



QuiQ

SERIES

Delta-Q QuiQ Series Installation and Design Guide

QuiQ 1000 - 1000W Industrial Battery Charger

QuiQ 1500 - 1500W Industrial Battery Charger

QuiQ-dci - 1000 W Industrial Battery Charger / DC-DC Converter



Delta-Q Technologies Corp.
3755 Willingdon Avenue
Burnaby, BC V5G 3H3
CANADA

Web: www.delta-q.com
Phone: +1.604.327.8244
E-mail: info@delta-q.com

Delta-Q QuiQ Series Design Guide: Table of Contents

1.0 Safety Notes 1

2.0 Regulatory Notes 3

3.0 QuiQ Series Charger Introduction 4

4.0 Mechanical Installation 11

5.0 Electrical Installation 14

6.0 Charger Operation 25

7.0 Troubleshooting 32

8.0 General Specifications 33

9.0 Glossary 35

10.0 Appendix 36

Intended Audience

This document is intended for engineers and technologists of Original Equipment Manufacturers (OEM) to aid them in incorporating the Delta-Q QuiQ Series Chargers into their products.

1.0 Safety Notes

This document is intended for use by personnel with knowledge and training in electrical design and safety. If you do not have this type of expertise, do not attempt the installation of the charger.

Read and comprehend this document fully before handling or working with the QuiQ Charger. Important safety, operation, and installation instructions are included.



DANGER: This product produces hazardous output voltages under normal operation. Exercise extreme care when working with the equipment and the batteries.



WARNING: DO NOT open or disassemble the charger. No user-serviceable parts are contained inside the unit. Do not operate charger if the AC supply cord is damaged or if the charger has received a sharp blow, been dropped, or otherwise damaged in any way – refer all repair work to qualified personnel. Not for use by children.

Electrical Safety Information



DANGER: Risk of electric shock. Connect charger power cord to an outlet that has been properly installed and grounded in accordance with all local codes and ordinances. A grounded outlet is required to reduce risk of electric shock – do not use ground adapters or modified plugs. Do not touch the uninsulated portion of an output connector or uninsulated battery terminals. Disconnect the AC supply before making or breaking the connections to the battery.



WARNING: On versions of the charger with connectors, using mating connectors of different manufacturers may void regulatory certifications and result in a hazardous situation. Always use mating connectors approved by the connector manufacturer.

Battery Safety Information



WARNING: Use charger only on battery systems with an algorithm selected that is appropriate to the specific battery type. Other usage may cause personal injury and damage. Lead acid batteries may generate explosive hydrogen gas during normal operation. Keep sparks, flames, and smoking materials away from batteries. Provide adequate ventilation during charging. Never charge a frozen battery. Study all battery manufacturers' specific precautions such as recommended rates of charge and removing or not removing cell caps while charging. Use care to prevent personal objects or metal tools from contacting terminals of the batteries. Severe burns can result.

Installation Safety Information



DANGER: Charger outputs and battery voltages pose an energy and/or shock hazard under normal use. These units must be installed in the host equipment in such a manner that the output cable and battery connections are only accessible with the use of a tool by qualified personnel.

Precautions

Hot Surfaces



During charging, the surface of the charger may become hot to the touch, especially in higher ambient temperatures. This is normal. Avoid touching the surface of the charger.

Precautions (continued)

Extension Cord Ratings

At 110VAC, use these minimum extension cord wire sizes for the following lengths:

- ✚ < 25ft (7.5m): 16AWG (1.5mm²)
- ✚ < 50ft (15m): 14AWG (2.5mm²)
- ✚ < 100ft (30m): 10AWG (6.0mm²)

Grounding

The AC input ground conductor must be connected to the product ground to ensure that any short circuit from AC line to ground in the product will open the overcurrent protection, preventing the product chassis from becoming live.

For UL2202 1st Edition compliance, a green bonding wire must be attached from the stud located on the charger to the vehicle frame. The installer should ensure that they follow the wiring rules in the standard(s) that are applicable to their installation.

15A or 20A Circuits

The charger may draw up to a continuous 12A at 105VAC during normal operation. Supplying additional appliances from the same branch circuit may result in opening of the circuit breaker. Reduce the amount of load on the circuit, or have a larger capacity branch circuit installed.

Sparking

When connecting the QuiQ-dci to the battery pack for the first time, sparking may occur as the input of the QuiQ-dci charges. To minimize this sparking, ensure there are no loads on the QuiQ-dci's 12V output when connecting the input to the battery pack.

Electromagnetic Interference

Certain conditions of electromagnetic interference may cause the LEDs on the charger panel to flicker. This is normal.

2.0 Regulatory Notes

North America

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Regulations. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

Listed: Only Delta-Q 913- and 916- series QuiQ chargers are “Listed” with UL. This is a regulatory approval which applies when the charger is used as a stand-alone product. A QuiQ charger that can be separated and used independent of the rest of the machine should be a Listed part number. A “Listed” charger may replace a “Recognized” charger in a system, but any modifications may invalidate the regulatory approval. Consult Delta-Q before modifying chargers.

Recognized: 912-, 914-, and 922- series QuiQ chargers carry “Recognized” approvals from UL. This qualifies them as components of a system. It is expected that the entire system will be inspected by a regulatory body when they are installed. A “Recognized” charger may not replace a “Listed” charger and must not be separated from the system.

All QuiQ chargers are fully compliant with Canada and US regulatory requirements, as shown by the “C” and “US” to the left and right of the “UL” or “UR” marks on the charger label.

All QuiQ chargers are also fully compliant with California Energy Commission battery charge efficiency standards.

Europe, Asia, Middle East, Africa

All QuiQ chargers are fully compliant with relevant EN Safety, Emissions, and Immunity standards. See Specifications for specific standards met.

Every effort has been made to ensure the QuiQ series of chargers is fully compliant with most world-wide regulations. If a particular region does not accept the above regulatory approvals for this product, contact Delta-Q Technologies for further information and assistance.

Copies of all approvals for the QuiQ charger are available upon request.



3.0 QuiQ Series Charger Introduction



Welcome to Delta-Q's QuiQ family of chargers and charger-converters! These compact, state-of-the-art products maintain your system's high performance level while minimizing total cost of ownership.

This document is intended to provide the system designer, integrator, and installer with valuable technical information for effective design and implementation of these products into electric drive systems. Proper care and maintenance of the QuiQ charger according to this document will ensure many years of reliable service.

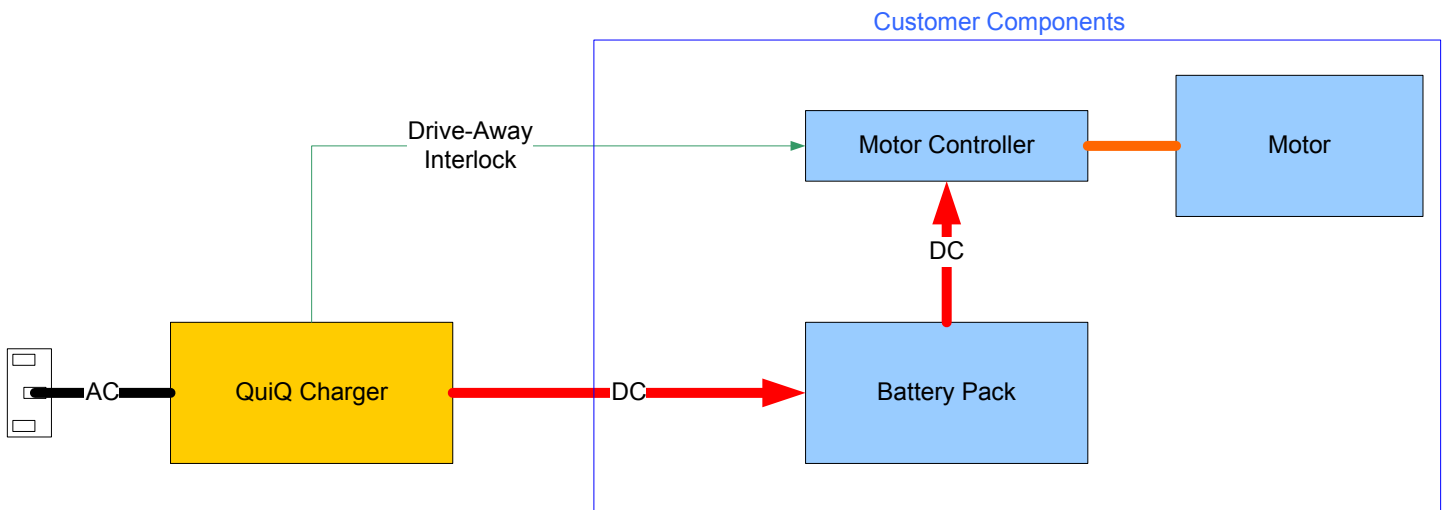
3.1 Overview

The QuiQ Charger is a versatile, intelligent, high-frequency battery charger. It performs equally well when integrated into a vehicle or used as a shelf or portable charger.

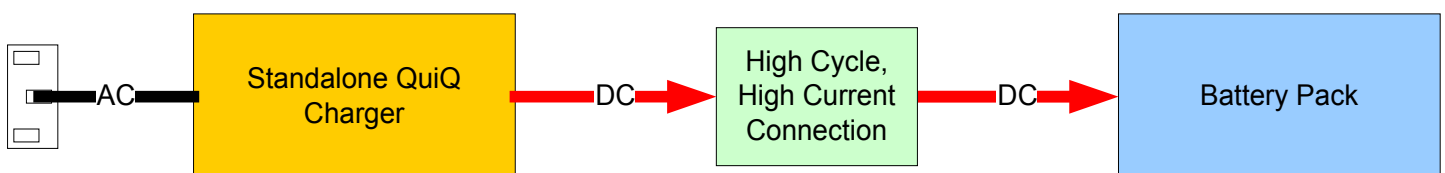
The diagrams below show a typical installation of a QuiQ charger onboard an electric drive system . A signal is provided to disable the motor controller when the charger is connected to AC power. A remote LED signal and remote temperature sensor is also available (not illustrated).

In an off-board configuration the charger can be supplied with a high cycle, high current connector for use external to the vehicle. Software options exist to allow for a spark-less connection and disconnection with the appropriate connector.

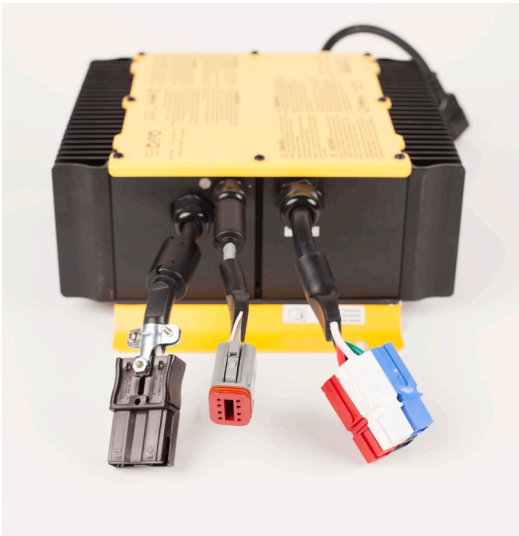
QuiQ Typical Onboard System Diagram



QuiQ Typical Offboard System Diagram



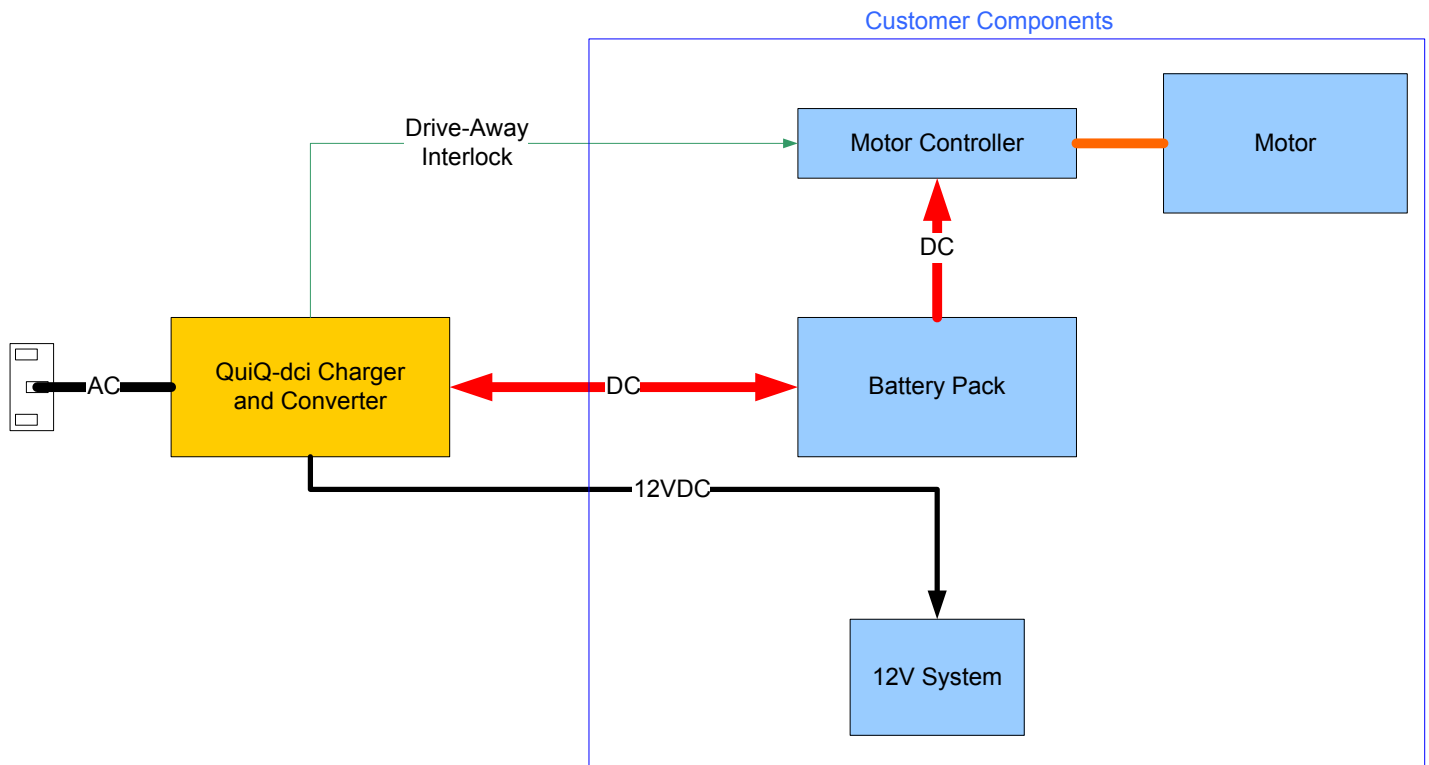
3.2 QuiQ-dci Charger/Converter



When ordered with the integrated, independent DC-DC converter the QuiQ charger becomes known as the QuiQ-dci and provides up to 400W of 12V power for accessory systems. This is designed to be mounted onboard and integrated into a vehicle system.

