CONCISE DESIGN GUIDE
VARTA EASY CHARGER (24 V / 36 V / 48 V)

Date: August 2022

RC 1000 24 V, RC 1200 36 V
Easy Charger 24 V, Easy Charger 36 V

ICL 1500 58 V
Easy Charger 48 V

https://www.varta-ag.com/de/industrie/produktloesungen/lithium-ionen-batterie-packs/asb
or contact: *power@varta-storage.com*

https://delta-q.com – support@delta-q.com

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1. SAFETY AND REGULATORY

1.1 General Safety

1.1.1 Shock Hazards:

- DO NOT open the case of the charger. Hazardous voltages inside
- DO NOT use ground adapters or remove AC ground pin

1.1.2 Hot Surfaces:

- Touchable surfaces of the charger will be hot to the touch, but comply with applicable safety regulations, typically < 75°C
- Compliant with UL touch safe: maximum 45°C rise over ambient
- Do not run cable with 85°C or less rating near the chargers

1.2 Regional Regulatory Compliances

1.2.1 United States and Canada

Safety

- **UL1564 File #E254286:** All Models UL Recognized, select models UL Listed
- **CSA C22.2 No. 107.2-01:** All Models
- Look for these logos on the charger:

EMI

- **FCC Part 15 Class B:** All RC/ICL and some IC650
- **FCC Part 15/ ICES 003 Class A:** All IC900/1200 and most IC650

Efficiency

- **California Energy Commission (CEC):** All Models
- **Dept of Energy (DoE), Natural Resources Canada (NRCAN):** "Consumer product" models
- Look for these logos (DoE does not require logo):

1.2.2 Europe and Australia/New Zealand

CB Report is available for all models. Chargers are CE certified and carry this logo. CE Declaration is available:

Safety

- **EN60335-2-29:** All Models
- RCM or AS/NZS 60335.1, 60335.2.29 Certificate available: Most models. Look for this logo:

EMI

- **CISPR 14-1 and 14-2:** All RC/ICL
- **EN61000-3-2/-3, EN61000-6-2/-4:** All models
- **UNECE R10 compliant:** All RC- and ICL- models

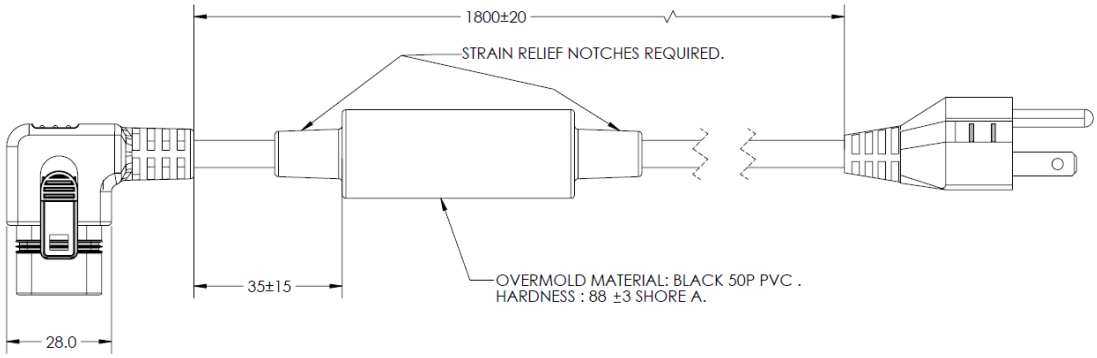
1.2.3 South Korea

KC available for some models – Contact Delta-Q Technologies. Look for this logo:

1.3 Special EMI Considerations

Please consult with Delta-Q Technologies before conducting independent EMI/EMC testing on our chargers. Special handling may be necessary to ensure a pass.

Beads MAY be required 35mm from AC connector on AC wire:

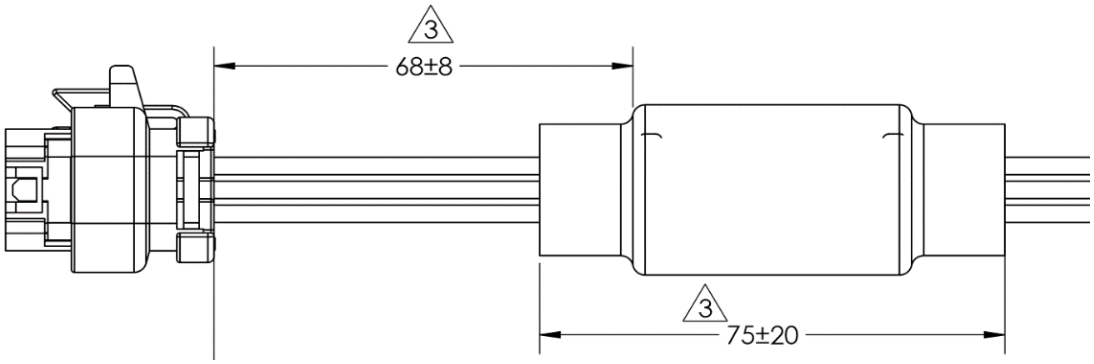


Bead: Laird Technologies 28B0686-200

RC/ICL CISPR models

Bead MAY be required 68mm from DC connector on signal wires:

- RC/ICL Series: FairRite 2631626402
  a. CAN only: two turns
  b. CAN, Interlock, Thermistor: one turn
- RC/ICL Series: FairRite 2631102002
  a. Up to 12 wires, one turn



1.3.1 Reducing EMI

Nearly all electronic and electrical devices create some form of electromagnetic emissions. These emissions, when they are of high magnitude and particular frequencies, can interfere with the operation of other nearby electrical devices. Accordingly, most countries place regulations on various products in order to limit the magnitude of EMI emissions at certain frequencies.

The characteristics of an installation can amplify, focus, or channel electromagnetic waves in unpredictable ways, leading to unexpected results. Delta-Q Technologies provides the following guidelines for EMI reduction:

Wire Routing and Selection

• Keep wires away from emission-causing components and route them as directly as possible. Wires routed alongside emission-causing components pick up and conduct these emissions.

• Avoid loops in wiring. Loops act as antennas. The bigger the physical area of a loop, the greater the risk it will emit and/or pick-up EMI.

• During testing, long cords, extension cords, and ground fault circuit interrupters (GFCIs) can detrimentally affect emissions. Most EMI regulations specify a minimum cord length for testing; shortening of wires to the minimum length in order to meet emission requirements is usually allowed. The regulations often allow shortening by trimming or by folding the cord back upon itself multiple times. Remember to avoid creating loops and do not coil the cord(s).

• Ensure the AC cord is of the correct type and gauge. Choosing the incorrect cord can adversely affect emissions.

Shielding and Grounding

• If wires must be routed near emission-causing components, shielding the wire reduces the severity of conduction. Regulations often allow the shielding to be connected to any point on the wire, but it is usually

most effective when connected to a chassis or circuit ground point. Similarly, emissions from wires can often be contained by a grounded shield. Shields should usually be grounded at only one point, generally at the source of the signals in the wire(s).

• If the equipment has a metal frame, the emissions can be reduced by electrically connecting the chassis of the emission-causing component to the frame.

