurable.

6.7.1 Overvoltage shutdown actuator redundancy

Two series-connected switches driven by separate microprocessors running different software must both be closed in order for the charger to operate. This ensures that either microprocessor can independently activate the overvoltage shutdown system. It also prevents a single failed actuator switch from disabling the overvoltage shutdown system.

6.8 Thermal protection

Should heat sink temperature rise to the maximum safe value (due either to excessive ambient temperature or blocked ventilation) the thermal protection system reduces output current limit to prevent further increase of heat sink temperature.

6.9 Reverse polarity protection

All chargers include an audible alarm that sounds if a battery is connected backwards when the recommended startup sequence is followed. The “Eliminator Plus” and “Extreme” charger configurations also include a reverse battery protection diode to prevent charger damage in case the DC breaker is closed into a reverse polarity battery.

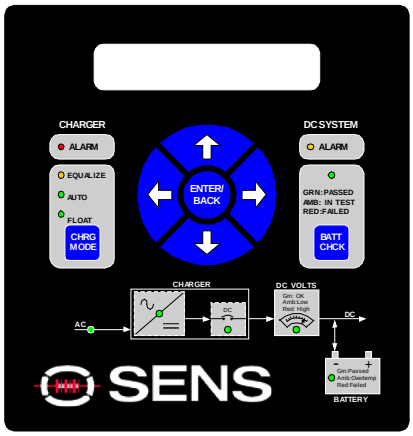
6.10 Optional blocking and reverse polarity diode assembly

The standard charger housing accommodates the blocking and reverse polarity diode assembly used in “Eliminator Plus” and “Extreme” models.

7 USER INTERFACE

7.1 Local interface summary:

The user interface includes a 2 x 20 character backlit LCD displaying plain language text, a multicolor LED mimic panel to show system status at a glance, and a user control panel with two dedicated function buttons and five multi function buttons. Abbreviated instructions for use of the keypad are silkscreened onto each charger front panel.



7.2 Digital meter

Charger is equipped with a 1% accuracy meter for indicating DC output voltage and 1% accuracy meter for indicating DC output current. Meter information is also available via Modbus communications when an optional CommsGenius communications board is included.

7.3 Settings and adjustments

Three levels of security are selectable via the User Interface Mode setting found in the menu, but can only be modified when a jumper selector behind the front panel is set to UNLOCK:

- Normal (Non-expert) mode allows minor, routine adjustments from the front panel

- Expert mode enables nearly any adjustment from the front panel
- Monitor Only (Lockout) mode prevents any front panel adjustment except silencing audible alarm

Remote adjustment is also available via Modbus communications when an optional CommsGenius communications board is included. When a charger is connected to a CommsGenius as a second charger for load-sharing, this second charger will automatically switch to the Remote Control mode. Remote Control mode disables the front panel, allowing adjustment only via the CommsGenius. This ensures that the settings on both chargers can be synchronized by the CommsGenius. If the CommsGenius becomes disabled or loses communication with the second charger, the charger will automatically revert back to the security mode selected in the settings menu.

