

IC/RC/ICL SERIES CONCISE DESIGN GUIDE

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<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 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:

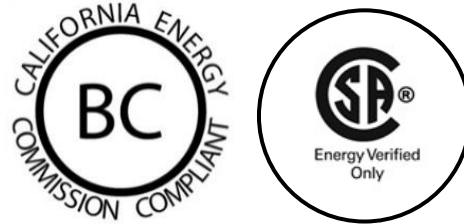


EMI

- **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:

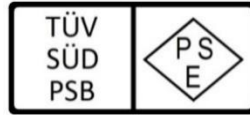


EMI

- **CISPR 14-1 and 14-2:** All RC/ICL and select IC650
- **CISPR 11:** All IC series
- **EN61000-3-2/-3, EN61000-6-2/-4:** All models
- **UNECE R10 compliant:** All RC- and ICL- models

1.2.3 Japan

PSE available for some IC650 only. Look for this logo:



1.2.4 South Korea

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



1.3 Special EMI Considerations

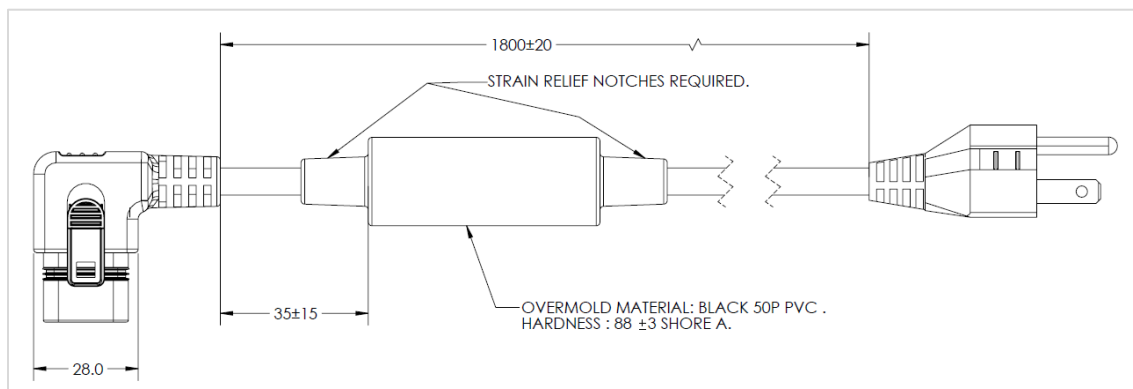
Please consult with Delta-Q before conducting independent EMI/EMC testing on our chargers. Special handling may be necessary to ensure a pass.

1.3.1 CISPR-14 compliance

IC Series CISPR Models

AC input attenuation bead required:

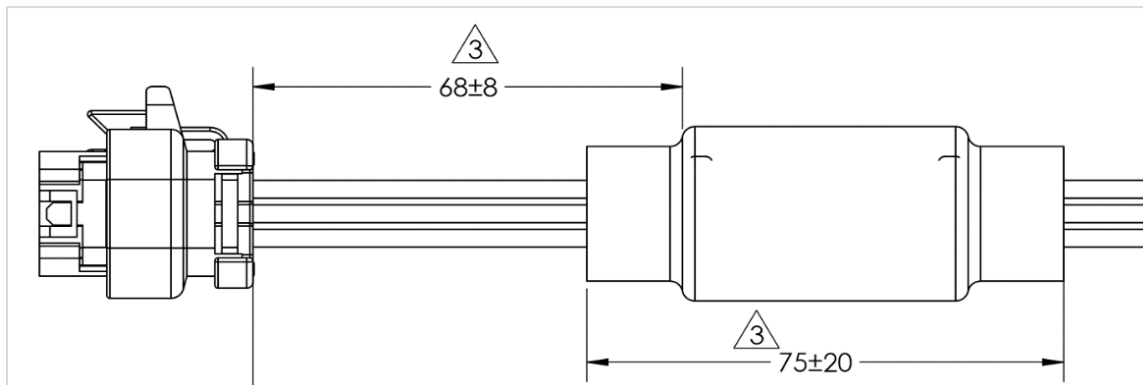
- Recommended bead (2 pcs): Laird Technologies 28B0734-000 or 28A2913-0A2
- Install over AC cord 20-50mm from charger:



RC/ICL and IC-series CISPR models

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

- IC-series: Laird 28B1020-100
- RC/ICL Series: Fair-rite 2631626402
 - a. CAN only: two turns
 - b. CAN, Interlock, Thermistor: one turn
- RC/ICL Series: Fair-rite 2631102002
 - a. Up to 12 wires, one turn

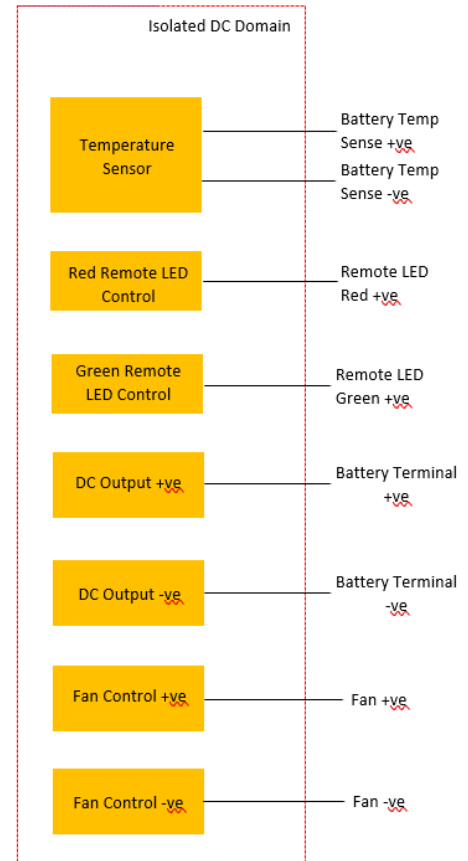
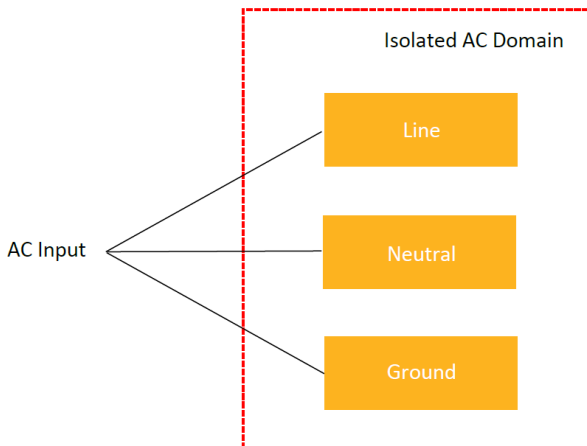
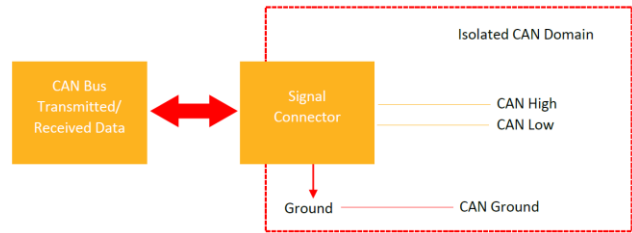
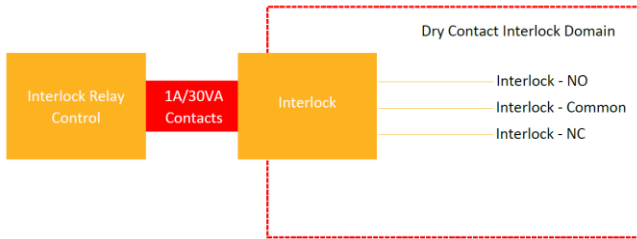


1.3.2 Reducing EMI

See App Note *Reducing EMI in Delta-Q Chargers* – contact your Delta-Q representative for a copy.