Filters and EMI Reducing Beads

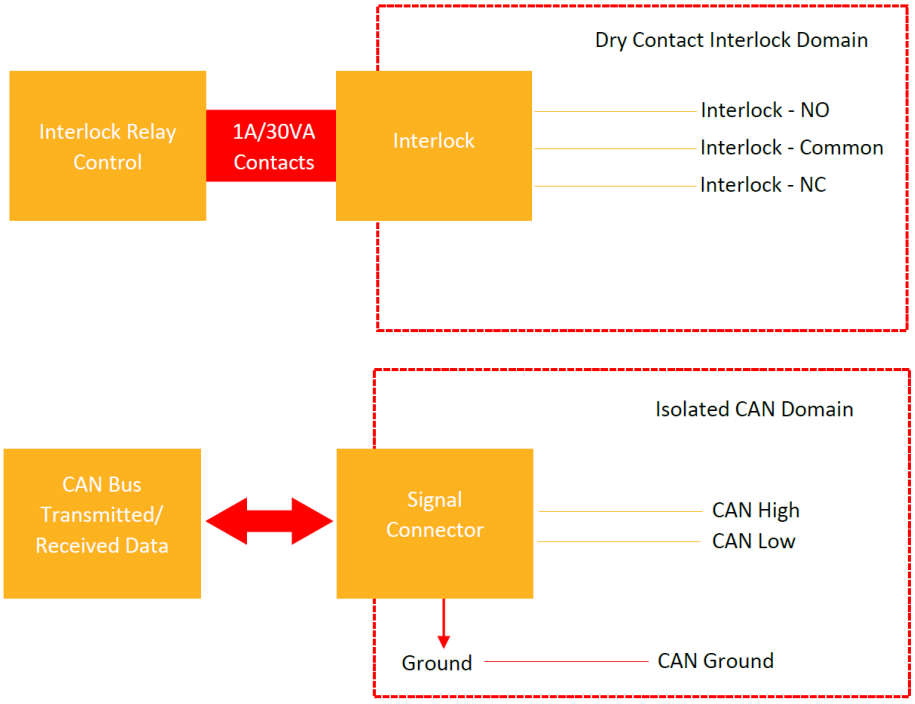
• Install all emission-reducing devices required for each component of your system. Refer to the user manual provided by the manufacturer for each of these components. Many Delta-Q charger versions require emission-reducing components to be installed in/on the wiring harness.

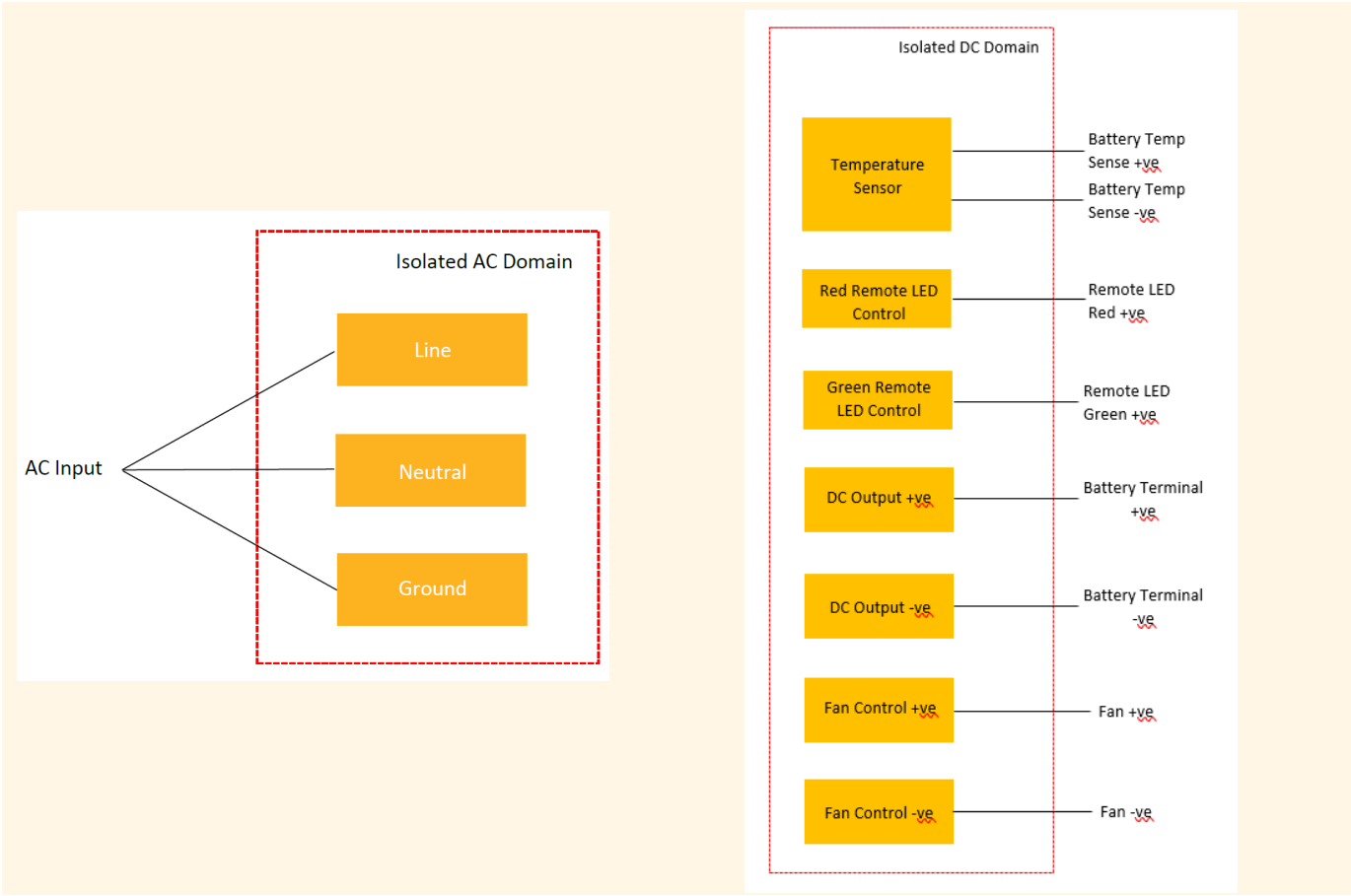
• Filters can be added to reduce emissions. Inline filters for the AC input such as Epcos B84112G0000B110, Schaffner FN2030-10-06, and Delta 10DSCG5 have been found to be effective in many cases. Be sure to select a filter designed for the application and one that meets local requirements.

• The ICL, and RC Series chargers are tested for worst-case radiated emissions by using a fully populated (12/14) wires on the Signals and Control connector. An EMI reducing bead is installed over all wires connected to the Signals & Control connector to meet the requirements of radiated emission. However, it is recommended to determine whether the ferrite bead is required or not in the end application while performing Electromagnetic Compatibility (EMC) testing on the entire system/vehicle. There is a good chance the ferrite bead may be reduced (in size) or not be required in cases where only a few wires are used on the Signals and Control connector, or where the signal wires are shielded or partially shielded by the application's housing/chassis.

2. GENERAL INFORMATION

2.1 Block Diagram and Isolation





Hi-Pot Testing:

Note that every charger is hi-pot tested at the factory. Subsequent hi-pot tests may damage EMC components. If continuity and insulation need to be checked after charger delivery, it is suggested to use a resistance test only.

2.2 Software configuration

VARTA ranges the Delta-Q models RC1000 (for Easy Blade 24 V and Easy Block 24 V), RC1200 36 V (for Easy Blade 36 V and Easy Block 36 V) and ICL1500-58 (for Easy Blade 48 V and Easy Block 48 V). These chargers are loaded with a VARTA Custom Software Configuration and are plug and play with the VARTA Easy Blade and Easy Block battery. If your Application require other power levels or harsh environments where fans may become liability, then other Delta-Q chargers of the IC, RC or ICL series can be made compatible with the VARTA Easy Blade and Easy Block batteries, however VARTA did not tested nor validated these combinations. Contact Delta-Q Technologies for more info about possible solutions.

3. MECHANICAL INSTALLATION

3.1 Fitment and Mounting

3.1.1 2D/3D Drawings

Charger and accessory 2D/3D prints are available from our homepage (https://www.varta-ag.com/de/industrie/produktloesungen/lithium-ionen-batterie-packs/asb). General drawing and mounting hole locations are in Appendix A.

3.1.2 Mounting Instructions

Robust mounting points are cast into the charger's aluminum enclosure. At each corner are 6.3mm (1/4") diameter slots, arranged to allow ample tolerance when mating with standoffs or pre-drilled holes in a machine. Use either ¼" or M6 screws of an appropriate length to secure the charger to the intended support.

If mounting the charger on a vehicle or machine frame that may be prone to flexing, it is recommended to mount the charger using only three of the mounting points to prevent the charger case and internal components from being subjected to undue stress and torsional loads.

- Mount the charger securely using the mounting points shown in this section.
- A bracket may need to be fabricated, particularly if there is insufficient cooling air flow.
- Do not drill holes in the charger.