7.3.1 Normal mode setting options

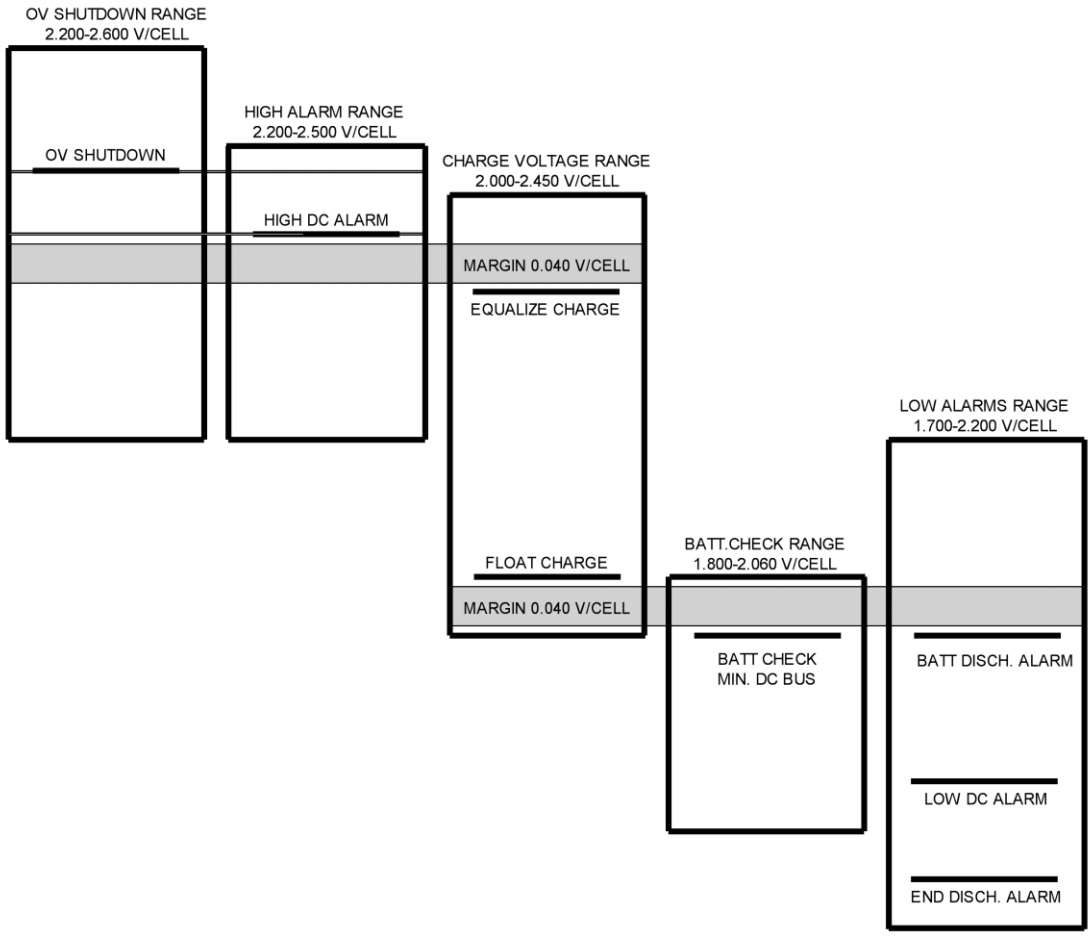
- Adjust charging mode: Float, manual equalize, auto boost/auto equalize
- Adjust manual equalize time
- Run battery test
- Silence audible alarms except for reverse-battery audible alarm