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 Operating Modes

- Charge on AC connection
 - a. **Note (IC-series only):** On AC disconnection, charger will resume in previous charging stage within 10 minutes of loss of AC (configurable)
- Charge on DC connection
 - a. **Note:** Charger output is off until battery voltage detected (configurable)
- Monitor/Maintain

2.3 Options by Voltage

Nominal Voltage (Lead)	Max Voltage (Lithium)	Power	Series	User Interface	COMM	CISPR-14*	CAN Termination
24V	36V	650/900/1200	IC	std	opt	opt 650	opt
24V	36V	1000	RC	opt	std	std	opt/select
36V	54V	650/900/1200	IC	std	opt	opt 650	opt
36V	54V	900/1200	RC	opt	std	std	opt/select
48V	72V	650/900/1200	IC	std	opt	opt 650	opt
48V	72V	900/1200	RC	opt	std	std	opt/select
n/a	57V	1200	ICL	opt	std	std	selectable
n/a	58V	1200/1500	ICL	opt	std	std	selectable
n/a	85V	1200/1500	ICL	opt	std	std	selectable
n/a	120V	1200/1500	ICL	opt	std	std	selectable

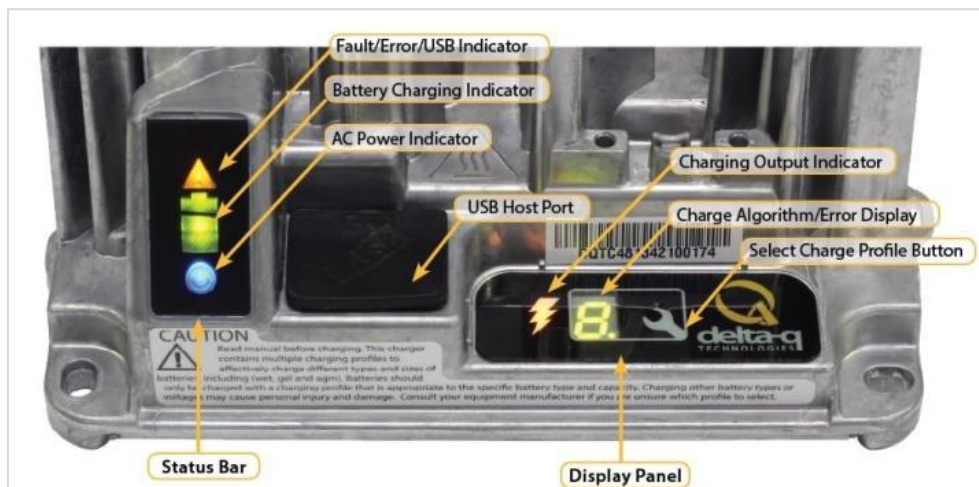
*See 1.3 Special EMI Considerations

2.4 Options by Charger Series







Model	Part Number Prefix	Nominal Voltages (Lead)	User Interface	COMM	CISPR-14*	CAN Termination
IC650	940-, 950-	24V/36V/48V	std	opt	opt	opt
IC900	942-, 952-	24V/36V/48V	std	opt	-	opt
IC1200	941-, 951-	24V/36V/48V	std	opt	-	opt
RC900	944-, 954-	36V/48V	opt	std	std	opt/selectable
RC1000	946-	24V	opt	std	std	opt/selectable
RC1200	945-, 955-	36V/48V	opt	std	std	opt/selectable
ICL900/1200 (no fan)	947-	-	opt	std	std	selectable
ICL1200/1500 (fan)	943-	-	opt	std	std	selectable

*See 1.3 Special EMI Considerations

2.5 User Interface – IC Series



2.5.1 Status Bar Display

	Solid Blue = AC power available
	Breathing Green = Low state of charge Solid green = High state of charge
	Breathing Green = High state of charge Solid Green = Charge completed
	Solid Red = Charger fault; See display panel for details
	Flashing Amber = External error condition – Caution See display panel for details
	Flashing Green = USB port active Solid Green = Safe to remove USB flash drive

2.5.2 USB Port – USB Storage Devices

On inserting a compatible, FAT-formatted USB device, the charger will first look for programming instructions in a “CHARGER” folder. If these files are found, programming will begin. On completion of programming, or if no suitable files are found, the charger will write charger data to a “CHARGER/RESP” folder.