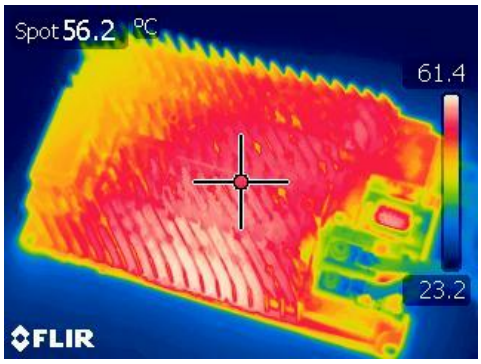
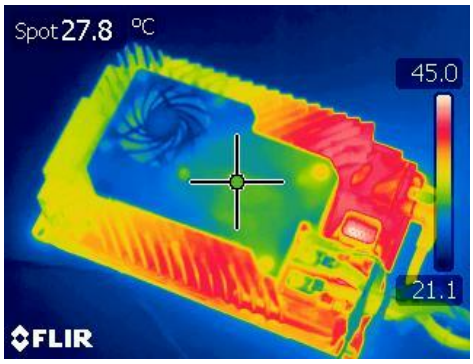
3.2 General Cooling

3.2.1 Ventilation

All chargers MUST have ventilation for hot air to escape the cavity and cool air to flow in.

3.2.2 Heat Generated

Designs should allow for up to 10% of the charger's maximum power to be exhausted. i.e. 10% of 1200W is 120W. Thermal images below show hotspots of various chargers:

RC/ICL non-fan	RC/ICL fan
	

3.3 Fan Cooling

3.3.1 Fan Details

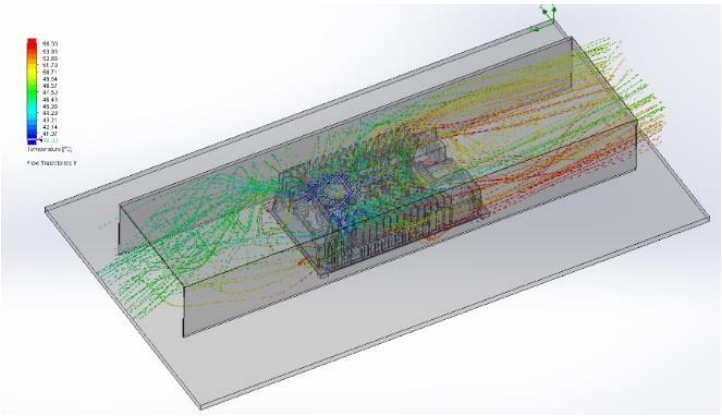
Note: Charger fan only runs during start up as a self-test, then only on demand.

- Quiet, IP67
- L10 life: 65,000hr

This is a Field replaceable part available from Delta-Q Technologies.

3.3.2 Air Direction and Clearance

Fans direct exhaust air to the rear (connector) side of the charger. Minimum 1" air gap around the sides of the charger is recommended. See simulation below:



3.4 Handle and Feet

Optionally, Fan-cooled chargers are available with molded-in handles - Rubber feet are common to all IC/RC/ICL series chargers: these parts are available from Delta-Q. For low volumes rework Kits are available, for high volumes specific model can be setup. Contact your distributor or reach out to www.delta-q.com/support.

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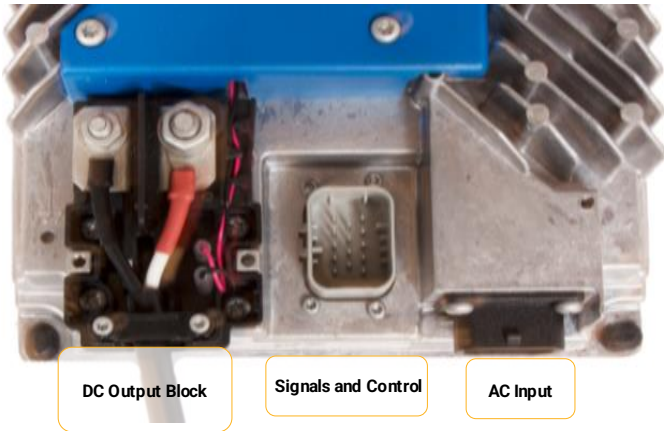
4. ELECTRICAL CONNECTIONS

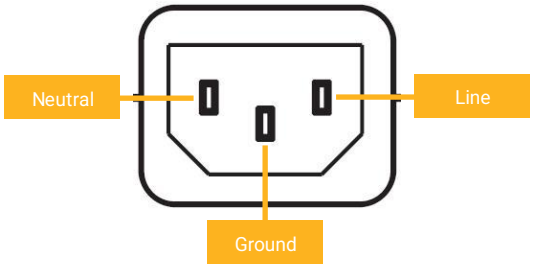
Standard RC/ICL series



4.1 AC Input

Connector Type: Standard IEC60320/C14

Recommended Connector Type: Delta-Q IP66 Sealed AC cord
Alternate Mating Connector: Standard IEC60320/C13



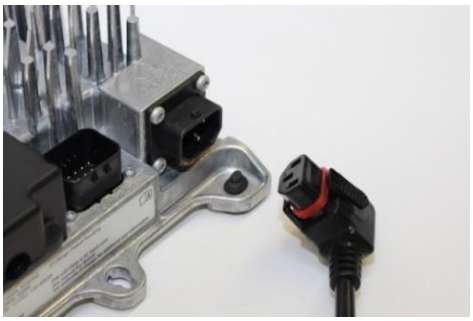
Pin	Wire Color Code	Description
L	Brown	AC Line
G	Green/Yellow	AC Ground
N	Blue	AC Neutral

4.1.1 Recommended AC Cords:

- **North America:** 3-conductor UL/CSA >1.8m (6ft), SJT w/ 300V 13A connector

  a. 16AWG max 7.5m (25ft)
  b. 14AWG max 15m (50ft)
  c. 10AWG max 30m (100ft)

- **Japan:** 3-conductor PSE with 100V 15A connector
- **Rest of World:** 3-conductor 1.0mm^2 w/ 250V 10A connector with ground plug



- Delta-Q IP66 Sealed, Locking AC Cord

It provides sealed, retained AC connection to the charger with positive latch with SCHUKO plug for Europe or NEMA 5-15 plug for North America.

VARTA offers currently 2 references:

VARTA P/N	VARTA Description	DQT P/N	Description
800751	AC Cord 3 m EU	475-0410	AC CORD 3.0M 1.0mm2 IEC320 H05VV-F CEE 7/7 IP66 10A 250V W/SEAL WITH SCHUKO PLUG - EUROPEAN PLUG
727150	AC Cord 3 m USA	475-0495	AC CORD 3.0M 16AWG IEC 320 SJTW NEMA 5-15 IP66 13A 120V - NORTH AMERICAN PLUG

Delta-Q Technologies offers also other type of cords, lengths, country specific plugs, or as bare wire pigtail for hard wiring to another country specific plug or cord reel. Contact your distributor or reach out to www.delta-q.com/support.

4.1.2 AC Cable Bend Radius Recommendations

475-0410 OD7.1mm (~30mm min bend radius)
475-0495 OD8.5mm (~35mm min bend radius)

4.2 DC Output

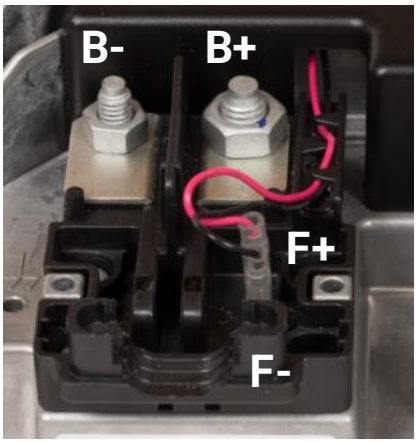
4.2.1 Torque Value Tables

RC/ICL Series

Battery Negative (B-)	10mm M6 Hex Nut	4.5Nm +/-0.2Nm*
Battery Positive (B+)	13mm M8 Hex Nut	6.0Nm +/-0.2Nm*
DC Cord Cable Clamp	Torx T10 screws (x2)	0.6Nm +/-0.05Nm
DC Terminal Block Cover Screws	Torx T20 screws (x2)	1.8Nm +/-0.1Nm

***Note:** If necessary, it is acceptable to use 5.25Nm for both B- and B+ on the RC/ICL terminals.

4.2.2 RC/ICL-Series DC Terminal Block



Pin	Description	Notes
B-	Battery negative	10mm M6 Hex Nut
B+	Battery positive	13mm M8 Hex Nut
F+	Fan power/control positive; 0-12 VDC (fan-equipped models only)	Fan-cooled models only 2.8mm (0.110”) quick-connect terminals
F-	Fan power/control return; 0-12 VDC (fan-equipped models only)	

4.2.3 Recommended DC Cable Size and Maximum Lengths

- For compliance with CEC and US DoE
- Total length from charger terminal to battery terminal (assuming B+ and B- same length)
- **Important:** DC connectors and termination must be rated above the maximum current of the charger!