The DC-DC converter is a high performance unit with isolated outputs and a burst mode capable of delivering up to 60A for 2 seconds. Among other benefits, the isolated outputs prevent higher battery voltages from appearing in the low voltage system should any faults occur, protecting 12V devices from severe over-voltage. The burst mode maintains the converter's voltage output when inductive loads, such as light bulbs, are activated. These features were included specifically to make the QuiQ-dci ideal for electric drive applications.

QuiQ-dci Typical Onboard System Diagram

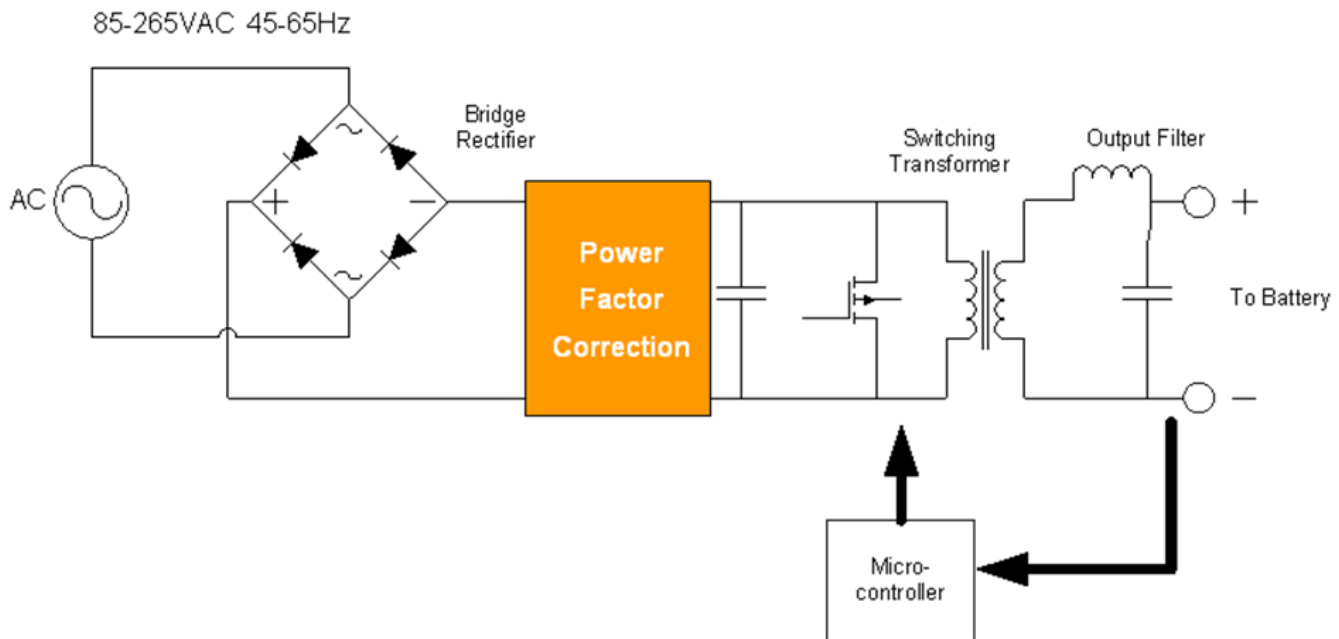


The diagram above illustrates a typical vehicle system which includes the QuiQ-dci.

3.3 Identifying QuiQ Models

Model	Model No.	Regulatory Certification
QuiQ 1000	912- 913-	UR, UL
QuiQ 1500	914- 916-	UR, UL
QuiQ-dci	922-	UR

3.4 AC Input/ DC Output



As an advanced power conversion device, the QuiQ charger is capable of accepting a wide range of AC power on its input while still maintaining accurate, ripple-free DC power on its output.

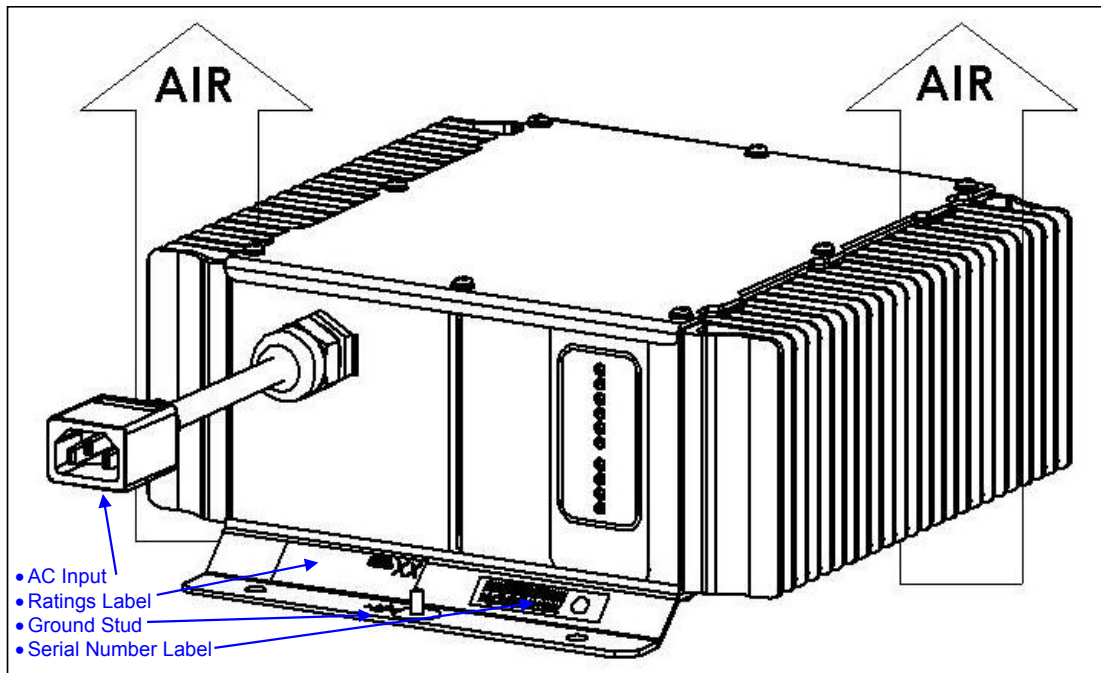
The diagram above shows the general schematic of the QuiQ charger.

The Power Factor Correction stage creates a near-unity power factor and is chiefly responsible for the charger's ability to accept a wide range of input voltages.

The high-frequency switching transformer is light and compact – one key advantage of high frequency power technology. The microcontroller is the other key advantage – it allows for precise monitoring and control of the charge cycle to supply a perfect amount of charge as well as making other unique features possible.

For more details, please see the Electrical Installation section of this manual.

3.5 Front Panel



3.5.1 AC Input



DANGER: Risk of electric shock. Always connect the charger to a grounded outlet.

The AC input is an IEC-60320/C14 connector with 15cm (6") of 1.5mm² (16AWG) SJT cord which has CSA, UL, and European safety approvals. It is rated for 13A @ 125VAC, 10A @ 250VAC.

Copies of all approvals for charger components are available upon request.

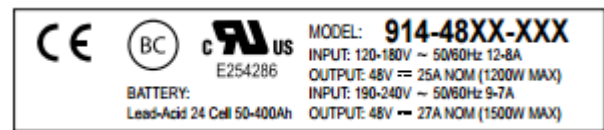
Notes:

- ✦ This connector is tested to EN60529, and meets an IP rating of IP20. It is suitable for indoor use only and must be kept clean and dry at all times. Use of heat shrink over the mated connection is strongly suggested for general use. Delta-Q now offers an AC cord that will seal this connection to IP66.
- ✦ Minimum wire size for the connecting cord is 16AWG (1.5mm²)
- ✦ At 110VAC, use these extension cord wire sizes for the following lengths:
 - < 25ft (7.5m): 16AWG (1.5mm²)
 - < 50ft (15m): 14AWG (2.5mm²)
 - < 100ft (30m): 10AWG (6.0mm²)
- ✦ Minimum bend radius of this cord is 60mm. See Mechanical Installation for more detail.

3.5.2 Ground Stud (w/ nut) AC Input

Use this stud to attach the charger's chassis to a vehicle chassis. This is required for UL2202 1st Edition compliance. See Mechanical Installation for more detail.

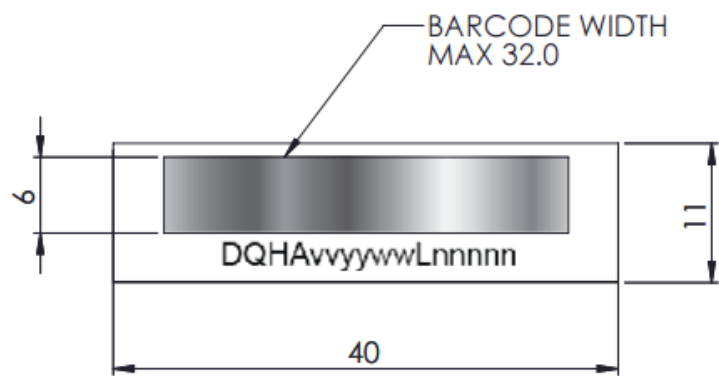
3.5.3 Rating Label



The ratings label provides important information needed to install the product. This is required by the regulatory bodies listed. See General Specifications for details of regulatory standards the chargers meet.

3.5.4 Serial Number Label

Some information is contained in the Delta-Q Serial Number label:



First 4 letters:

- DQCP – Original Charger (2004)
- DQCT – Field Reprogrammable Software (2006)
- DQCR – RoHS Compliance (2009)
- DQCM – Updated Microcontroller (2011)
- DQDB – Robustness Updates (2013)
- DQHA - QuiQ 1500 (2015)

First 2 digits:

Charger voltage: 24, 36, 48, 72, 84 or 96.

Next 4 digits:

Year and Week of manufacture: Eg. 1431 - Year 2014, Week 31.

Note that this does not represent the beginning of the warranty period.

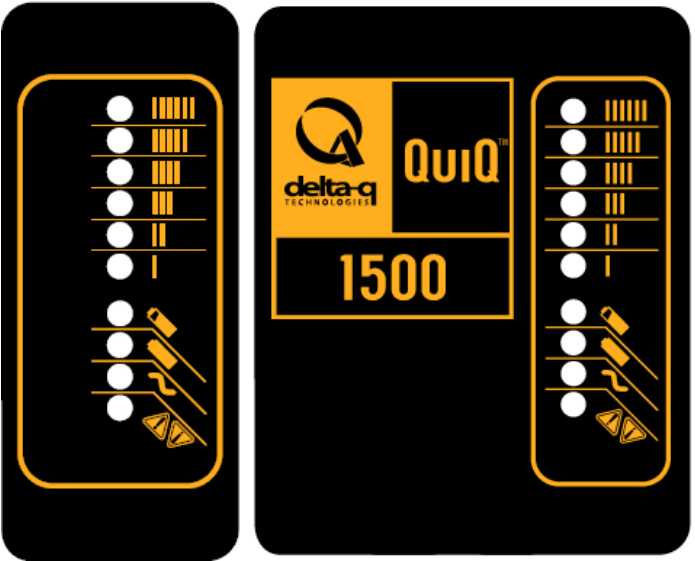
Remaining 6 digits:

Serial number sequence for week of manufacture.

W

3.5.5 10-LED Display (standard)

The QuiQ Charger ships with a 10-LED display on the AC input panel.



Ammeter (Amber)

Solid: Displays approximate scale of current output during charging.

Approximate current indicated by each Ammeter LED:

QuiQ 1000	24V	36V	48V	72V	84V	96V
	30	24	18	12	10	9
	25	20	15	10	8.3	7.5
	20	16	12	8	6.6	6
	15	12	9	6	5	4.5
I	10	8	6	4	3.4	3
	5	4	3	2	1.7	1.5

QuiQ 1500	48V	72V
	29	19
	24	16
	19	13
	15	10
I	10	6
	5	3

A flashing "I" indicates the output is well below the "I" level. These are approximate levels. Contact Delta-Q Technologies if a detailed map of ammeter indications is required.

Flashing: Current output reduced to this level due to high internal charger temperature. See charger derating chart in Charger Operation section.

Solid (Startup): If an Algorithm from #1 through #6 is selected, it will be indicated by a solid light on the matching LED for 11 seconds when no battery is connected. In addition, the 80% LED below will flash.

80% Charge (Amber)



Solid: Bulk charge phase complete, 80% charged. Charger now in absorption phase.

Flashing: With no battery connected, indicates the charge algorithm # selected by the number of flashes. Refer to Programming Instructions section for more details.

100% Charge (Green)



Solid: Charging complete. If supported by the charge algorithm, the charger will enter Maintenance Mode. See Delta-Q publication 710-0088 Algorithm Descriptions for details on individual algorithms.

Flashing: Absorption phase complete. Charger in Finish phase

AC On (Amber)



Solid: AC Voltage normal

Flashing: Low AC Voltage, check voltage and extension cord length (max 100', 10 AWG).