7.3.2 Expert mode setting options, in addition to normal mode

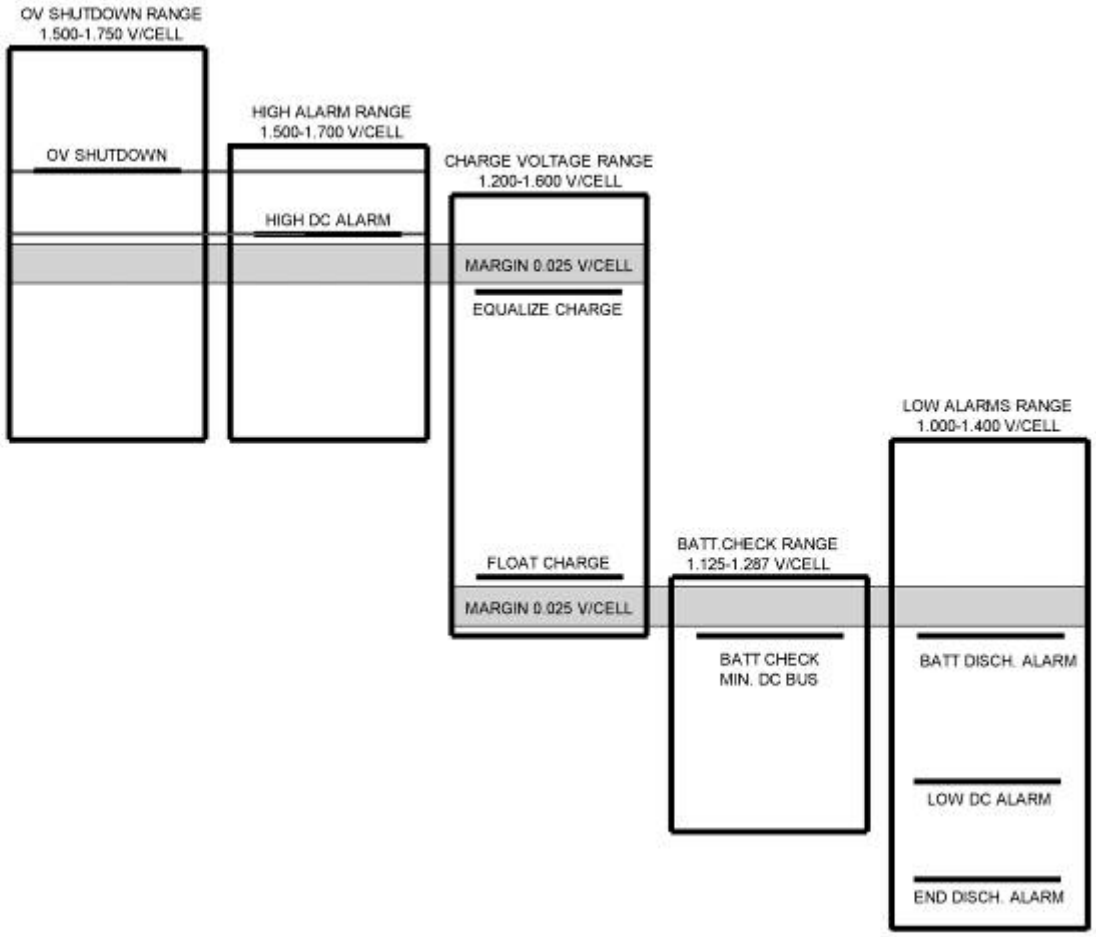
- Adjust output voltages and current limit
- Change battery type
- Change number of battery cells
- Initiate commissioning charge
- Turn on/off temperature compensation system, and adjust compensation slope as specified in Paragraph 5.6.
- Activate or deactivate alarms and other indications
- Adjust alarm threshold values, including ground fault resistance
- Adjust normal equalize time
- Activate/adjust battery test mode duration, voltage and interval of automatic test
- Set alarm relay delay duration
- Set “equalize delay after restart”
- Remove / insert black box data recorder
- Activate/silence audible alarm feature

Control software prevents conflicts between operating voltage setpoints, temperature compensation system and alarm setpoints to prevent false alarms, as shown below.

Charger Adjustment Limits for Flooded and VRLA Batteries:



Charger Adjustment Limits for Nickel-Cadmium Batteries:



7.4 Audible alarm

- The audible alarm operates if the battery is connected backwards with AC applied to the charger, until the backwards battery condition is remedied or AC is turned off. Silencing the audible alarm feature does not silence the backwards battery alarm.
- The alarm sounds at 1 Hz intervals when the battery check fails, until the ENTER/BACK key is pressed or after a 25 second timeout occurs.
- The alarm beeps once at low volume at the onset of any other alarm condition.
- The audible alarm feature is activated/silenced via the front panel.

8 ALARMS AND INDICATIONS

8.1 Alarm indication

Any alarm indication causes plain language text to appear in the LCD, and changes the appropriate LED on the mimic panel. Normal LED indication is green. Alarm LEDs are red. Warning LEDs are amber. Multiple alarms result in the relevant LEDs changing color and multiple alarm message screens on the LCD. Alarm status is also available via Modbus communications when an optional CommsGenius communications board is included.

One summary alarm Form C relay is standard. Packages of either five ("Standard") or seven ("Extended") individual alarm relays are optional, and fit in the standard charger housing. Either of these multiple relay packages may be retrofitted in the field.

8.2 Standard alarm conditions

Alarm conditions meet the requirements defined in NEMA PE-5 and NFPA 110, and include enhanced function. All alarm messages, LEDs and relays are non-latching, with the exception of Battery Check Fail (see Section 8.2.8). All alarm events are recorded in the on-board data logger (see Section 10).