Maximum DC Cable Length (in meters)		AC Cable: 3m, 1.0mm² (16AWG)					AC Cable: 2m, 2.0mm² (14 AWG)				
		Wire Gauge (AWG/mm²)					Wire Gauge (AWG/mm²)				
Charger	**Voltage (V)**	**14/2.5**	**12/4.0**	**10/6.0**	**8/10.0**	**6/16.0**	**14/2.5**	**12/4.0**	**10/6.0**	**8/10.0**	**6/16.0**
RC1000	24			1.6	2.6	4.2			1.9	3.0	4.8
ICL1500	58			1.6	2.6	4.2			1.9	3.0	4.8

4.2.4 DC Cord Clamps

RC, and ICL-series DC Cord clamps are reversible to support different wire sizes.

RC/ICL Series

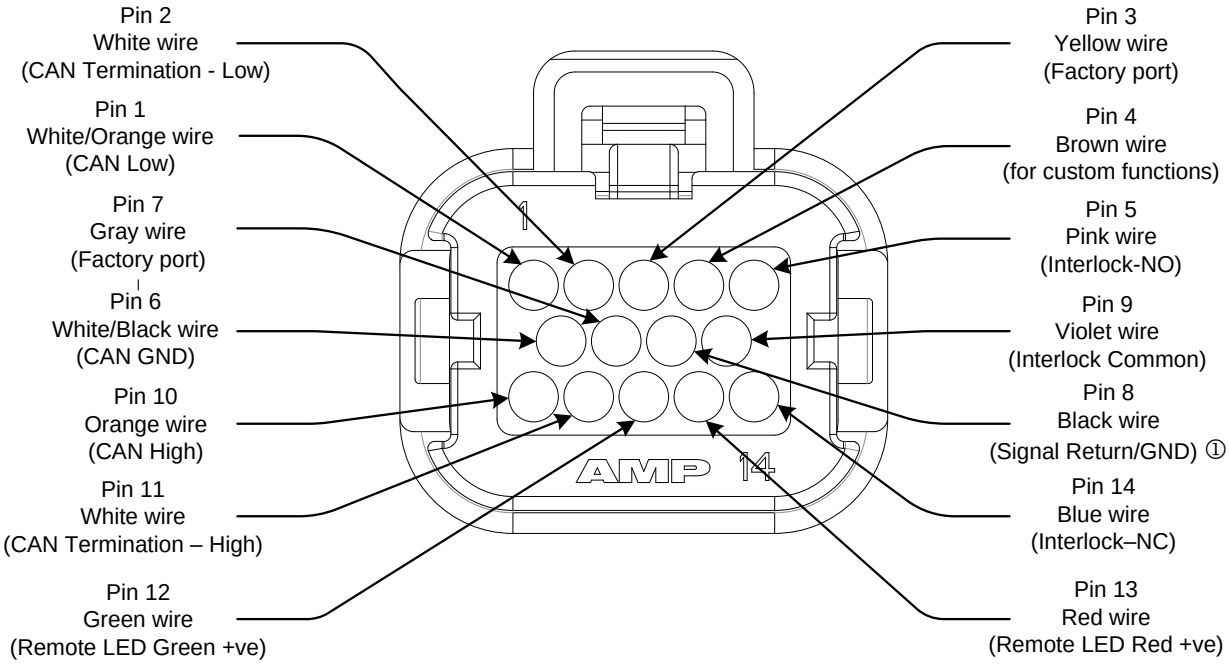
Ref	Min O.D.	Max O.D.
A	8.0 mm	10.0 mm
B	9.0 mm	12.5 mm

4.3 Signals Connector

Delta-Q Technologies uses the TE AMPSeal line of connectors for signals. There are two different keyings and layouts – IC Series (Black housing) is different from RC/ICL Series (Grey housing).

4.3.1 RC/ICL Series

Description	TE Part Number
Charger Header *(for reference only)*	776262-4
Cable Plug *(body only)*	776273-4
Contacts *(loose piece)*	770854-1
Contacts *(strip form)*	772520-1



RC/ICL Series COMM Pinout

Wire Colour	Pin No.	Description	Details
White/Orange	1	CAN Low	Isolated CAN Low
White	2	Selectable CAN Models(*)	Connect Pins 2 & 11 to enable internal CAN bus termination
		All other models	Control Panel Ground
N/A	3	Factory port	Factory use only
White/Red	4	Master input	In a **single charger** system or in a stackable system in order to work properly, **pin 4 and 8 must be populated/shorted in the system connector** on the master and left open on all secondary chargers.
Pink	5	Interlock-NO	Dry Contact Interlock relay: Normally open contact
White/Black	6	CAN GND	Isolated reference ground for CAN
N/A	7	Factory port	Factory use only

Wire Colour	Pin No.	Description	Details
Black ○	8	Signal Ground	Pin 8 is the ground reference for Pins 3, 4 & 7 on all ICL & RC models (and also for Pins 12 & 13 in some Remote LED installations) Pin 11 is the ground reference for the Panel on RC W/UI and ICL W/LED models. Both are electrically connected, via a low-impedance resistor/inductor circuit, to the Battery Negative terminal on the DC block
Violet	9	Interlock-Common	Dry Contact Interlock relay: Common contact
Orange	10	CAN High	Isolated CAN High
Black ○	11	Unused or Control Panel Ground	RC Base models: not used. RC W/UI models: Control Panel Ground reference
		Selectable CAN(*)	Connect Pins 2 & 11 to enable internal CAN termination
Green (White on Remote LED accessory)	12	Remote LED Green +ve (anode) / Red -ve (cathode)	Base Models: for an optional Remote LED: Pin 12 goes high with respect to Pin 13 to light the LED green, and vice versa to light the LED red. W/LED or UI models: for the Panel LED: Same but with respect to pin 11
Red (Black on Remote LED accessory)	13	Remote LED Red +ve (anode) / Green -ve (cathode)	See 4.6.1 Remote LED
Blue	14	Interlock-NC	Dry Contact Interlock relay: Normally closed contact

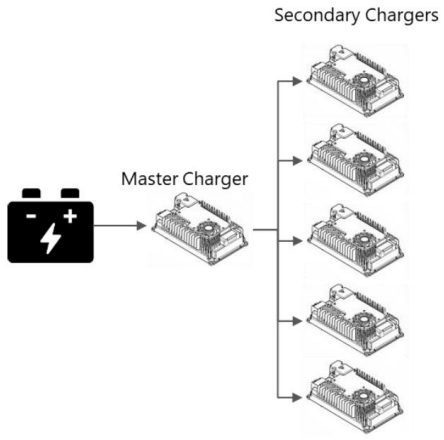
○ ***NEVER*** connect Pin 8 or Pin 11 in the RC models directly to the Negative terminal of the battery, nor to the Negative terminal in the DC block.

* Chargers ranged by VARTA are by default CAN termination selectable, however the first models RC1000 (24V) are CAN unterminated. Check P/N on charger: 946-0002 is CAN unterminated.

4.4 Stackable Charging System

The Stackable Charging System (SCS) is a modular, scalable, fast-charging solution that meets stringent OEM requirements for automotive, material handling, and construction electric vehicles. The base chargers are ruggedized, the installation can be distributed, and the SCS can support both on- or off-board operation.

The SCS is intended for medium to large battery packs of all chemistries and voltages up to 120 Vdc. Up to six (6) chargers of the same model may be stacked to meet high power demands. The system works using a master and secondary principle, with a harness jumper providing the master/secondary designation. This allows secondary chargers to be inserted into the master spot to continue operation in the rare case that a master would fail.



4.4.1 Mechanical Installation Guidelines

Install chargers as per Section 6.0 of the ICL & RC Series Battery Chargers Installation and Design Guide.

Note: It is not possible for secondary chargers to match their CAN addresses to their installation locations in the system.

4.4.2 AC input

Delta-Q Technologies require OEMs/integrators to be responsible for distributing AC power from the source to the SCS.