Fault (Red)



Flashing: Charger or battery fault. Note the number of blinks between pauses, reset charger power, and refer to Troubleshooting section. The blinking rate is 0.2s on, 0.2s off, and 1.2s between repeats.

3.4.6 Internal or External Single-LED Display (optional)

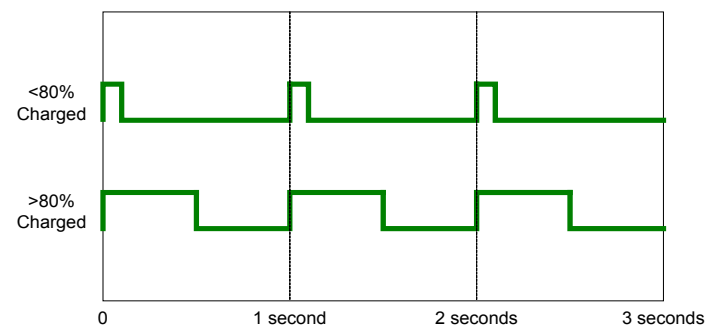
Optionally, the QuiQ charger can be supplied with a single LED on the panel, or with a single LED on a remote cable for mounting into the vehicle panel.



Green

Solid: Charging complete. If supported by the charge algorithm, the charger will enter Maintenance Mode. See Delta-Q publication 710-0088 Algorithm Descriptions for details on individual algorithms.

Flashing: The figure below illustrates the two types of green flashing that can be observed:



Short: <80% Charged. 0.1s on, 0.9s off.

Long: >80% Charged. 0.5s on, 0.5s off

When no battery is connected, the algorithm number selected is indicated by the number of flashes. Refer to Programming Instructions for more details.

Amber

Flashing: Reduced 80% Power Mode: Low AC Voltage or high internal charger temperature.

- QuiQ 1000: AC < 105 VAC
- QuiQ 1500: AC < 180 VAC

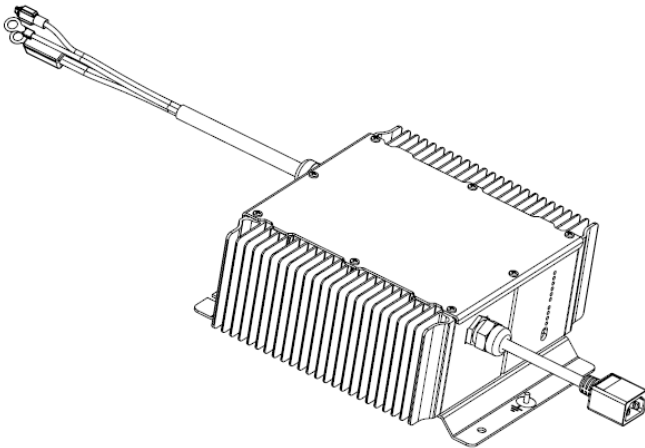
Red

Flashing: Charger or battery fault. Note the number of blinks between pauses, reset charger power and refer to Troubleshooting section.

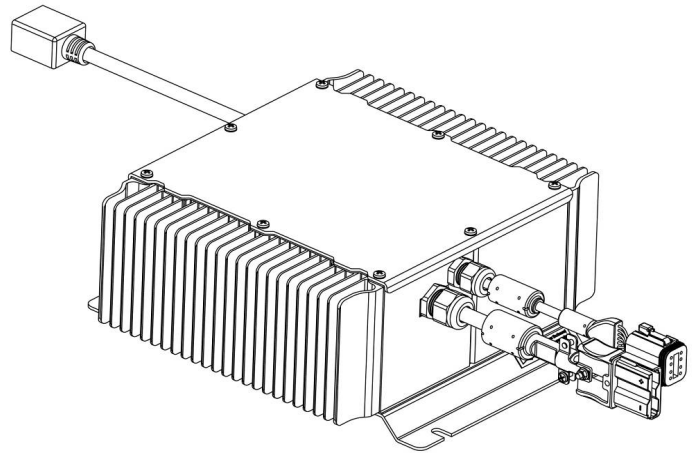
3.6 Rear Panel

3.6.1 DC Output

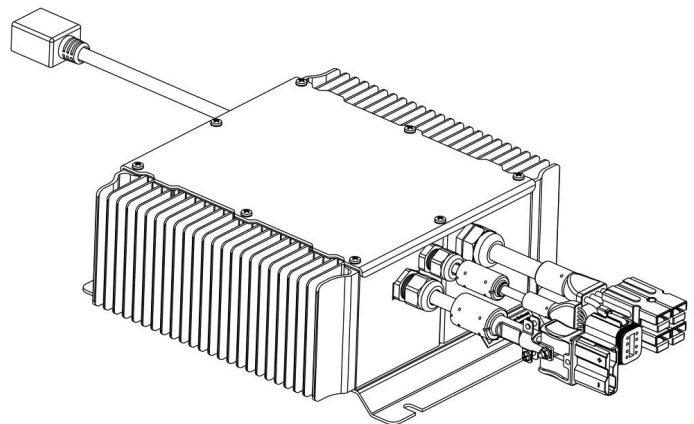
The QuiQ charger has several DC output options. The standard configuration is a 1.8m, 4 wire output cable, which includes a positive lead, negative lead, temperature sensor, and interlock. This is illustrated below with the output cable shortened.



As the QuiQ charger is primarily an OEM solution, some versions exist with customized output configurations. These versions are specific to those OEM installations and are only supplied to those specific OEMs. For ease of customizing the charger to the application, Delta-Q has developed an inline connector option shown below.



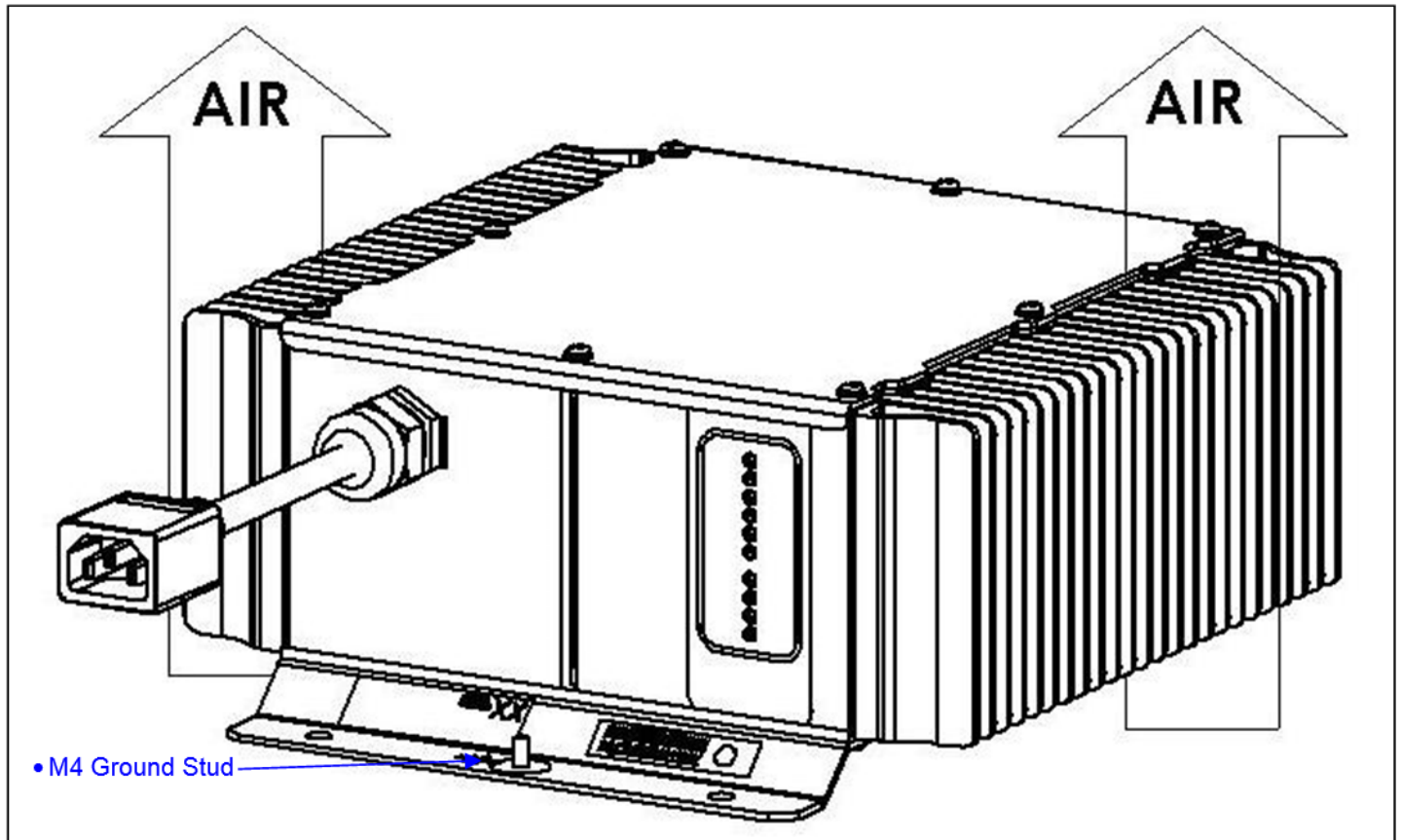
The inline connector version is also available with the 12V DC-DC converter, and is the only output configuration option for the DC-DC converter. This is shown below. It is identical to the charger inline connectors, but with a third connector for the 12V converter.



Details of all of these outputs are in the Electrical Installation Section.

4.0 Mechanical Installation

Proper mechanical installation of the QuiQ charger is essential to its effective operation.



4.1.1 Environment

Locate the charger with adequate ventilation. Ideally it will be mounted horizontally with airflow from below as per the arrows in the illustration above. See 4.1.2 Mounting for more options.

The charger case is an IP66 enclosure. It is well protected against fine dust (IEC60529 IP6x), and capable of operation in heavy seas, temporary flooding, and heavy water streams (IEC60529 IPx6).

The input cord IEC60320 connector is rated IP20 at this time. It is suitable for indoor use only and must be kept clean and dry at all times. Use of heat shrink over the mated connection is strongly suggested for general use.

Delta-Q now offers an AC cord that will seal the connection to IP66. Contact Delta-Q for more details.

During charging, the surface of the charger may become warm, especially in higher ambient temperatures. This is normal. Install such that risk of human contact with hot surfaces is reduced.

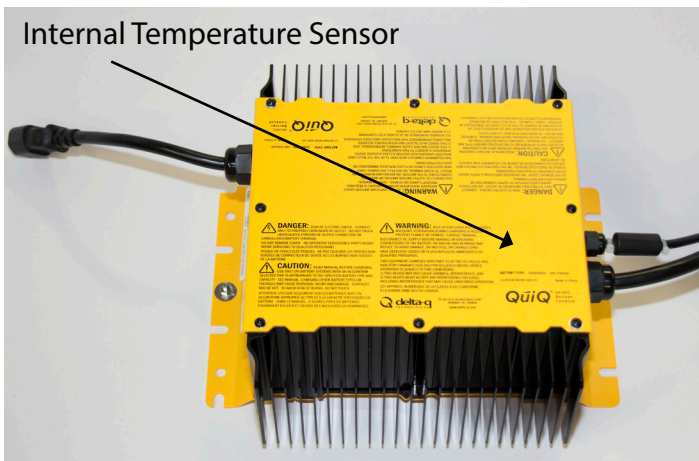
4.1.2 Mounting

Mount the charger by the mounting plate using appropriate fasteners (ie. locking ¼" or M6 bolts), and all of the mounting slots provided. See product drawing in Appendix.

If mounting in an enclosed area, test the charger and monitor it for reduced power operation.

If mounting the charger vertically, there are two considerations: charger performance and charger life. The charger's internal temperature sensor is located approximately 2.5cm (1") behind the DC output cord strain relief.

For performance closest to horizontal installation: Place the DC output at the lower end of the charger to delay thermal cutback, maximize charger output, but potentially cause higher temperatures inside the charger. These orientations are shown below:



For potentially better life: Keeping the temperature sensor higher will result in earlier thermal cutback of power, minimizing internal temperatures and minimizing potential component failures. However, there is no data to demonstrate the amount of lifetime savings that may be gained by using this orientation over the above.

4.1.3 Safety

For UL2202 1st Edition safety compliance in electric vehicle applications, a 12AWG green bonding wire must be attached from the M4 stud located on the charger (see above) to the vehicle frame. This is for electric shock safety. The recommended torque is $1.6 \pm 0.1 \text{ N-m}$.

Alternatively, M6 star washers can be used on the mounting holes to "bite" through the paint on the base plate to make electrical contact. The recommended torque for this is $7.0 \text{ N-m} \pm 0.2 \text{ N-m}$.

If used in an electric vehicle application, UL2202 and the National Electrical Code (NEC) requires the charger's AC plug be located at least 18" above the ground and the display should be visible to the user.

Typical maximum surface temperature of the QuiQ charger is 60°C (140°F).

4.1.4 Vibration

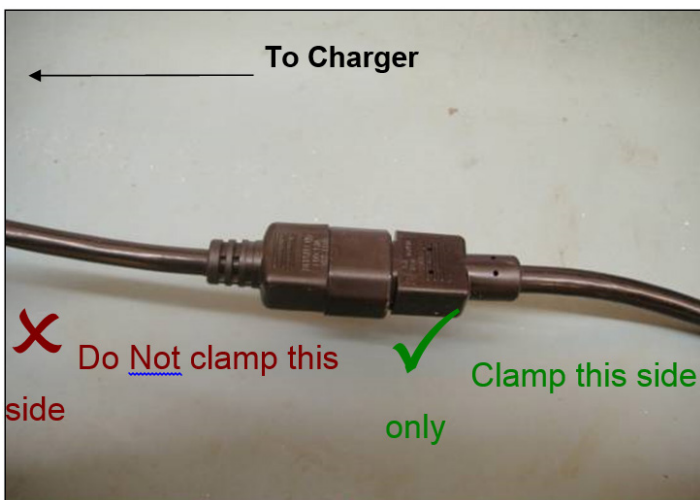
The QuiQ charger is designed to UL2202 1st Edition and the vibration test specified within. It is not intended for heavy-duty vehicle applications.