8.2.1 AC Failure alarm

When AC supply voltage is below ~ 80% of nominal the summary alarm and optional AC failure alarm relay activate immediately, without delay.

8.2.2 AC Input Out of Specification indication

When AC input is between 80-84% of nominal or above ~110% of nominal the mimic panel AC LED changes to amber color to indicate that AC voltage is out of normal specification. No failure relay activates.

8.2.3 Charger Failure alarm

When the charger is not delivering the expected output (either failing to deliver current when demanded, or delivering current when not demanded) the summary alarm relay and optional "charger fail" alarm relays activate after the time delay.

8.2.4 Ground Fault alarm

- Ground fault indicates excessive leakage current from the charger output to earth ground. The ground fault detection circuit works by measuring the voltage imbalance in a resistance bridge. If the DC output terminals are floating with respect to chassis ground, the bridge is balanced, the voltage difference is zero between the two sides of the bridge, and the ground fault alarm is inactive. If the bridge is unbalanced, the magnitude of the imbalance indicates the approximate resistance of the unwanted electrical path to ground.
- Ground fault alarm sensitivity is adjustable via the front panel control to three user-selectable sensitivity settings (High, Medium, Low), and "OFF" to disable.

- Ground fault alarm thresholds are based on insulation resistances of 3K to 30K (0.41mA to 0.06mA) for 12 & 24VDC units, 10K to 100K (0.62mA to 0.07mA) for 48VDC & 120VDC units and 20K to 200K (0.63mA to 0.17mA) for 240VDC units. Worst-case initial tolerance of resistance values is +/- 30%.

If the ground fault alarm is enabled, a positive or negative ground fault activates the summary alarm relay and optional ground fault relay after the time delay.

8.2.5 Low DC Voltage alarm

The low DC voltage alarm is adjustable from 1.70-2.20 V/cell for lead acid and VRLA batteries, or 1.00-1.40 V/cell for NiCd (per NEMA PE-5). This setting is inhibited from being adjusted below the End of Discharge alarm setting.

When the low DC voltage alarm threshold is reached, the summary relay and optional low DC voltage relays activate after the time delay. If the alarm condition goes away during the time delay, the relays do not activate.

8.2.6 High DC Voltage alarm

The high DC voltage alarm is adjustable from 2.20-2.50 V/cell for lead acid and VRLA batteries, or 1.50-1.70 V/cell for NiCd (per NEMA PE-5). This setting is inhibited from being adjusted above the Overvoltage Shutdown setpoint.

When the high DC voltage alarm threshold is reached, the summary relay and optional high DC voltage relays activate after the time delay. If the alarm condition goes away during the time delay, the relays do not activate.

8.2.7 Selective Overvoltage Shutdown

Function is described in Paragraph 6.7. The Overvoltage Shutdown setting is adjustable from 2.20-2.60 V/cell for lead acid and VRLA batteries, 1.50-1.75 V/cell for NiCd (per NEMA PE-5). This setting is inhibited from being adjusted below the High DC Voltage alarm setting.

An overvoltage shutdown immediately shuts down and locks off the charger power train and illuminates the relevant LCD and LED front panel indicators. The summary alarm relay and optional high DC voltage alarm relays are latched in the “failed” position. The charger must be manually powered-off and reset to clear the alarm relays and restart the charger.

8.2.8 Battery Check Failure alarm

Battery check operation is described in Paragraph 5.2.5. A battery check failure activates the summary alarm relay and the optional battery check alarm relay on the Extended Alarm Relay Card after the time delay. The audible alarm will sound for 25 seconds, but pressing the front panel ENTER/BACK key before the 25 second timeout will shut off the audible alarm. Pressing the ENTER/BACK key again (or after the 25 second timeout) will reset the alarm relays. In either case, the battery status LED remains latched red until either a manual reset using the keypad or a successful recheck.