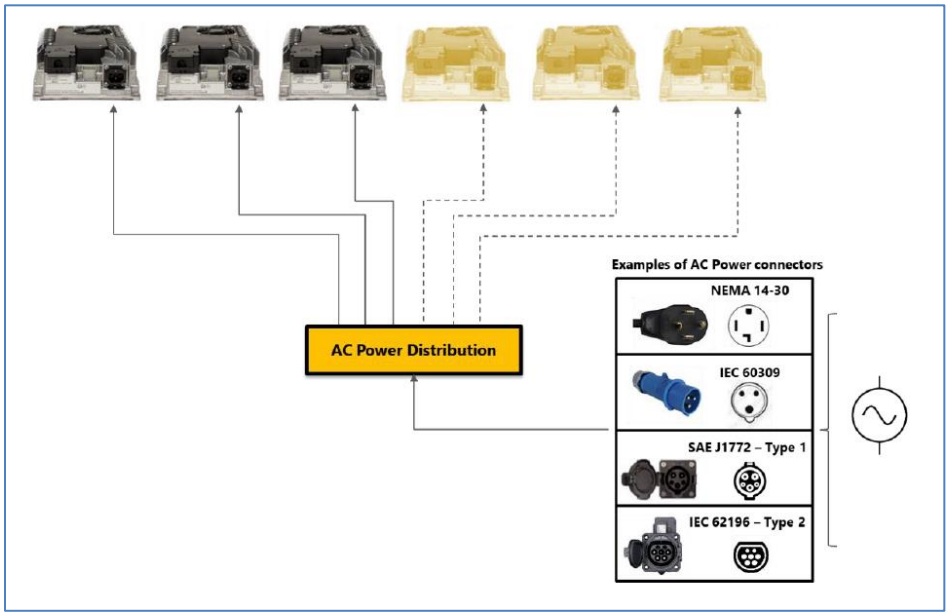
AC cord (PN: 475-0509) is recommended for use with the chargers for a few reasons:

• It is pigtailed for easy integration with an AC distribution system.
• It is sealed and latched at the charger end.
• At 3.8m long, it can also be cut to the desired length
Contact Varta or Delta-Q Technologies for more options

Notes on AC Operation

Individual chargers continue to use the existing AC derating curves.

The SCS may have its current limited from the VCIM or from the vehicle via CAN but not both. Some configuration settings may also limit the input current



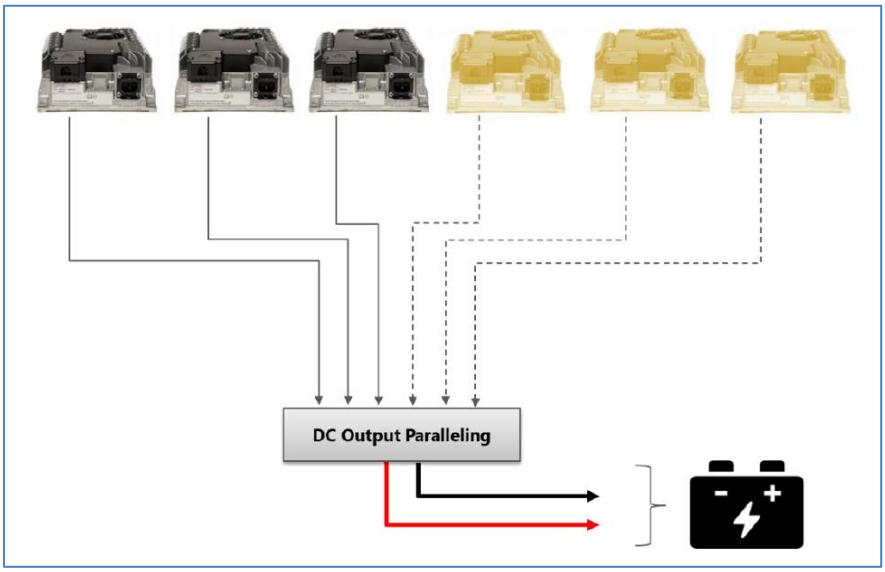
4.4.3 DC Output

OEMs/integrators are also responsible for safely connecting the charger outputs in parallel and selecting a suitable size connection/cable system to the battery. See the ICL & RC Series Battery Chargers Installation and Design Guide for DC wire gauge recommendations for the individual chargers.

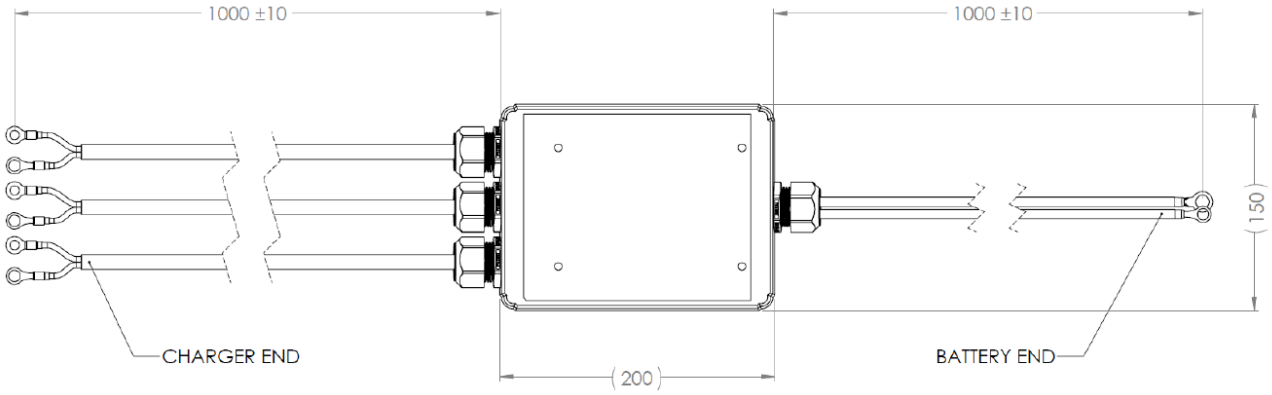
The master charger should be placed closest to the battery, ideally with a direct connection to battery posts (i.e., not connected to a secondary charger before going on to the battery). This minimizes the effects of voltage drop due to resistance in the cables.

The installation should be designed with properly rated cables so, at maximum output current, the voltage measured at the chargers' outputs are all within one volt or each other. However, if that is not possible, the master charger should still be placed closest to the battery but with no more than one joining node between itself and the battery.

NOTE: Do not stack more than two ring terminal connections onto a connection post.



DC Output Paralleling Example



4.4.4 SCS CAN Communications

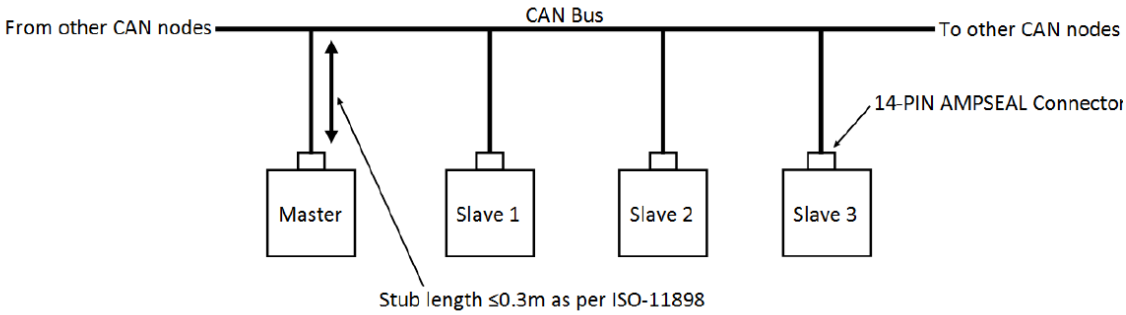
In the SCS, the master charger controls the output of secondary chargers using proprietary J1939 messages (PGNs). Secondary chargers' addresses are allocated via the J1939 Network Management protocol SAE J1939-81. While all this uses 29-bit identifiers, it can work alongside a CAN bus operating with 11-bit identifiers.

It is intended for the vehicle to communicate with the master charger in J1939 or CANopen as per a single Delta-Q Technologies charger. It is not possible to communicate directly with the secondary chargers.