4.1.5 Cable Strain

High strain on the AC Input Cord combined with heating and cooling over time may cause one or more conductors in the cord to break and the charger to fail. The recommended minimum bend radius on all cables leaving the charger is 60mm (2.36"). This is illustrated below on the AC input cord.



If it is necessary to clamp the AC cord to the machine, it is recommended to clamp the AC attachment cord that is brought to the QuiQ charger's AC Input, not the QuiQ charger's AC input cord itself. This is to isolate any possible wear or damage to the easily replaceable attachment cord, and not the charger. An illustration of this appears below.



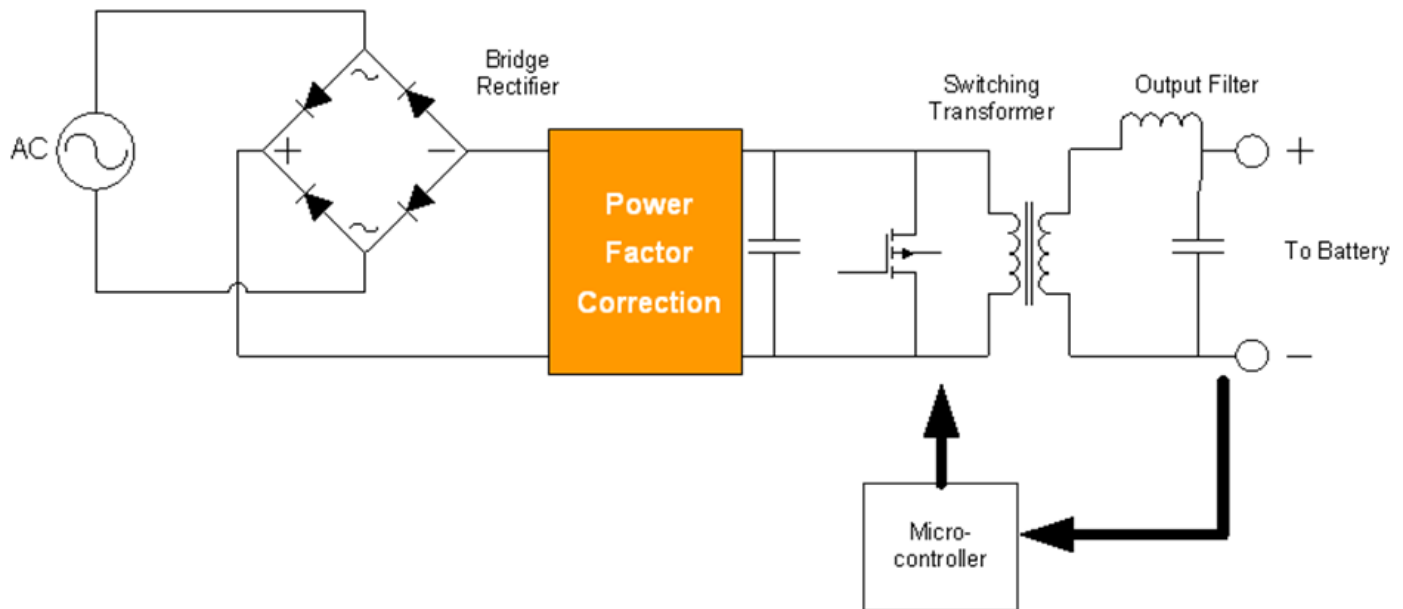
5.0 Electrical Installation

As the QuiQ charger is available in dozens of different output configurations, pay close attention to the specific configuration of your charger and follow the information below for maximum performance from your installation.

5.1 AC Input

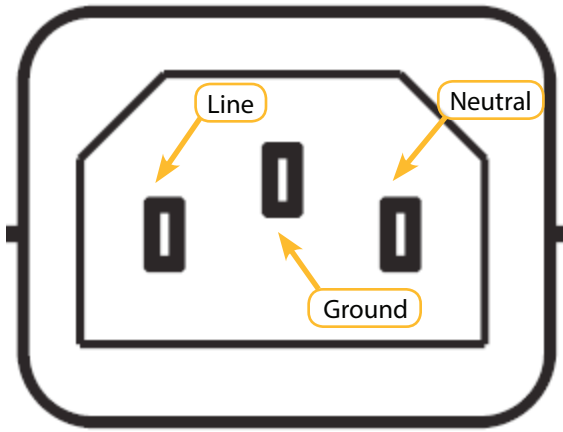
The AC Input of virtually all QuiQ series chargers use the standard IEC60320/C14 Connector. See the Front Panel section for more details on this input connection.

The QuiQ charger's AC input is designed to accept a nominal 85-265VAC (QuiQ 1500: 100-265 VAC) 45-65Hz input to accommodate worldwide operation. It is a standard filtered, full-wave, bridge-rectified input as illustrated in the diagram below.



Notes:

- ✚ Turn-On input voltage is 85VAC (QuiQ 1000) and 110VAC (QuiQ 1500).
- ✚ Turn-Off input voltage is 80VAC (QuiQ 1000) and 100VAC (QuiQ 1500).
- ✚ Charger may handle a much wider range of input frequencies. Contact Delta-Q Technologies if a non-standard frequency input is anticipated.
- ✚ A Class A Ground Fault Circuit Interrupter (GFCI) is recommended for use with the charger if there is a risk of electric shock while handling the charger.
- ✚ The QuiQ has been tested with a number of portable AC power generators. DQDB and newer chargers can be used with virtually any generator rated 2kW or higher. Lower rated generators may also work – as ratings vary widely, test the charger under load with the generator before putting it into service. Older chargers should be used with a sine-wave inverter generator only.
- ✚ QuiQ 1500 will reduce power to 1200W if AC voltage falls below 180VAC.
- ✚ QuiQ 1500 will resume maximum power if AC voltage rises above 189VAC.

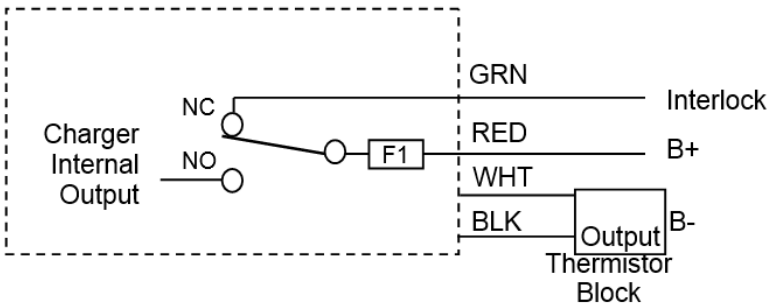
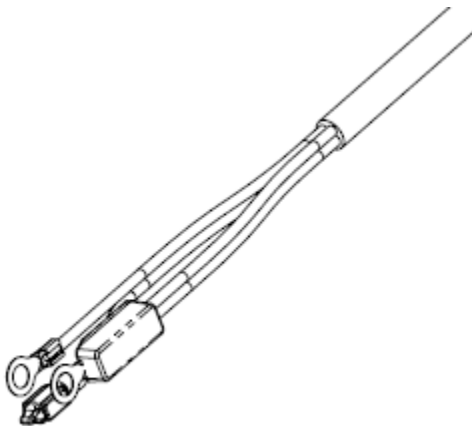



Connector Pin Configuration

Pin No.	Wire Color Code	Minimum Wire Gauge	Description	Notes
L	Brown	14AWG / 2.5mm ²	AC Line	Recommended Extension Cords (110VAC): 10AWG/6.0 mm ² : max length of 30m (100ft) 14AWG/2.5 mm ² : max length of 15m (50ft) 16AWG/1.5 mm ² : max length of 7.5m (25ft)
G	Green / Yellow		AC Ground	
N	Blue		AC Neutral	

5.2 Standard DC Output Cord

A 1.8m (6') 4-wire, 12AWG (3.3mm²) cable is the standard output of the QuiQ charger. The termination of this cable is shown below. Also below is a simplified internal diagram of the charger's output connections.

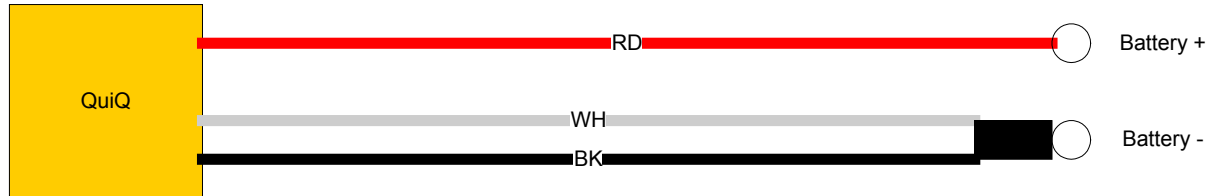


Wire Colour	Termination	Wire Size	Description	Notes
Red	3/8" Ring Terminal	12AWG / 3.3mm ²	Battery Positive	<ul style="list-style-type: none"> ✚ It is recommended to install an appropriate size fuse from the battery terminal to the vehicle system. This may also prevent damage to the charger.
Black	3/8" Ring Terminal via Thermistor Block	12AWG / 3.3mm ²	Battery Negative	<ul style="list-style-type: none"> ✚ Important: Connect the ring terminal with overmould directly to the battery negative post; if not, the sensor will not have accurate battery temperature information and charge performance may be affected. ✚ In the photo below the order from bottom to top is: Battery Post, System Cable Terminal, Charger Terminal, Flat Washer, Lock Washer, Battery Post Nut: 
White	Overmoulded Thermistor Block	12AWG / 3.3mm ²	Temperature Sensor Signal	<ul style="list-style-type: none"> ✚ If this cable end is damaged, or if the negative wire needs to be separated from the thermistor, a Thermistor Repair Kit (900-0002) is available. <p>See 5.2.1 below for more details of the Temperature Sensor Signal wire operation</p>
Green	Female 1/4" Spade Terminal (ships shrouded)	12AWG / 3.3mm ²	Interlock	<ul style="list-style-type: none"> ✚ Internally connected to Battery Positive when charger is not connected to AC Power. ✚ Contact Delta-Q for "Reverse Interlock" equipped units. ✚ Important: Install a 1A fuse inline to avoid damage to internal relay. Do not allow this wire to contact Battery Negative. ✚ NOTE: On 24V-72V units the interlock will be set to B+ even when the charger is connected to AC Power when the charger is in Fault State 1, 2, or 6

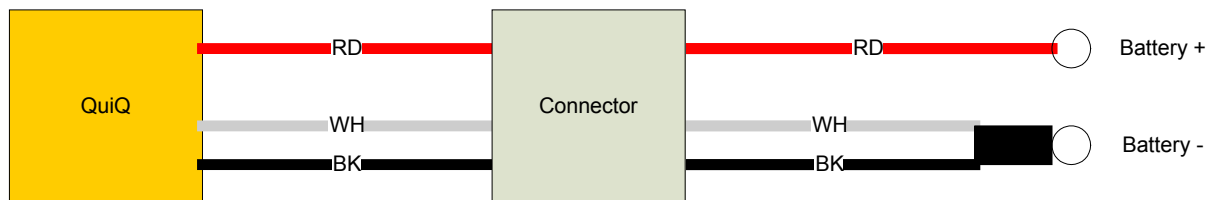
5.2.1 Temperature Sensor Signal Operation

There are four main operating modes for the Temperature Sensor Signal:

1. **Temperature Sensor Installed Onboard:** An NTC 10k 5% thermistor installed between this signal and battery negative will provide the charger with temperature information. The charger is expecting to see temperature information from a battery post.

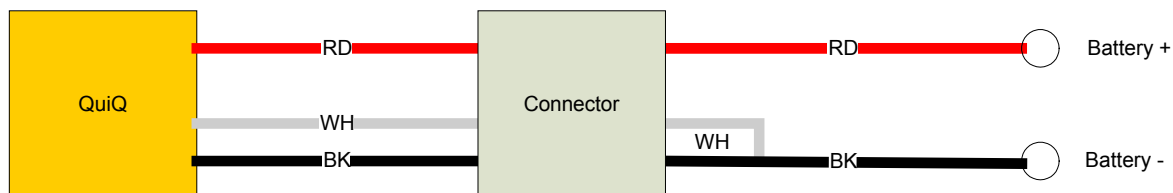


2. **Temperature Sensor Installed Offboard:** The charger will operate normally when connected to batteries. On disconnection it may create a spark. In certain stages of charging the output relay may stay closed after disconnection until the fault condition is detected and the charger enters a fault code 2 state (refer to Troubleshooting section).

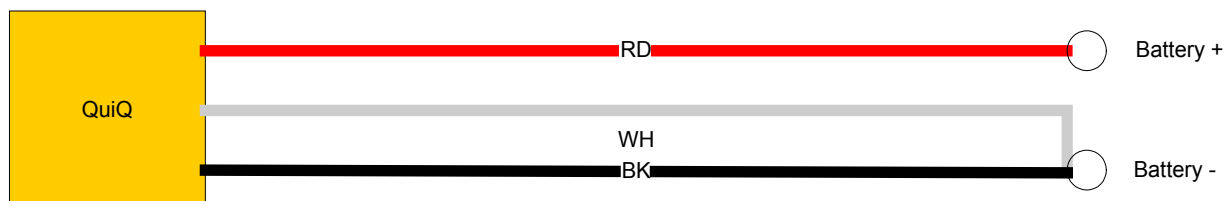


3. **Offboard Sparkless Disconnection:** When used with an offboard connection, the QuiQ charger can disable its output before the main contacts are disconnected. This is achieved by connecting the Temperature Sensor Signal input to Temperature Sensor Signal Negative (Temp Sense -) or Battery Negative (Batt -). This connection should be made after the main contacts are connected, and then opened before the main contacts are opened. The time required to disable the charger output is typically < 0.2s. Due to hardware limitations, the sparkless disconnection feature does not work if a temperature sensor is installed on this signal line.

On disconnection, the charger will indicate a fault code 2 as the batteries are not connected (refer to Troubleshooting Instructions section).