8.2.9 Battery End of Discharge alarm

The battery end of discharge alarm is adjustable from 1.70-2.20 V/cell for lead acid and VRLA batteries, 1.00-1.40 V/cell for NiCd. This setting is inhibited from being adjusted higher than the Low DC voltage alarm setting.

When the end of discharge voltage alarm threshold is reached, the summary relay and the optional end of discharge relay on the Extended Alarm Relay Card activate after the time delay. If the alarm condition goes away during the time delay, the relays do not activate.

8.2.10 Battery Discharging alarm

The battery discharging alarm is adjustable from 1.70-2.20 V/cell for lead acid and VRLA batteries, 1.00-1.40 V/cell for NiCd. This setting is inhibited from being adjusted lower than the Low DC voltage alarm setting.

The battery discharging alarm does not activate the summary relay.

8.3 Optional pilot relay

The Extended Alarm Relay Card includes one pilot relay that automatically closes when the charger enters EQUALIZE mode and opens when the charger reverts to FLOAT mode.

8.4 Alarm relay time delay

Relays activate between five and fifty seconds after alarm occurrence, except for AC line failure, which has no delay. The first alarm begins the delay timer. Relays for subsequent alarm conditions occurring within the original delay period activate at the end of the delay period started by the first alarm.

8.5 Alarm relay and display test

Test alarm and display function by forcing alarm and display conditions via the front panel.

9 OPTIONAL DATA COMMUNICATIONS SYSTEM

The IQ battery charger may be equipped with a CommsGenius accessory module. The two primary functions are data communications and synchronizing of the operating modes of two digitally controlled IQ chargers including forced load sharing. Including the CommsGenius in an IQ battery charger provides the ability to monitor and/or configure the battery charger remotely using either serial or Ethernet Modbus connections, or locally via the USB maintenance port. Each communication method allows the user to adjust charger operating modes, view system settings, and adjust system settings.

10 BLACK BOX DATA LOGGER

10.1 Summary

A record of all alarms, analog values and user adjustments is regularly written to the optional black box data recorder, enabling download and analysis of complete charger, DC system and environmental data for purposes of troubleshooting and root cause analysis. SENS *Insight*™ is a graphical, easy-to-use PC-based data analysis software tool available on request from SENS.

11 ENVIRONMENTAL

11.1 Ambient operating range

- Operates from –40C to +50C; Full specification performance, is –25C to +50C (except +40C in 100 and 150A units). At higher temperatures, thermal protection automatically reduces the charger's current limit. Humidity: 5% to 95%, non-condensing.
- Altitude: 0-6,500 ft (2,000 meters). Above this altitude, output is derated 0.012% per meter at rated ambient temperature.

11.2 Cooling
Natural convection.

11.3 Environmental ratings
- Weather protected environments (pollution degree 3) for 12V - 120V models.
- Normal indoor environment (pollution degree 2) for 240V models.
- Not for use in hazardous (classified) locations subject to NFPA 70 Article 500 or local equivalents.

12 MECHANICAL

12.1 Enclosure material and finish
Heavy gauge cold-rolled steel with electrostatically applied, oven hardened, semi-gloss gray polyester finish. Non-cosmetic internal parts are heavy zinc plated.

12.2 Mounting configuration and dimensions
Housing size Q1: Wall mount: 19.4" (493mm) W x 13.0" (330mm) D x 17.6" (448mm) H
Rack mount: 19.4" (493mm) W x 13.0" (330mm) D x 17.6" (448mm) H
Housing size Q2: Wall mount: 23.6" (600mm) W x 16.1" (409mm) D x 27.8" (707mm) H
Rack mount: 23.6" (600mm) W x 16.1" (409mm) D x 27.8" (707mm) H
Free standing: 23.6" (600mm) W x 16.1" (409mm) D x 30.8" (782mm) H

12.3 Protection rating - standard
NEMA-1
IP20

12.4 Protection rating options
NEMA-2 and IP21 or IP22 with optional drip shields

12.5 Seismic ratings
UBC seismic zone 4 tested
IBC certified for wall mount chargers only when properly installed to an S_{ds} value of 2.50g for grade, below grade and roof-level installations in essential facilities requiring post-event functionality.