4.4.5 CAN bus Connections

It is important to consider the following:

- SCS chargers must be on the same CAN bus to communicate with each other.
- Only one set of stacked chargers can be present on the CAN bus.
- Individual chargers should not have CAN terminations.



CANopen master charger's node ID is a fixed factory settable Node ID.(VARTA =100d)

CAN Termination: Chargers with CAN termination should not be used in a SCS. Independent CAN terminators should be used on the CAN bus instead of relying on the chargers.

Diagnostic Charge Cycle Data: Diagnostic charge cycle data returned by the master is for the stacked system as a whole. It is not possible to read individual secondary charger data.

4.4.6 CAN bus Connections

Signal Connector: **Important:** In order for SCS to work properly, pin 4 and 8 must be populated/shorted on the master and left open on all secondary chargers.

For more details on the 14-pin AMPSEAL connector, see Section 3.3.1

Master Charger Required AMPSEAL Connections

Pin Number	Function
1	CAN Low
10	CAN High
6	CAN Ground
4	Master Charger Select/Temperature Sensor
8	Signal Return/GND

- Ensure pins 4 and 8 are always shorted or connected to a temp sensor at the master charger. The detection of the master/secondary chargers is done at master power on ON only.
- Ensure there is only one master for each SCS.

Secondary Charger(s) Required AMPSEAL Connections

Pin Number	Function
1	CAN Low
10	CAN High
6	CAN Ground
4	Do Not Connect
8	Signal Return/GND

- Ensure pins 4 and 8 are open circuit for all secondary chargers.

4.4.7 Electromagnetic Compliance

Depending on the EMC requirements required in the final application, it may be necessary to install a filter at the AC inlet. A Corcom 20VQ1 filter has been shown to be effective for the SCS. Contact Delta-Q Technologies to discuss your specific requirements.

Further EMC guidelines can be found in Section 1.3 or the Support Article at support.delta-q.com, Reducing Electromagnetic Interference

4.4.8 Cooling

Ensure the chargers have sufficient clearance for airflow for maximum performance. Obstruction of airflow will result in de-rated performance. Refer to the ICL & RC Series Battery Chargers Installation and Design Guide for details.

The master charger should be placed in the coolest position in the SCS as it will be outputting more power on average than the secondary chargers

4.4.9 Stackable Configuration

All chargers in an SCS are loaded with the exact same software configuration. In addition to making the SCS very simple to configure and program, this also allows any charger to become the master by simply moving the charger to the master plug position.

- Fixed vs. Variable Number of Secondary Chargers
  The stackable system can be configured to check the number of secondary chargers and prevent the stack from operating if there are additional/missing chargers. If configured for a variable number of chargers, this check cannot be done. (This is the default)
- Standard Configuration Options
  A Delta-Q Technologies Application Engineer can help you configure the SCS for Baud rate, PDO mappings, masters Node ID, missing message behaviour, incorrect PDO length, etc., as for standard single chargers.

- SCS Required Configuration Options

  - Secondary chargers CANopen Nodes ID range
  - J1939 Addressing: secondary chargers select a J1939 address from a factory configured range
  - Number of chargers (fixed or variable)
  - AC Input Current Limits for both NA nominal and European Nominal AC Voltage ranges

- Constraints on the System
  - Standard Delta-Q Technologies chargers cannot be added to an SCS without special programming.
  - Not all Delta-Q Technologies algorithms are supported for use in the stacked system. Please contact Delta-Q Technologies to discuss your specific requirements.
  - It is not possible to detect other charging devices on the same battery as the SCS. This includes other non-SCS Delta-Q Technologies chargers on the CAN bus.
  - During the transition from constant charging (CC) to constant voltage (CV) charging, there may be a small reduction in output power to allow a smooth transition.

4.4.10 Stackable Load Sharing

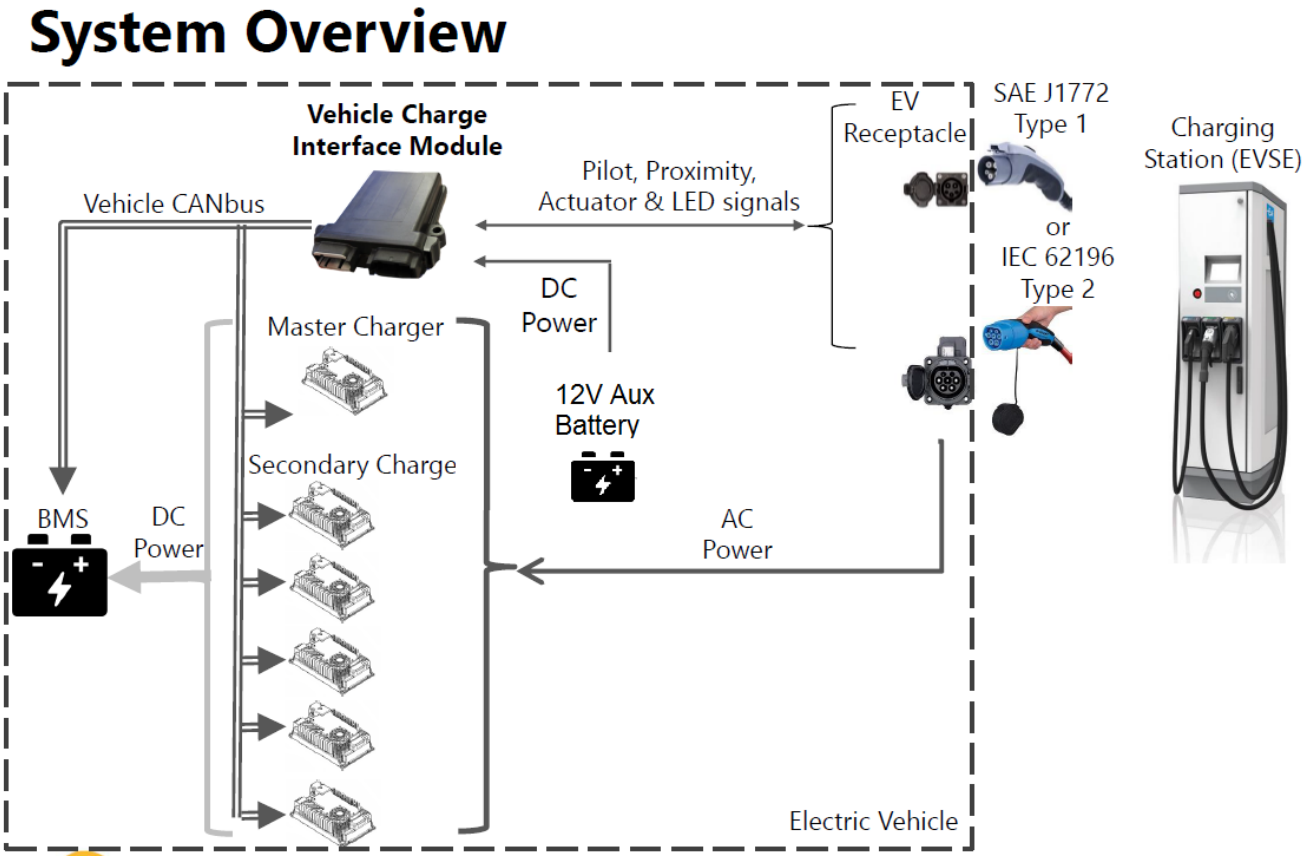
The master charger will evenly distribute current between secondary chargers as best as possible. But as the current reduces during charging, it will gradually shut chargers off to prevent them from operating in less efficient regions.

If one or more chargers begin to de-rate due to temperature or input voltage, the master charger will actively shift the load away from those chargers.

4.5 Vehicle Charge Interface Module

The Delta-Q Technologies Vehicle Charge Interface Module (VCIM) is a standalone Electronic Control Unit (ECU) fitted to an Electric Vehicle (EV), that detects and manages the connection to the Electric Vehicle Supply Equipment (EVSE). It acts as a bridge between the EVSE and Charger/EV. It can either be controlled by the EV via CANopen or SAE J1939, or it can operate in a stand-alone mode with just the charger stack. Please refer to the Delta-Q Technologies VCIM Application Note: Vehicle Charge Interface Module (PN: 740-0027) for functional behaviour. The VCIM is known as an Electric Vehicle Charging Connection (EVCC) in the J1939 standard.