4. **Temperature Sensor Not Installed:** If a temperature sensor is not installed and sparkless disconnection is not desired, the Temperature Sensor Signal input must be connected directly to the Temperature Sensor Signal Negative (Temp Sense -) or Battery Negative (Batt -).



5.3 Inline Connector (ICON)

The inline connector version of the QuiQ chargers are fitted with an extensively-tested, high performance connector system.

The following pages describe the connector configuration. Each connector's part number and mating part number is listed along with the pin configurations.

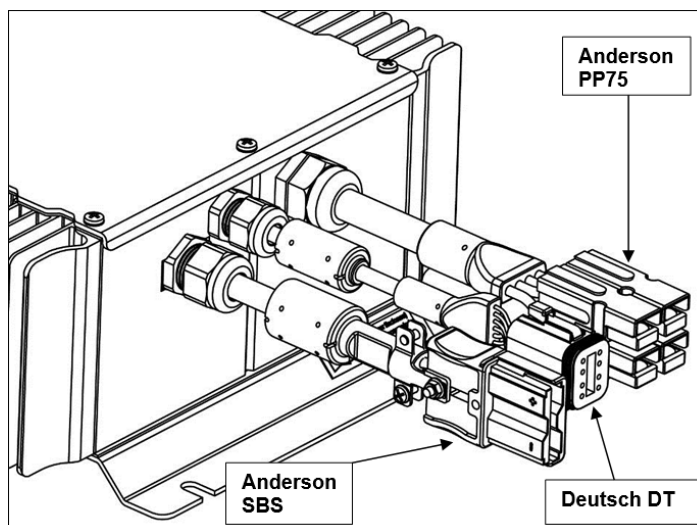
Metric Wire Size Recommendations

In this section, standard AWG size recommendations are listed. The table below shows the equivalent Metric Wire size recommendation for each AWG size. Please note that this conversion table only applies to this section of this document.

Recommended AWG	Recommended mm ²
8	10.0
10	6.0
12	4.0
14	2.5
16	1.5
18	1.0
20	0.75
22	0.5

5.3.1 General Connector Information

Two different series of connectors are used on the QuiQ "ICON" version: The Anderson SBS-50 for the battery connection, and the Deutsch DT06-08S for auxiliary signals. For the QuiQ-dci, the Anderson PP75 is added for the 12V DC interface. Important information and references for the installation of these connectors is given below.



Anderson Power Products SBS Series

The Anderson SBS50 can accept four different contacts for 6AWG, 8AWG, 10AWG, and 12AWG wires. In addition, three different bushings are available to reduce the largest contact well down to 8AWG, 10 and 12AWG, or 14 and 16AWG. See section 5.3.2 for wire gauge recommendations for each model of QuiQ charger.

Contact P/N	Wire Size	Rating
1339G2	6 AWG	75A
1339G5	8 AWG	60A
1339G3	10 AWG	45A
1339G3	12 AWG	35A

Bushing Number	For Use With	Wire Size
5912	1339G2 Contacts	8 AWG
5910		10-12 AWG
5913		14-16 AWG

The SBS50 housings can be ordered in six different colours – all keyed differently to prevent wrong voltages being mixed. A cable clamp is also available for the SBS50 connector. See the Anderson Power Products “Multipole SBS Connectors” webpage for more information and to download the Assembly Instructions, which contain important information about part numbers, cable stripping, and crimping techniques:

<http://www.andersonpower.com/products/multipole-sbs.html>

Deutsch DT Series

The Deutsch DT Series is a fully sealed connector system suitable for signals. The DT06-08S used on the QuiQ “ICON” supports 20-14 AWG wire with Deutsch’s “Contact Size 16” and has numerous options for contacts, back shells, and mounting/sealing accessories. It is recommended to obtain the DT Series Technical Manual from Deutsch Industrial or Ladd Inc for more information.

Please note that the Deutsch “Contact Size” is their reference, and is not related to wire gauge sizes supported by that contact.

http://www.laddinc.com/images/stories/datasheets/DT_Series_Technical_Manual.pdf

http://www.laddinc.com/images/stories/misc/helpful_hints.pdf

References:

www.deutsch.net

www.laddinc.com

Anderson Power Products PP75 Series

The Anderson PP75 series can accept wire sizes from 6 – 16 AWG and a variety of contacts are available. The main types of contacts are shown below. More are available – see the Anderson data sheet for more information.

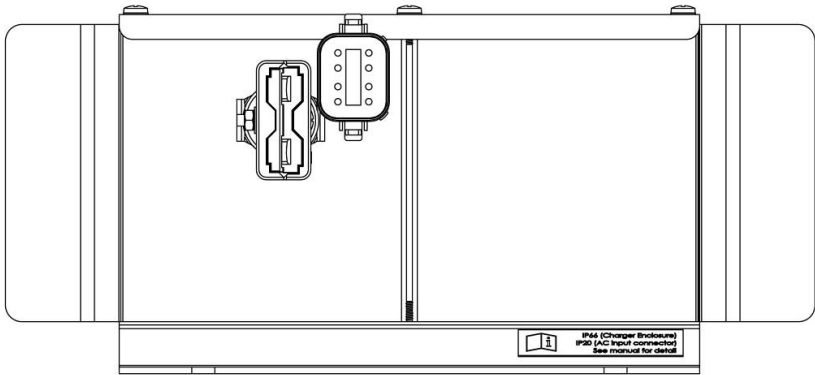
Contact P/N	Wire Size	Detent
1307	6 AWG	High
5900	6 AWG	High
5914	10 AWG	High
5915	10-12 AWG	High
5952	10 AWG	High
5953	10-12 AWG	Low

Detent	Force
Low	22N (5lbf)
High	31N (7lbf)

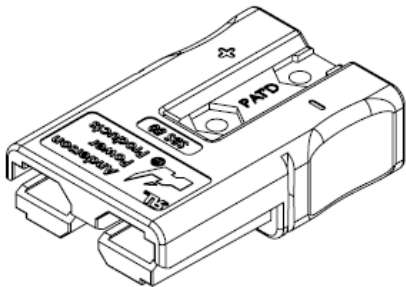
The same bushings as the SBS series can be used to reduce the contact well down to 8 – 16 AWG. These must be used with the 5900 or 1307 contact.

5.3.2 24V / 36V / 48V / 72V / 84V / 96V Model

912-2454, 912-3654, 912-4854, 912-7254, 914-4854-01, 914-7254-01, and 912-9654



DC Output Connector



Connector: Anderson Power Products
24V – Red (SBS50RED)
36V – Gray (SBS50GRA)
48V – Blue (SBS50BLU)
72V – Green (SBS50GRN)
84V – Black (SBS50BLK)
96V – Brown (SBS50BRN)

Mates with: Same as above, depending on voltage

Recommended Contact: 1339G3 with 12AWG wire (Hand Crimper 1309G4)

Pin Configuration:

Conn. Pin No.	Wire Dia. (AWG)	Description	Notes
"_"	6-16	Battery Negative	Minimum recommended wire gauges: 24V / 36V / 48V QuiQ 1500: 12AWG 48V QuiQ 1000 / 72V: 14AWG (use 5913 with 1339G2) 84V / 96V: 16AWG (use 5913 with 1339G2)
"+"	6-16	Battery Positive	

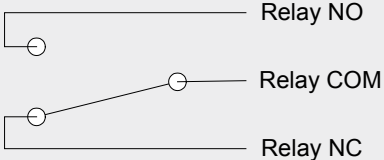
Signal Connector



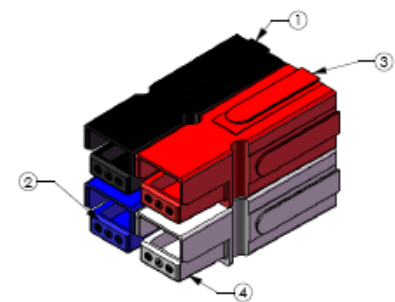
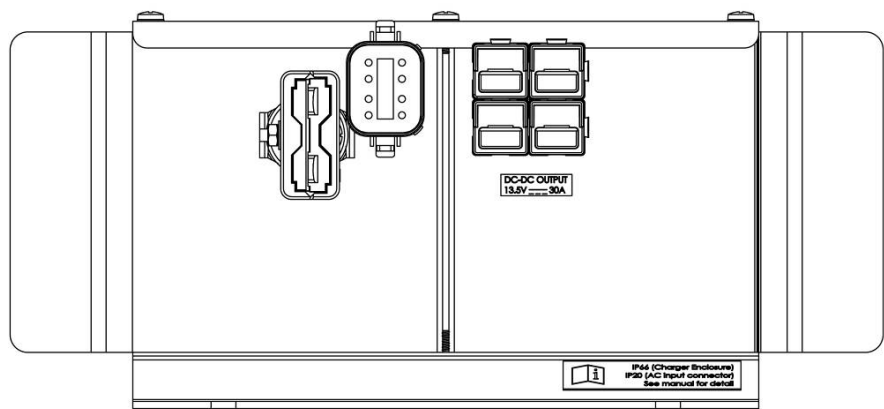
Connector:	Deutsch DT06-08SA
Mates with:	Deutsch DT04-08PA with W8P wedge lock
Recommended Contact:	1060-16-0122, stamped & formed (supports 14-18AWG) 0460-202-16141, solid (supports 16-20AWG) Hand Crimper #HDT-48-00
Supported Wire Insulation:	2.24-3.68mm diameter (0.088-0.145" dia)

NOTE: Sealing Plug 114017 will be required for pin 8

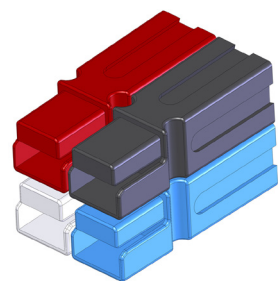
Pin Configuration:

Conn Pin No.	Wire Dia. (AWG)	Description	Notes
1	14-20	Temp Sense+	Connect to NTC 10k 5% Thermistor. IMPORTANT: Connect to Battery Negative or Temp Sense Negative if not used. CAUTION: Ensure B+ and B- polarity are correct before connecting this pin, otherwise this input may be damaged. See Accessory Information below.
2	14-20	Temp Sense-	Internally connected to battery negative
3	14-20	Relay NC	Normally Closed
4	14-20	Relay COM	Common, 1A maximum. Inline 1A fuse installation recommended. 
5	14-20	Relay NO	Normally Open
6	14-20	LED +	Red Cathode, 4.5mA See Accessory Information below.
7	14-20	LED -	Green Cathode, 4.5mA See Accessory Information below.
8	-	NOT USED	Install sealing plug 114017

5.3.3 48V / 72V / 96V QuiQ-dci 922-4854, 922-7254, and 922-9654



Charger-side connector configuration



Mating connector configuration

- Connector:** Anderson Power Products
114958G1 (shown above) or assemble separately from:
- + Item 1 (top left), Qty 1: 5916G4, Black Housing
 - + Item 2 (bottom left), Qty 1: 5916, Blue Housing
 - + Item 3 (top right), Qty 1: 5916G7, Red Housing
 - + Item 4 (bottom right), Qty 1: 5916G5, White Housing
- Mating Connectors:** 114960G1 or assembled separately from the above and arranged to mate.
- Recommended Contacts:** 5953, 10-12 AWG, Low Detent. Charger side contacts are Low Detent. Mate with High Detent for approx 26N (6lbf) of force per connector (104N/24lbf total). Hand Crimper 1309G4

Pin Configuration

Conn Pin Clr.	Wire Dia. (AWG)	Description	Notes
BLACK	10-12	12V Ground	
BLUE	10-16	Switched Output Enable (Input)	8 – 17VDC on this pin activates the 12V Switched Output pins
RED	10-12	12V Unswitched Output	Always active 12V output
WHITE	10-12	12V Switched Output	Activated by the Switched Output Enable

NOTE: The 12V Output is not designed to be connected to or charge a 12V battery

5.4 Accessory Information Inline Connector (ICON)

5.4.1 Remote LED

Hardware

The Remote LED recommended for use with the QuiQ charger's LED outputs is the Delta-Q Accessory Part #900-0058 Remote LED 3m Shielded Bare Wires



The following items may also be used with the remote LED connections on the QuiQ charger.

Recommended Remote LED: Lite-On LTL-293SJW or similar 2.0V bi-colour LED, 5mm T1-3/4
Recommended LED Holders: Lumex SSH-LX5091 and SSH-LX5090 or similar (max 1.5mm panel)
Bivar CR-174L for 1.5 - 6.4mm panel
Bivar CR174 for 0.8 - 3.2mm panel

Cable: 22AWG (0.5mm²) 2-conductor w/ shield grounded to chassis
Max Length: 7.5m (25ft) using standard 22AWG wire.

Operation

LED Polarity:

LED + is RED Cathode / GREEN Anode (White wire)

LED - is GREEN Cathode / RED Anode (Black wire)

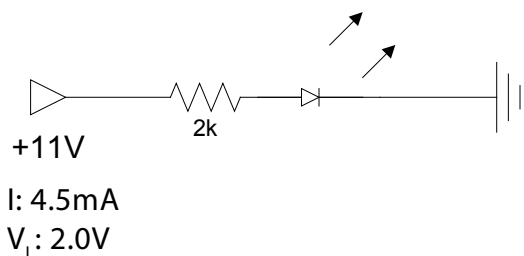
LED Signal Operation:

GREEN: LED - line low 0%, LED + line 1kHz @ 90% duty cycle

RED: LED - line 1kHz @ 90% duty cycle, LED + line low 0%

YELLOW: Both lines 1kHz at 92% duty (one line inverted from the other so one is low for 92% while the other is high for the same time)

Simplified Internal Schematic:



5.4.2 Remote Thermistor

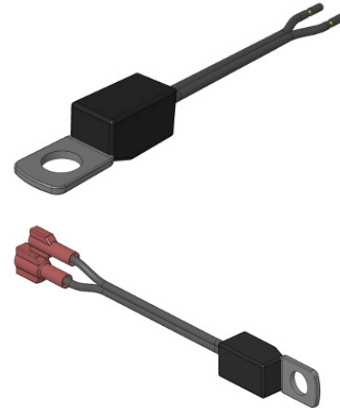
Hardware

CAUTION: Ensure B+ and B- polarity are correct before connecting a remote thermistor. If the polarity is reversed the temperature input may be damaged.