12.6 Accommodation of optional accessories
Optional equipment (higher interrupt circuit breakers, blocking/reverse polarity diodes assembly, and optional alarm relay contacts) is accommodated inside the charger housing. A supplemental surge protective device is available external to the charger, see Section 6.3.

12.7 Field wiring
Intended for permanent installation using hard-wired electrical conduit

13 DUAL MICROPROCESSOR CONTROL SYSTEM
The dual processor control system reduces the power system consequence of a failed microprocessor or other control problem. One processor provides basic charger control functions while a separate processor manages the user interface, most alarms, the history log, and external communications. To provide redundancy in alarm indications, the control processor drives the summary alarm relay, while the monitor processor drives the optional discrete alarm relays. Each processor is capable of independently operating the overvoltage shutdown system.

14 STANDARD NAMEPLATE DATA

14.1 The standard permanent adhesive nameplate contains the following data:

- SENS name, address and web site address
- Product description
- Model number
- Serial number
- Date of manufacture
- Input voltage rating
- Input frequency rating
- Input current rating
- Nominal output voltage rating
- Output current rating
- Applicable safety and EMC agency marks
- Applicable IBC seismic certification

15 DRAWINGS AND DOCUMENTS

15.1 A final test report and user manual containing information shown is supplied with each charger. Drawings and documents reflect the manufacturer's standard cataloged product.

15.2 Documents and drawings are created to best commercial practice, and are supplied on standard 11" x 17" paper, or on 8.5" x 11" paper.

15.3 User manual documentation

- Safety instructions
- Product description
- Mechanical installation instructions, with drawings
- AC input ratings and terminal configurations
- Electrical connections
- Operation instructions with explanation of operating modes and controls
- Adjustment instructions and explanations, including standard factory settings
- Troubleshooting table
- Detailed dimensional drawing
- Connections drawing, with minimum and maximum wire sizes shown

15.4 Extra cost documentation items

- Customer-specific information (e.g. P.O. number, company name, job number) can be included at extra cost. Addition of this information to standard documents adds lead-time and cost at prevailing shop rate to the charger.
- Customer drawing "approval", if required, adds lead-time, and cost at prevailing shop rate depending on the number of changes requested.
- Extra copies of documentation beyond one copy per charger are supplied at the list price prevailing at time of order.

16 QUALITY ASSURANCE, INSPECTION AND TEST

16.1 Quality assurance

The following quality assurance steps are included in the manufacturer's ISO 9000 registered standard procedure:

- Source control documents are maintained for all purchased parts
- A master list of all approved purchased components and vendors is maintained

- All assembly personnel are trained in the manufacture of the product
- Bills of material, drawings, procedures, photographs, visual method sheets and other documents affecting the manufacture and test of the product are controlled so that engineering changes are incorporated at the appropriate time.
- Inspection is performed at every step of the assembly process. (Quality is "built-in" rather than "inspected in")
- Hardware and software function is validated at final test

16.2 Standard factory assembly and test procedure

The standard assembly process prescribes the tests and calibration that are performed on the product. These activities include, but are not limited to the following:

- Insulation breakdown test using a "hipot" device to the standards prescribed in UL standards
- Performance testing to insure that the product meets its critical performance specifications
- Calibration to the correct output, alarm and shutdown voltages
- Correct function of alarms

An extra charge may be applied if supplemental test activities (e.g. extended burn-in) are required.

16.3 Witness of standard factory procedures

Customers are welcome to witness assembly and test procedures. If requested, SENS will make a reasonable effort to inform the customer of the date on which his product will be built. Special inspections requiring deviation from normal factory schedule will be billed to the customer at the prevailing shop rate, or quoted ahead of time.

17 WARRANTY

17.1 SENS warrants its products to be free of defects in material or workmanship for a period specified in standard contract documents or terms and conditions. Contact SENS for a complete statement of warranty.

18 CHANGES TO SPECIFICATION

18.1 In order to meet evolving customer requirements, changes to the product and to this specification may be made without notice from time to time.

END OF SPECIFICATION