The connection between EVSE and EV may carry high currents and/or voltages and is subject to regulatory standards such as IEC 61851-1 in Europe and SAE J1772 in North America. There is a large degree of harmonization between these two sets of standards. While the physical connectors may be different, the underlying electrical circuitry and control logic are virtually identical. option.



Please contact Delta-Q Technologies for more info about this feature

4.6 Signal Accessory Features

4.6.1 Remote LED

Pre-made harnesses from Delta-Q are available for the Signal connector. Contact Delta-Q Technologies for existing options.

Alternate LEDs:

Any 5mm T1-3/4, 10 – 20 mA nominal

- Everlight/Fairchild MV5491A
- Lite-On LTL-293SJW

Other 2-lead bipolar LEDs which work with ~6–9 mA forward current can be used but may not produce bright amber colour.

LED Holders

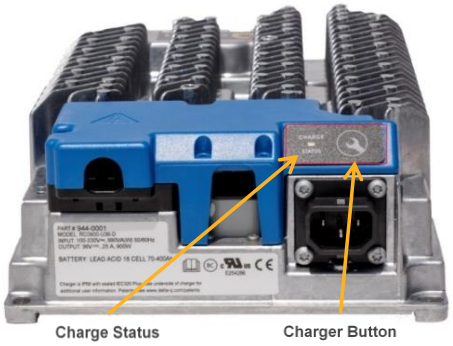
- Lumex SSH-LX5091 and SSH-LX5090 or similar (maximum 1.5mm panel)
- Bivar CR174 for 0.8 – 3.2mm panels
- Bivar CR-174L for 1.5 – 6.4mm panels

Recommended Cable

16-20AWG 2-conductor, maximum 7.5m (25')

4.6.2 User Interface – RC/ICL Series

There is an optional UI part available for RC/ICL Series. It has LED which reflects the charging status. Contact your distributor or reach out to www.delta-q.com/support.

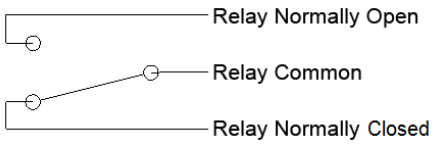


4.6.3 Interlock

Many applications require a safety mechanism to prevent the machine driving away while plugged in.

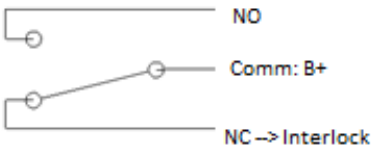
Dry Contact Interlock

These are isolated, non-powered contacts on the signal's connector with the below logic:



See pinouts in section 3.3.1.

Example to use the dry contact relay as interlock:
- B+ when not connected to AC
- Open circuit when connected to AC



Important: There will be a de-energization delay on loss of AC depending on the dissipation of the internal energy.

Charger	Interlock De-Energize Delay
RC/ICL Series	<5s

Dry Contact Interlock Resistive Current Limits

Voltage Range	Min	Max
0 - 30VDC	0.1mA	1000mA
30 - 110VDC	0.1mA	500mA
110 - 125VDC	0.1mA	300mA

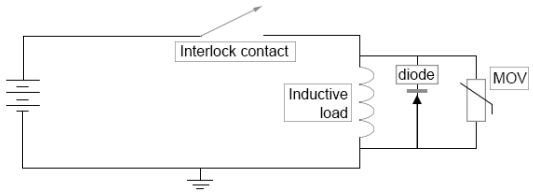
Important: Protect these contacts with an external fuse if there is a risk of overcurrent.

Protecting Interlock Relays

In addition to fusing for resistive loads at the limits listed above, protection for inductive kickback and surge loads should also be considered:

Inductive Kickback

Voltage spikes (kickbacks) occur if the load is inductive, such as a relay or motor, and may damage the charger interlock circuits. A free-wheeling diode, a metal oxide varistor (MOV), or a transient voltage suppressor (TVS) will minimize this kickback. See example circuit below:



Surge Loads

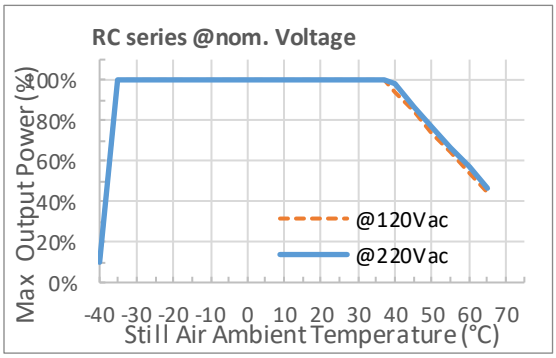
Many loads (e.g., motors, light bulbs, and electronic equipment) often have an inrush or surge current when first connected to power which will weld or severely damage relay contacts. To protect against this, test for surges with an oscilloscope and a current sensor and install a suitable resistor in series to reduce the surge. Delta-Q Technologies can help you select this resistor.

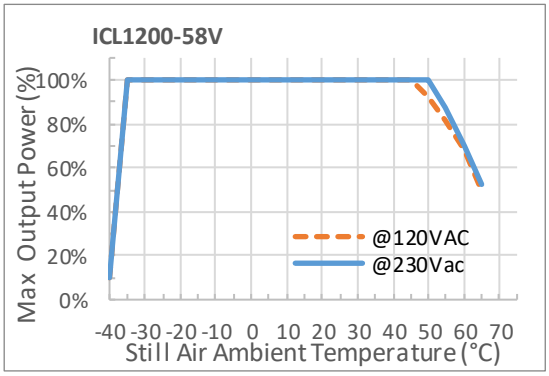
5. OPERATION IN ADVERSE CONDITIONS

5.1 Temperature Extremes

The supported ambient temperature range of operation for all chargers is -40°C to +65°C. The chargers will de-rate output to regulate internal temperatures.

Charts of Maximum Output Power vs. Ambient Temperature:





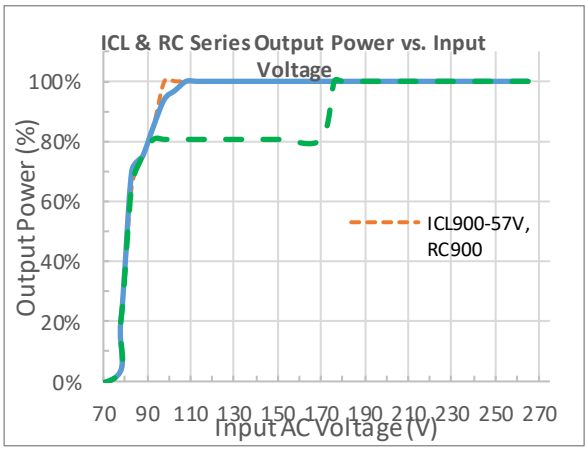
5.2 AC Voltage Extremes

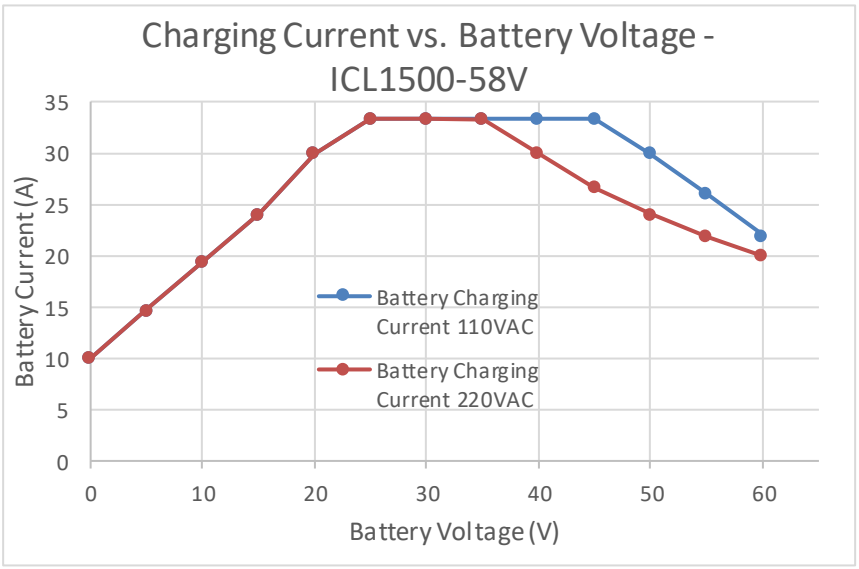
Low AC Voltage

- Derate below ~100VAC
- Shut off at 80VAC
- Turn on at 85VAC

High AC Voltage

NOTE: Charger hardware may be damaged if exposed to AC voltage above 280VAC! Contact Delta-Q Technologies if protection for high AC voltage is required.