The recommended thermistors for use with the QuiQ charger's temperature sensor input are:

- 900-0059 Isolated Temp Sensor 140mm Bare Wires
- 900-0028 Isolated Temp Sensor 200mm Bare Wires (250pcs)
- 900-0060 Isolated Temp Sensor 1.2m Bare Wires
- 900-0056 Isolated Temp Sensor 3m Shielded Bare Wires

- 900-0064 Isolated Temp Sensor 140mm Fast-on Tab/Plug



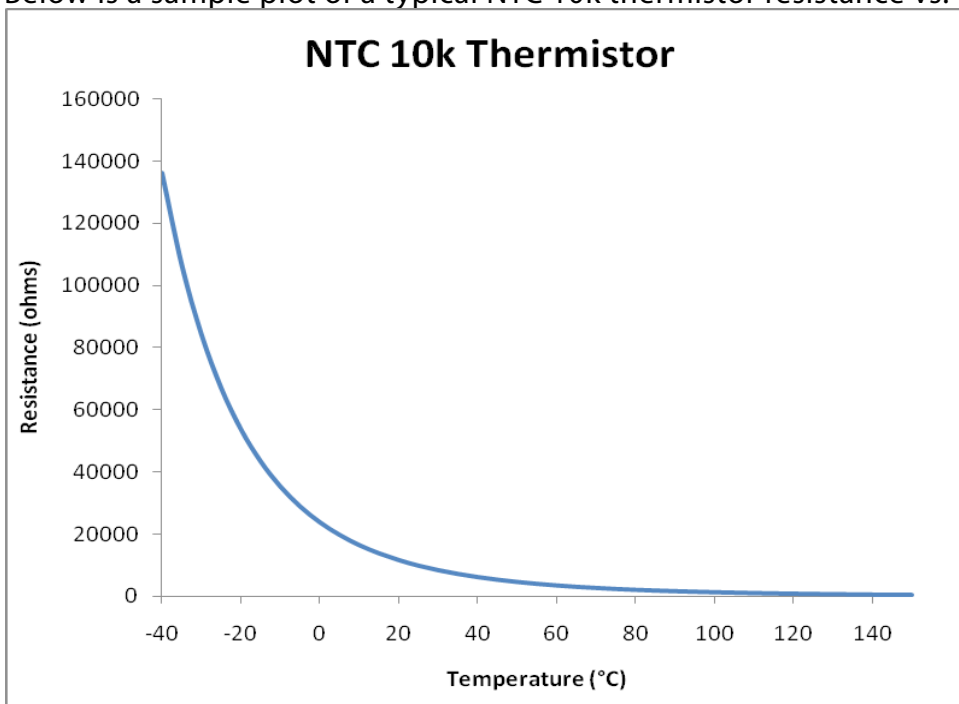
Other part numbers may also be available. Check with your OEM Account Manager.

An alternative part number which will be compatible with the QuiQ charger is:
Vishay BCC 238164063103, NTC 10k 5% Thermistor, B25/85 = 3977K

If using other thermistors in a harness design, it is recommended to use 1mA as the figure to calculate limitations on wire gauge and length.

Operation

Below is a sample plot of a typical NTC 10k thermistor resistance vs. temperature:



6.0 Charger Operation

As a fully automatic, modern, high-frequency charger, the QuiQ needs very little maintenance to operate. This section describes standard and adverse operating conditions of the QuiQ charger.

6.1 Normal Operation

Onboard

- + Charger is always connected to battery pack
- + Charger is connected to AC Power to begin a charge cycle
- + LEDs perform start-up self-test (LEDs light up in sequence)
- + Charger begins charging (See 710-0088 Algorithm Descriptions for charge algorithm parameters, and Front Panel section for LED operation)
- + Charger completes charging and enters Maintenance Mode

Offboard

- + Charger is often left connected to AC power
- + Charger is connected to battery pack to begin a charge cycle
- + LEDs perform start-up self-test (LEDs light up in sequence)
- + Charger begins charging
- + Charger completes charging and enters Maintenance Mode
- + Charger is disconnected from batteries and enters standby mode. If standby mode is entered before charge has been completed, there is a possibility of battery voltage at the terminals if the sparkless disconnection feature is not used.

Note: If no battery is connected and the charger is plugged into AC power, the charger will enter "Algorithm Display Mode" for 30 seconds. See Programming Instructions for more details on this mode.

6.1.1 QuiQ-dci Operation

- + 30A maximum continuous output across up to 2 different pins
- + 60A peak for up to 2.0 seconds
- + Low Power Mode after 60 minutes below ~2A output

Unswitched Output:

- + 13.5V output always on if input DC voltage requirements are met.

Switched Output:

- + 13.5V output on if input DC voltage requirements are met and 8 – 17VDC to Switched Enable input signal is met.
- + Delayed shut off of < 3 seconds when Switched Enable signal is < 8VDC
- + Hardware option for 30 second shut off delay and 0 second off delay (may affect short circuit function)

6.2 Adverse Operating Conditions

High Ambient Temperature Operation

This is defined as when the ambient air temperature around the charger is greater than approximately 35°C. This may occur if there is insufficient airflow around the charger.

As in Normal Operation except:

- ✚ During bulk phase, current may derate to a lower level, indicated by the current ammeter LEDs. This is described in the Front Panel section.

The result of this is that the charge cycle may take longer, possibly even reaching a pre-programmed time-out due to excessive length. This is indicated by fault code 3.

The figure in 6.4 Performance Curves shows the derating operation of the charger at high internal temperatures. The internal microprocessor temperature is typically 20°C higher than surface temperature. Surface temperature of the charger depends on the charger's output power, air flow around the charger, and ambient temperature. Ensure proper testing of the charger is done if it is installed in a vehicle as this derating may occur.

Low Ambient Temperature Operation

As shown in 4.4 Performance Curves, when the internal temperature is below 0°C (32°F), the charger operates at 50% power until above 0°C (32°F). This "defrosting" normally takes just a few minutes and the charger then proceeds to Normal Operation.

Discharged Battery Operation

From as low as 0.5 Volts per cell the charger will turn on and begin its charging cycle. Most charge algorithms trickle charge at 5A until the average cell voltage is higher than 2.0V/cell. Normal operation follows this.

Damaged or Aged Battery Operation

Batteries in this state may not reach a target voltage (typically set to 2.4V/cell) which will cause the charger to continue its bulk current output until bulk phase timeout. This may further deplete electrolyte levels and accelerate battery deterioration. Batteries should be checked regularly if these symptoms appear.

Low AC Voltage Operation

The QuiQ 1000 charger's wide-range input allows it to operate between 85 and 265 VAC. In order to maintain compliance with the National Electrical Code (US, Canada), the charger is limited to a maximum of 12A continuous AC draw so that it can be operated from a single 15A AC branch circuit. Below 105VAC the charger reduces its output by up to 20% to maintain this compliance.

The QuiQ 1500 can operate as low as 100 VAC. It reduces its output by 20% to 1200W below 180 VAC.

Input Voltage cutback characteristics for all charger models are shown on the next page.

Use With Lithium Batteries

The QuiQ charger may be used with lithium batteries. Please consult with your Delta-Q Application Engineer if considering using the charger with lithium batteries. Special charger configurations and precautions may be necessary.

6.2.1 QuiQ-dci Conditions

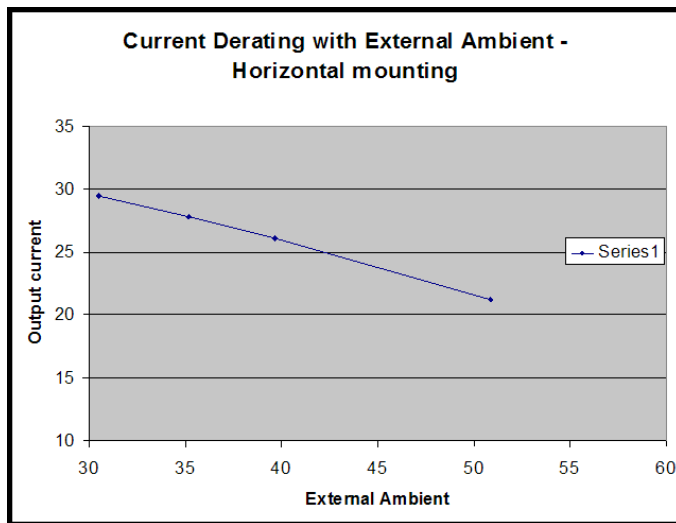
DANGER: Ensure safety-critical systems have a suitable backup in case of DC-DC shut down or failure.

Shut down and restart

If the QuiQ-dci output shuts down due to overload or temperature, it will shut off for 30 seconds and then attempt to restart. If after 2 seconds of operation it still detects an overload or over temperature condition, it will shut down again and restart after 30 seconds. This sequence continues indefinitely.

High current draw, High ambient temperature operation

The DC-DC converter in the QuiQ-dci will protect itself from damage by shutting down at a certain internal temperature. Depending on the current output, the ambient temperature this occurs at is approximately shown below. The DC-DC will restart once the temperature falls into normal range.



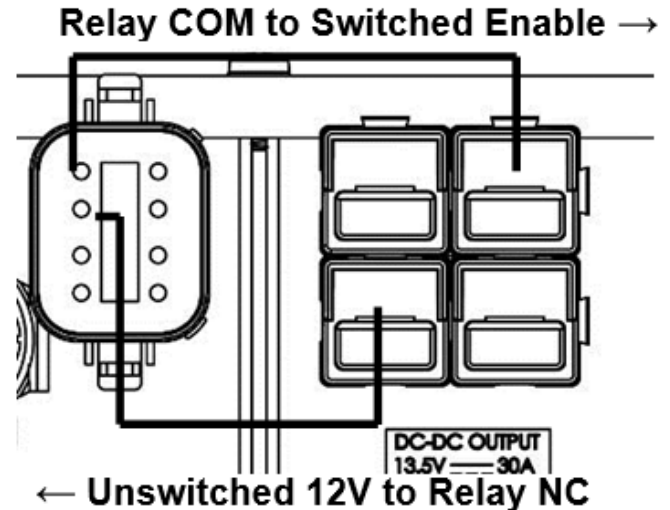
Reverse Polarity:

The DC-DC section of the QuiQ-dci has reverse polarity protection on its input but not on its output. The output of the QuiQ-dci is not intended to be connected to a battery. Connection to a reverse polarity source could damage the DC-DC converter.

Simultaneous Charger and Converter operation:

Aside from sharing the connections to the battery, the DC-DC converter operates completely independent of the charger. In the unlikely situation where charger and DC-DC converter are both in operation, the charger will not be aware of any power used by the DC-DC converter while it is charging the batteries. This may cause batteries to be undercharged.

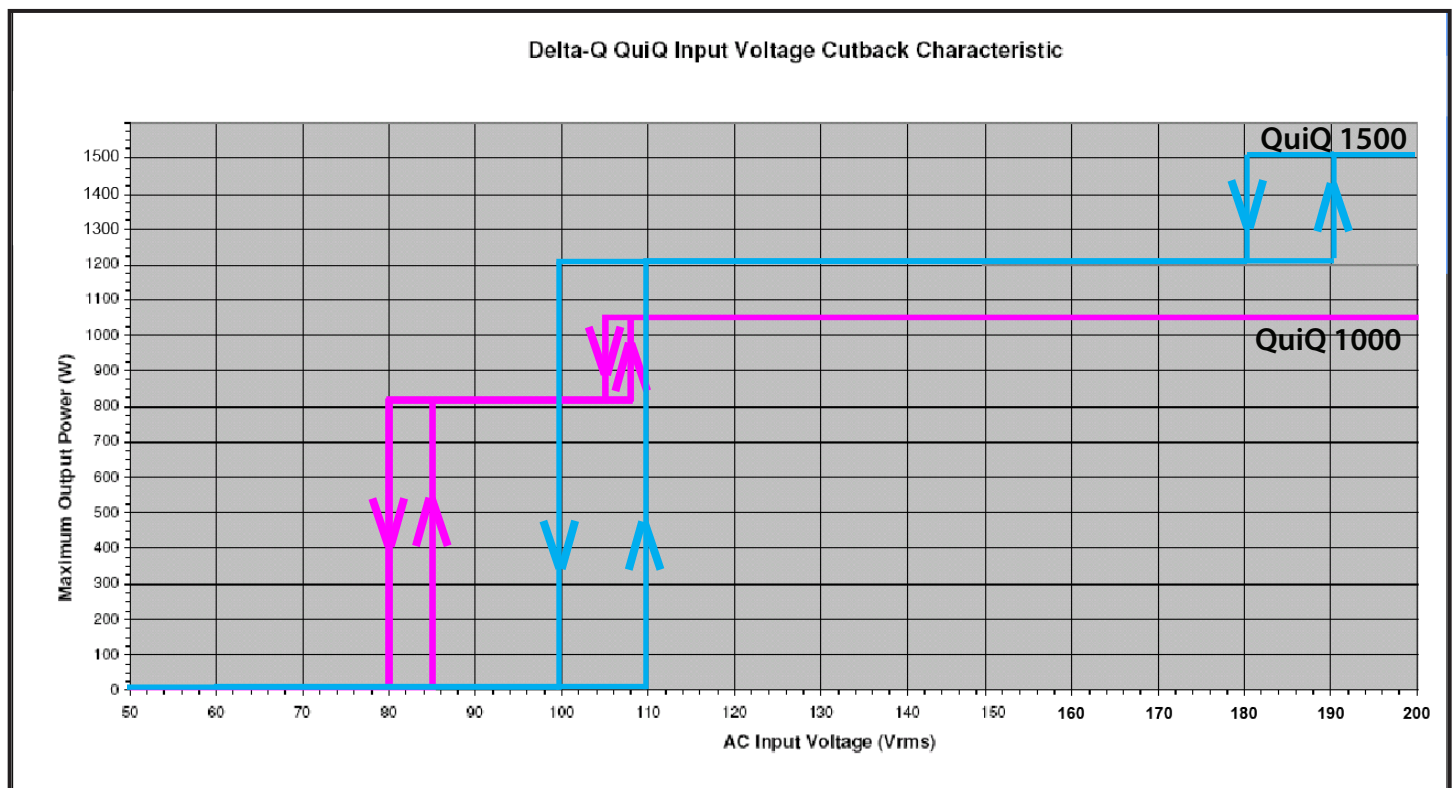
To avoid this situation, always minimize the DC-DC load when charging is active. A hard-wired interlock may be installed for the DC-DC from AC power; simply connect the charger interlock circuit to the DC-DC switched enable. The suggested wiring below only activates the DC-DC switched outputs when there is no AC power.