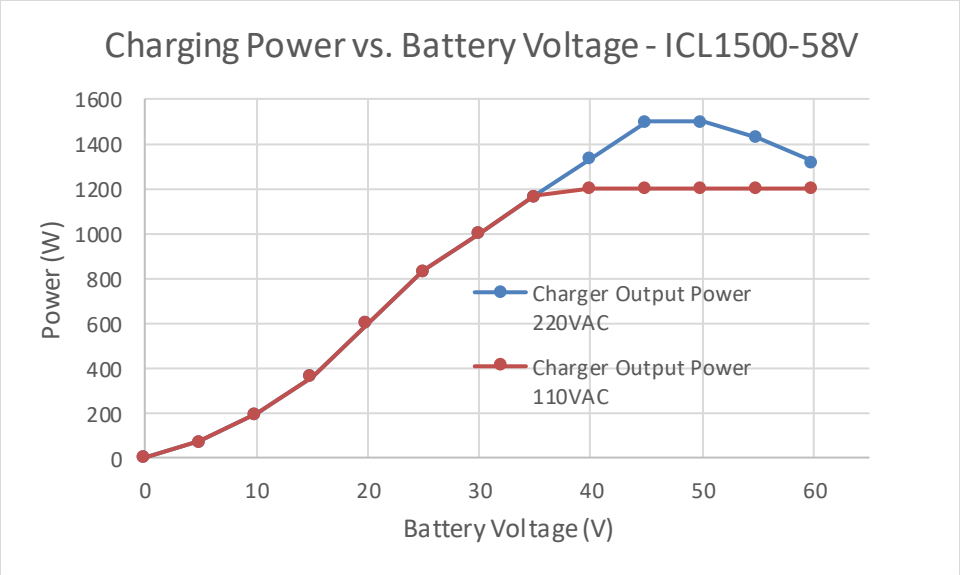


5.3 DC Voltage Extremes

RC, ICL Series chargers are *Constant Power* devices. Below a certain voltage they will be *Current Limited*. In addition, at high battery voltages and high AC voltage, some models will have a slight power limit. See charts below.

RC- series	Min Batt V to start charge	Current Limited below	Max Output V
24V	1.2V	24.0V	36.0V
36V	1.8V	36.0V	54.0V
48V	2.4V	48.0V	72.0V

ICL-series	Current Limited Below	Max Output V
58V	36.0V	58.0V



5.4 Charger Power on AC or DC Only

	Power on with AC in Range	DC-Only Off Delay	Power on with DC in Range
RC/ICL-Series	Yes (85-270VAC)	Cannot be powered by DC	

6. OTHER REFERENCES

6.1 Service

6.1.1 Changing Algorithms

- *Not required – The Delta-Q charger is equipped with custom software to communicate with the VARTA Easy Blade and Easy Block batteries*

6.1.2 Faults and Error Codes

See *Faults and Error Codes - IC/RC/ICL Series. There is no HMI on the RC/ICL series: errors are reported on the CAN bus (CANopen)*

6.2 Integration / Design-In

6.2.1 FMEA

FMEA available upon request. Contact your representative.

6.2.2 Cable and Accessory Installation

See separate App Notes:

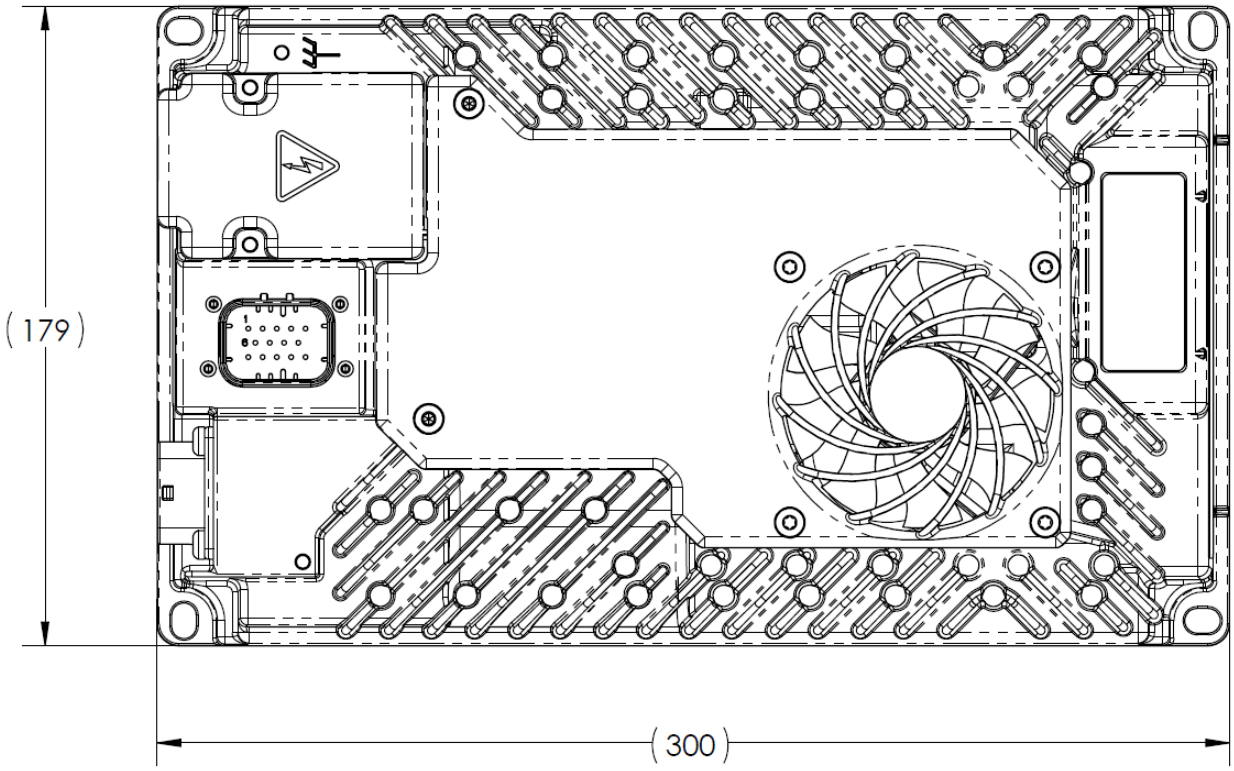
- ICL-RC-Setup Guide

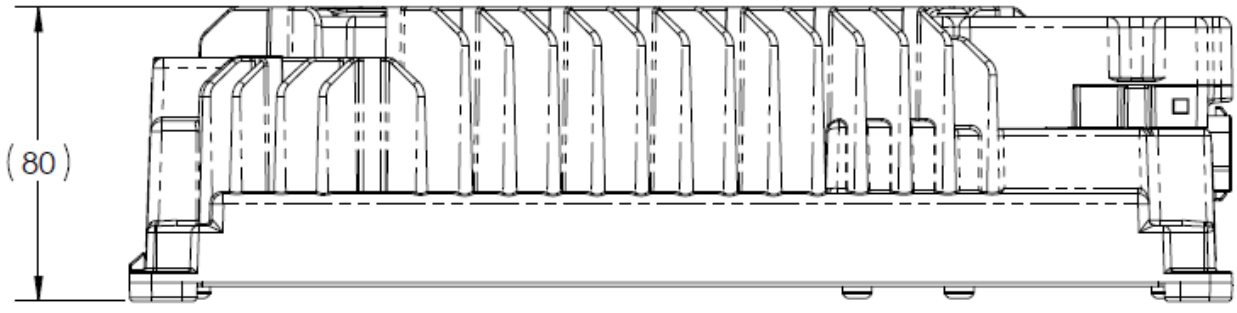
6.2.3 2D and 3D drawings

2D drawings and 3D models are available for all chargers on our homepage (https://www.varta-ag.com/de/industrie/produktloesungen/lithium-ionen-batterie-packs/asb)

APPENDIX A: MECHANICAL DRAWINGS

RC/ICL Series





SIDE VIEW

Mounting Point Detail