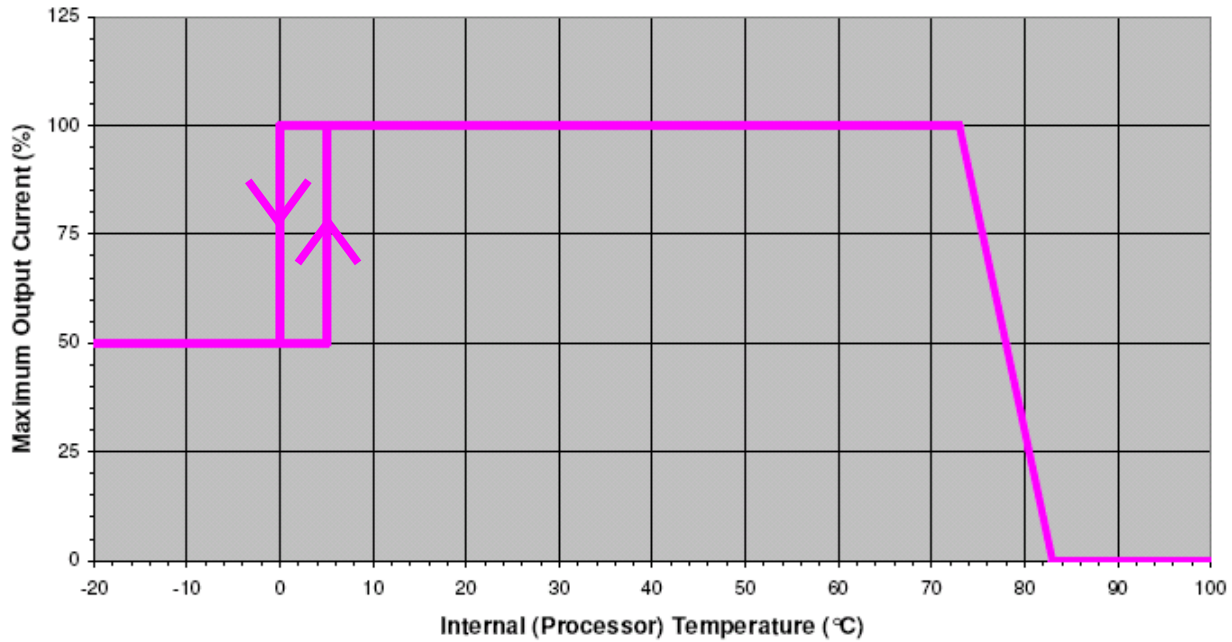
6.3 Maintenance Information

- ✚ Keep the charger free of oil, dirt, mud, or dust to keep the cooling fins operating as efficiently as possible.
- ✚ For flooded lead-acid batteries, regularly check water levels of each battery cell after charging and add distilled water as required to level specified by battery manufacturer. Follow the maintenance and safety instructions recommended by the battery manufacturer.
- ✚ Make sure charger connections to battery terminals are tight and clean.
- ✚ Do not expose charger to oil, dirt, mud or direct heavy water spray when cleaning vehicle.
- ✚ Extension cords must be GROUNDED. At 110VAC, use a 3-wire cord no longer than 30m (100') at 10AWG (6.0mm²) or 7.5m (25') at 16AWG (1.5mm²). A spark may be observed on connection.
- ✚ Avoid connecting a QuiQ charger and another device to a single 15A/20A circuit or the circuit may become overloaded.

6.4 Performance Charts

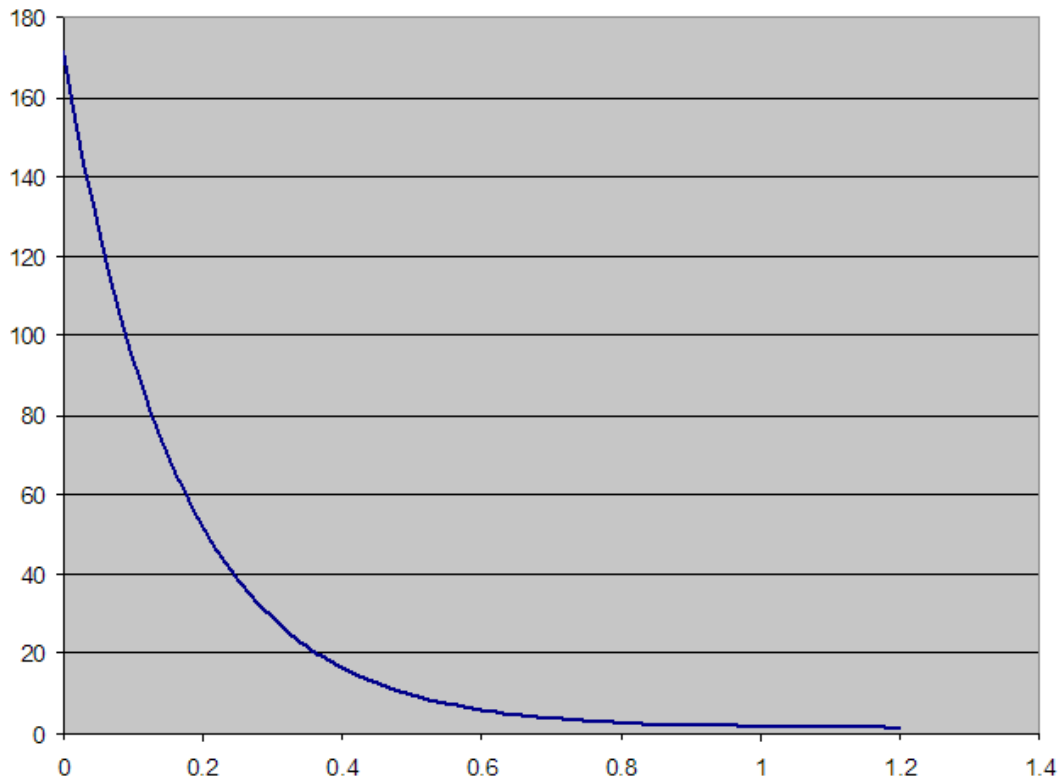


Delta-Q QuiQ Thermal Cutback Characteristic



Typical processor temperature = Ambient + 20°C

Voltage Decay vs Time
(worst case, unplug at peak of 120V sinewave)



The above graph shows Vac drop off at the charger input connector following disconnection. It may be useful for homologation and safety purposes. Y-axis is Vac, x-axis time in seconds.

6.5 Programming Instructions

The QuiQ charger is pre-loaded with up to 10 different charge algorithms. Dozens of different charge algorithms for different battery types and sizes are available. Consult with Delta-Q Applications Engineering or Technical Support if an algorithm not loaded on your charger is required. The table below is the standard set of algorithms loaded on the QuiQ charger. Your charger's algorithms may differ.

Alg #	Battery Types
1	Trojan Flooded
3	Trojan T105 constant power dv/dt
5	Trojan 30XHS
6	Deka 8G31 Gel
7	Trojan J305 constant power dv/dt
8	Concorde 10xAh AGM
11	generic 225 Ah flooded constant power dv/dt (parallel enabled)
27	Crown CR-325
43	Discover AGM
73	generic 400 Ah flooded constant power dv/dt (parallel enabled)

There are two methods of altering the algorithms: via the built-in display and change functions, or the external programming tool.

6.5.1 Built-In Programming Functions

The QuiQ charger can display and increment through the stored algorithms by following the sequences below. This allows an end user to change algorithms without any special tools.



Check Default Charge Algorithm

Enter Algorithm Display Mode:

1. Disconnect AC Power.
2. Remove positive lead from battery pack.
3. Apply AC power and the charger will display the algorithm number after the Power On Self Test:
 - a. All algorithms will display as a series of flashes of the '80%' LED.
 - b. Algorithms #1 - 6 will also be indicated by the Ammeter LEDs (see User's Guide).

Examples:

 = Algorithm # 7

 <Short Pause>  = Algorithm #43

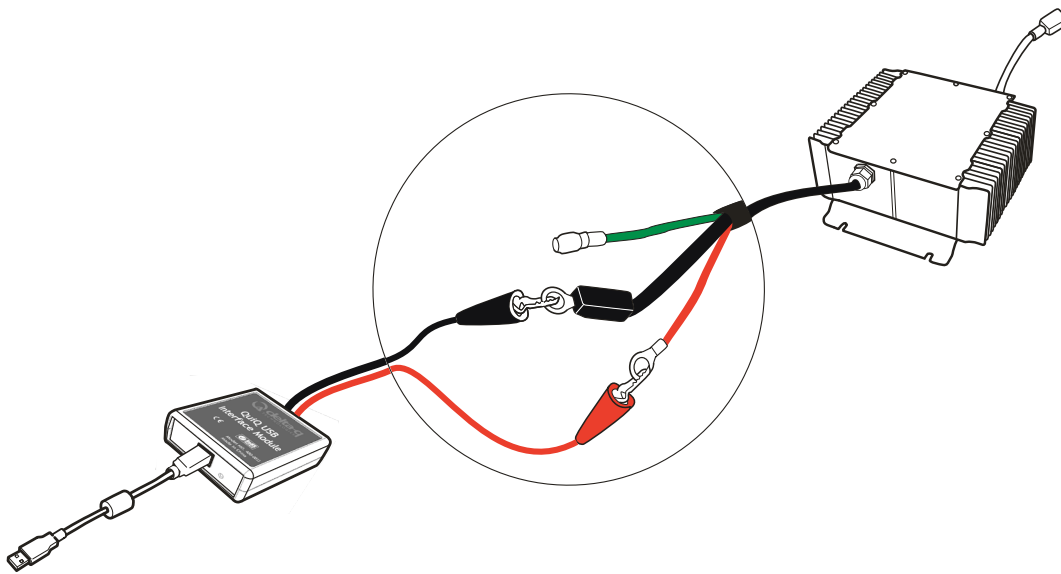
4. Algorithm number display repeats for 11 seconds, then Algorithm Display Mode ends.
5. Remove AC Power and reconnect positive lead.

Change Default Charge Algorithm

1. Enter Algorithm Display Mode (as above).
2. While Algorithm Number is displayed (for 11 seconds), touch positive lead to the battery pack positive terminal for 3.0 seconds (+/- 0.5s).
3. Remove lead from battery pack. Algorithm Number will increment.
4. To increment the Algorithm Number again, repeat Steps 2 and 3 within 30 seconds.
5. Touch positive lead to positive terminal and hold until relay clicks (>10 seconds). The new default algorithm is now stored.
6. Remove AC Power and check default algorithm (as above)

6.5.2 QuiQ Programming Kit (900-0089-02)







This kit is provided with hardware and software to allow a Windows-based personal computer to add, remove, and change algorithms loaded into compatible QuiQ chargers. The kit is shown below and available only to OEMs directly from Delta-Q. It may be used as a service tool as it allows for easy changes to the charger's software.



See the document 710-0027 "Instructions for Using the Delta-Q QuiQ Programming Kit" for more information on the use of this item.

7.0 Troubleshooting

If a fault occurs, count the number of red flashes between pauses and refer to the table below:

Red Flashes	Cause	Solution
	Battery high voltage	Check battery size and condition. This fault will automatically clear once the condition has been corrected.
	Battery low voltage	Check battery size and condition. This fault will automatically clear once the condition has been corrected.
	Charge timeout caused by battery pack not reaching required voltage. Charger output was reduced due to high temperatures	Check connections. Operate charger at a lower ambient temperature. Reset charger (interrupt AC power for 15 seconds).
	Check battery: battery could not be trickle charged up to minimum voltage	Check for shorted or damaged cells. Reset charger (interrupt AC power for 15 seconds).
	Over-temperature: charge shut down due to high internal temperature	Ensure sufficient cooling air flow and reset charger (interrupt AC power for 15 seconds).
	Charger internal fault	Reset charger (interrupt AC power for 15 seconds). Return to qualified service depot if fault persists.

More detailed troubleshooting information can be found in the Delta-Q publication 710-0009 QuiQ Troubleshooting Guide.

Note: Certain OEM-specific QuiQ and QuiQ-dci models do not adhere to the above fault table. Refer to the manual for that product or contact Delta-Q for more information.

7.1.1 QuiQ-dci

The DC-DC converter in the QuiQ-dci is a highly reliable, high performance unit. It has no operating indicators. If abnormal performance is noticed, consult the symptoms and possible solutions under the QuiQ-dci section in the Delta-Q publication 710-0009 QuiQ Troubleshooting Guide.

8.0 General Specifications

DC Output	QuiQ 1000 (912-, 913-)					QuiQ 1500 (914-, 916-)	
	24xx	36xx	48xx	72xx	96xx	48xx	72xx
Voltage-nom (V)	24	36	48	72	96	48	72
Voltage-max (V)	33.6	50.4	67.2	101	134	68	100
Current-max (A)	25	21	18	12	9	30	20
Battery Type	Specific to selected algorithm						
Reverse Polarity	Electronic protection - auto-reset						
Short Circuit	Electronic current limit						

AC Input	QuiQ 1000 (912-, 913-)	QuiQ 1500 (914-, 916-)
Voltage Range (Vrms)	85 - 265	108 - 265
Frequency (Hz)	45 - 65	
Current - max (Arms)	12A @ 104VAC (power reduced by 20% < 104V) 6A @ 230VAC	12A @ 120VAC 9A @ 230VAC
Current - nom (Arms)	10A @ 120VAC 5A @ 230VAC	10.5A @ 120VAC 7A @ 230VAC
AC Power Factor	>0.98 @ 120VAC >0.99 @ 230VAC	
Standby Power Draw	<7 W	

Mechanical	
Dimensions	28.0 x 24.5 x 11.0 cm (11 x 9.7 x 4.3")
Weight	<5 kg (11 lbs) w/ standard cord
Environmental	EN60529 - Enclosure: IP66, AC Input connector: IP20 (without Delta-Q IP66 AC cord)
Operating Temperature	-30°C to +50°C (-22°F to 122°F); derated above 30°C (86°F) and below 0°C (32°F)
Storage Temperature	-40°C to +70°C (-40°F to 158°F)
AC Input Connector	IEC60320/C14 (requires ≥1.8m / 6ft localized cord for UL compliance)
DC Output Connector	inline connectors or 1.8m (6ft) w/ 12AWG wire

Operation	
Battery Temperature Compensation	Automatic via included temperature sensor or isolated temperature sensor input
Maintenance Mode	Specific to charge algorithm

Regulatory	
Safety	
EN 60335-1/2-29	Safety of Appliances/ Battery Chargers
UL2202 1 st Edition	EV Charging System Equipment
UL1564 3 rd Edition	Industrial Battery Charger
CSA-C22.2 No. 107.2	Battery Chargers - Industrial

Emissions (Radiated and Conducted)	
FCC Part 15/ICES 003	Unintentional Radiators Class A
EN 55011	ISM Equipment Radio disturbance characteristics (Class A)
EN 61000-3-2	Limits for harmonic current emissions
EN 61000-3-3	Limits of voltage fluctuations and flicker

Immunity	
FCC Part 15/ICES 003	Unintentional Radiators Class A
EN 55011	ISM Equipment Radio disturbance characteristics (Class A)
EN 61000-3-2	Limits for harmonic current emissions
EN 61000-3-3	Limits of voltage fluctuations and flicker
Efficiency	Up to 94%, California Energy Commission (CEC)

8.1 QuiQ-dci

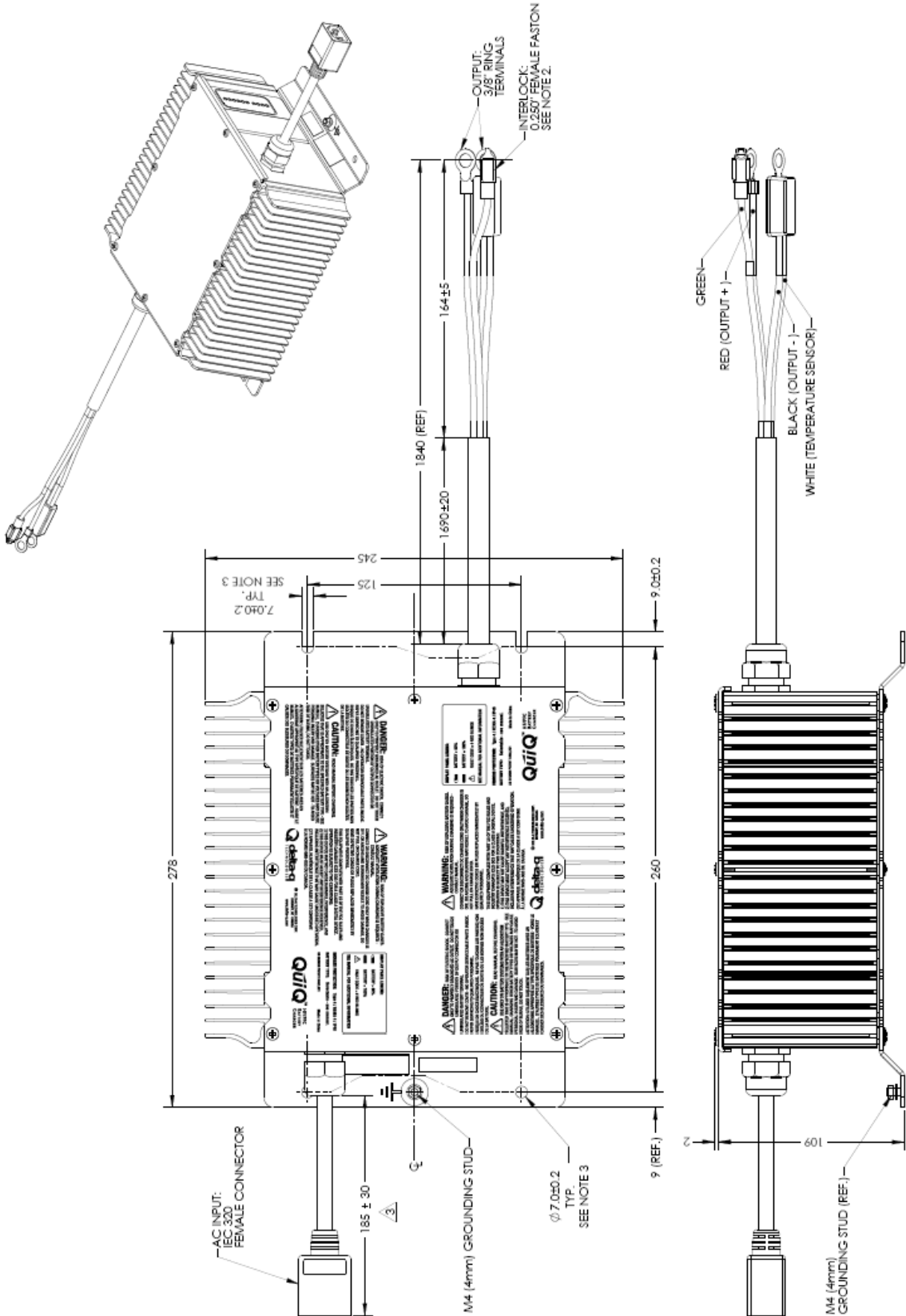
DC-DC Output QuiQ-dci Model: 922-	48xx, 72xx, 96xx
Voltage	13.5V
Current - max	30A
Current - surge	60A - max 2 seconds
Short Circuit	Electronic current limit
Reverse Polarity	Electronic protection

DC-DC Input QuiQ-dci Model: 922-	48xx	72xx	96xx
Voltage Range	35 - 87V	50 - 130V	60 - 150V
Current - max (peak)	12A (24A)	8A (16A)	4.5A (12A)
No-load power draw (low power mode)	< 0.7W		< 0.9W
Voltage Range for Switched Output Enable	8 – 17VDC (50uA @ 13.5VDC)		
Reverse Polarity	Electronic protection		

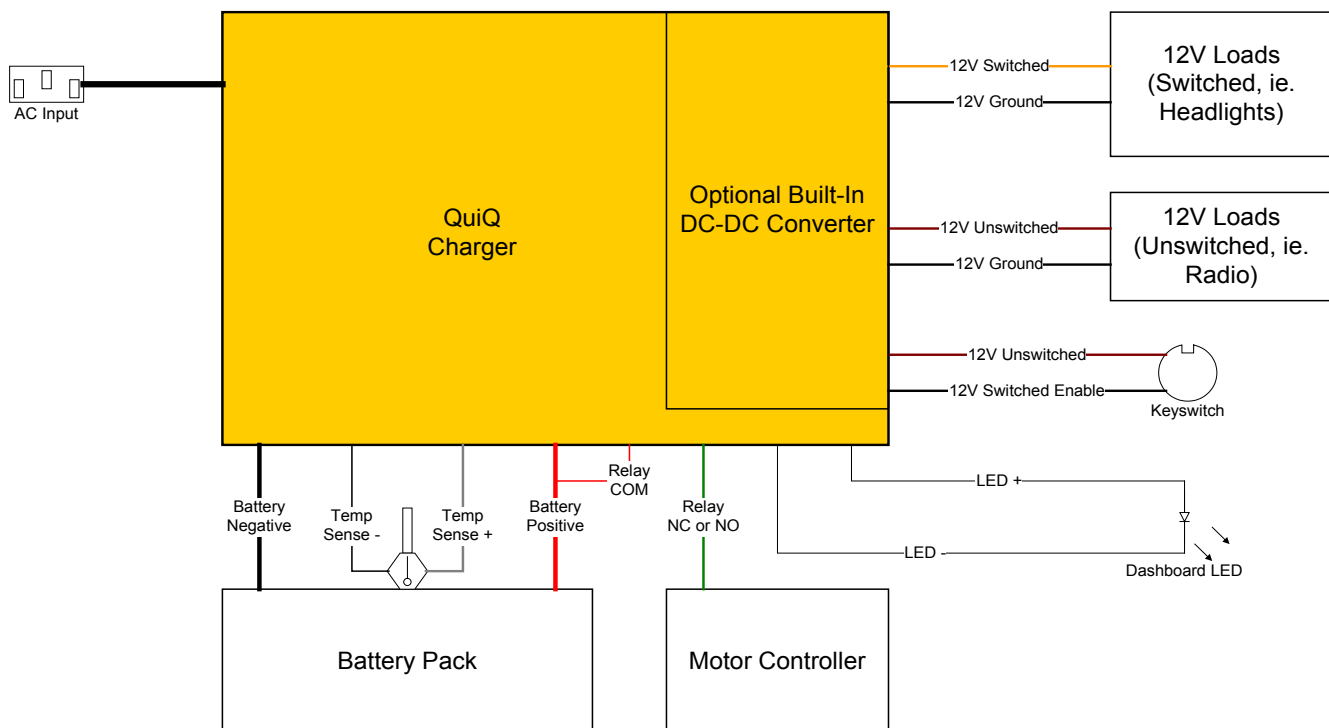
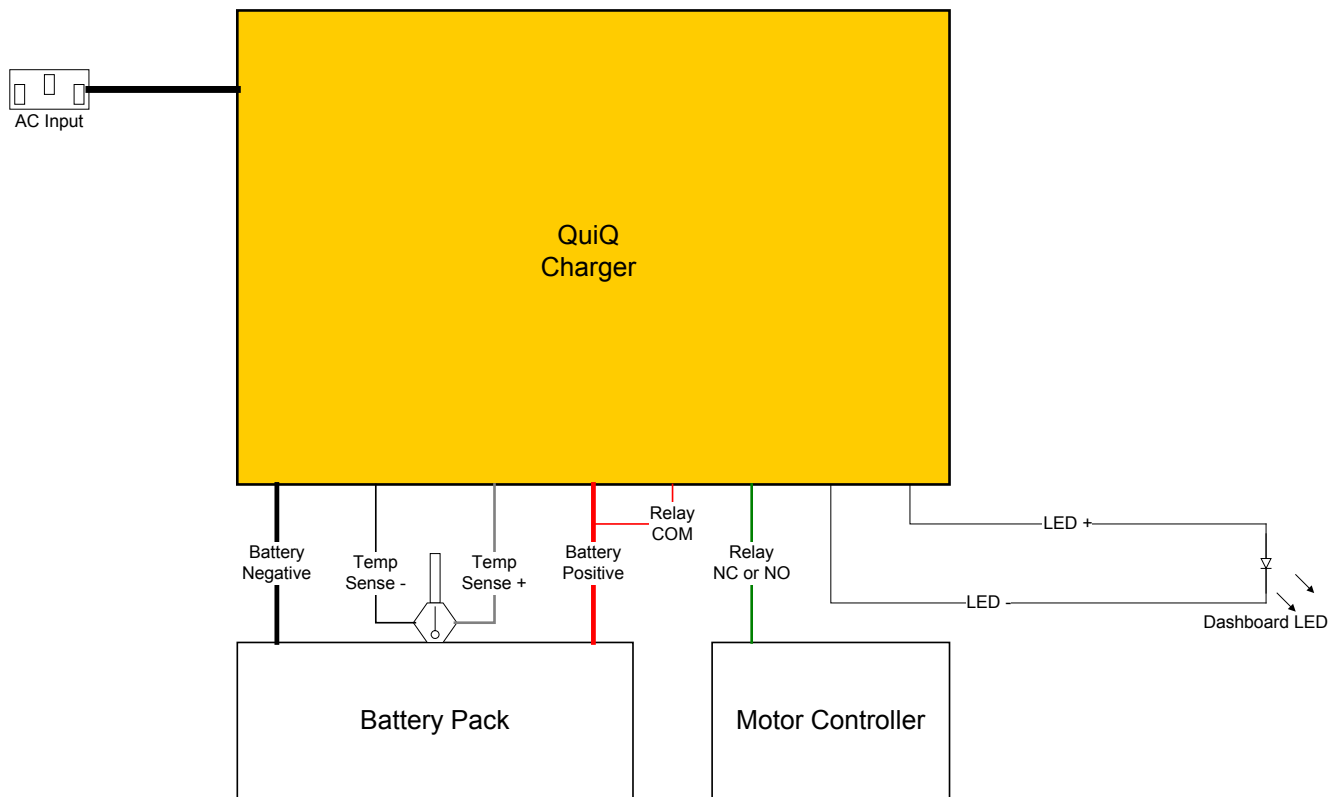
9.0 Glossary

Term	Definition
AC	Alternating current
AWG	American wire gauge
COM	Common
DC	Direct current
DSP	Digital signal processor
GND	Ground
HF	High frequency
HV	High voltage
HW	Hardware
ID	Identification
kW	kiloWatt
LED	Light emitting diode
LV	Low voltage
MCU	Microcontroller
NC	Normally closed
NEG	Negative
NO	Normally open
OEM	Original equipment manufacturer
POS	Positive
PFC	Power factor correction
SW	Software
TBD	To be determined

10.0 Appendix



10.1 Appendix - Sample System Diagram



WARNING: Connecting 12V ground to battery negative bypasses the DC-DC converter's isolation and may allow hazardous battery voltage to appear on the 12V system.



www.delta-q.com



QuiQ

SERIES