Important: Ensure the device does NOT have programming files in a “CHARGER” folder if you do not intend to reprogram the charger!

2.5.3 USB Port – Power

Charger Model	Max USB Current Rating
IC650	200 mA
IC900/1200	500 mA

2.5.4 Charge Output Indicator

Indication	Description
Solid Yellow	Output Active
Flashing Yellow	Externally Disabled

2.5.5 Seven-Segment Display Panel

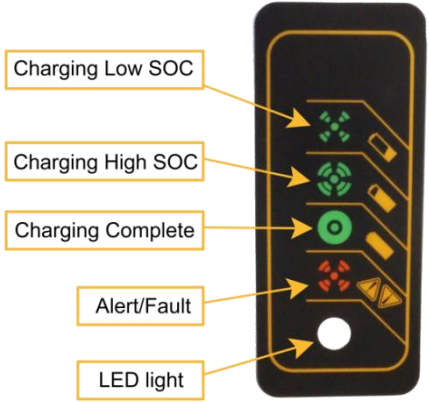
Code	Description
F-#-#-#	Fault Code – see Faults and Errors Guide
E-#-#-#	Error Code – see Faults and Errors Guide
P-#-#-#	Algorithm Number
U-S-b	USB Port Active – do not remove USB flash drive!
C-#-#-#-# or S-#-#-#	Checksum and Software Version – Contact Delta-Q for details

2.5.6 Wrench Button

Function	Details
Change Algorithm	See Algorithm Change Procedure
Display Software Settings	Long Press for 5 seconds (SW v4.3.3 and later)
Power Off Charger on DC only	Long Press for 10 seconds (SW v4.3.3 and later)

2.5.7 Remote LED

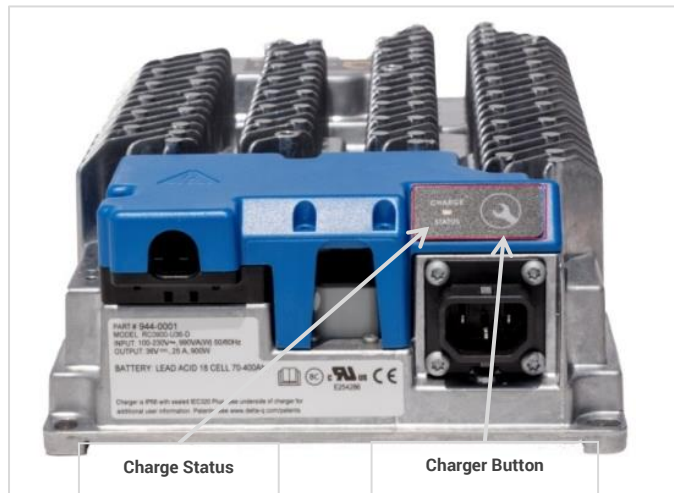
Status	LED Operation
No AC	OFF
Charging: battery at low state of charge	Slow GREEN breathing (1s on; 0.2s off)
Charging: battery at high state of charge	Fast GREEN breathing (0.4s on; 0.1s off)
Charge Complete	Solid GREEN
Error	Rapid AMBER flashing (0.5s on; 0.5s off)
Fault	Solid RED



Note: LED patterns might be different in custom setups and CAN-driven chargers

2.6 User Interface – RC/ICL Series

This optional UI for RC/ICL Series has an LED which functions identically to the above. See IC Series Setup and Troubleshooting Guide for use of the button (non-selectable termination CAN chargers ONLY).



3. MECHANICAL INSTALLATION

3.1 Fitment and Mounting

3.1.1 2D/3D Drawings

Charger and accessory 2D/3D prints are available from your Delta-Q Account Manager.

General drawing and mounting hole locations are in [7.2.4 2D and 3D drawings](#).

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 1/4" 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.

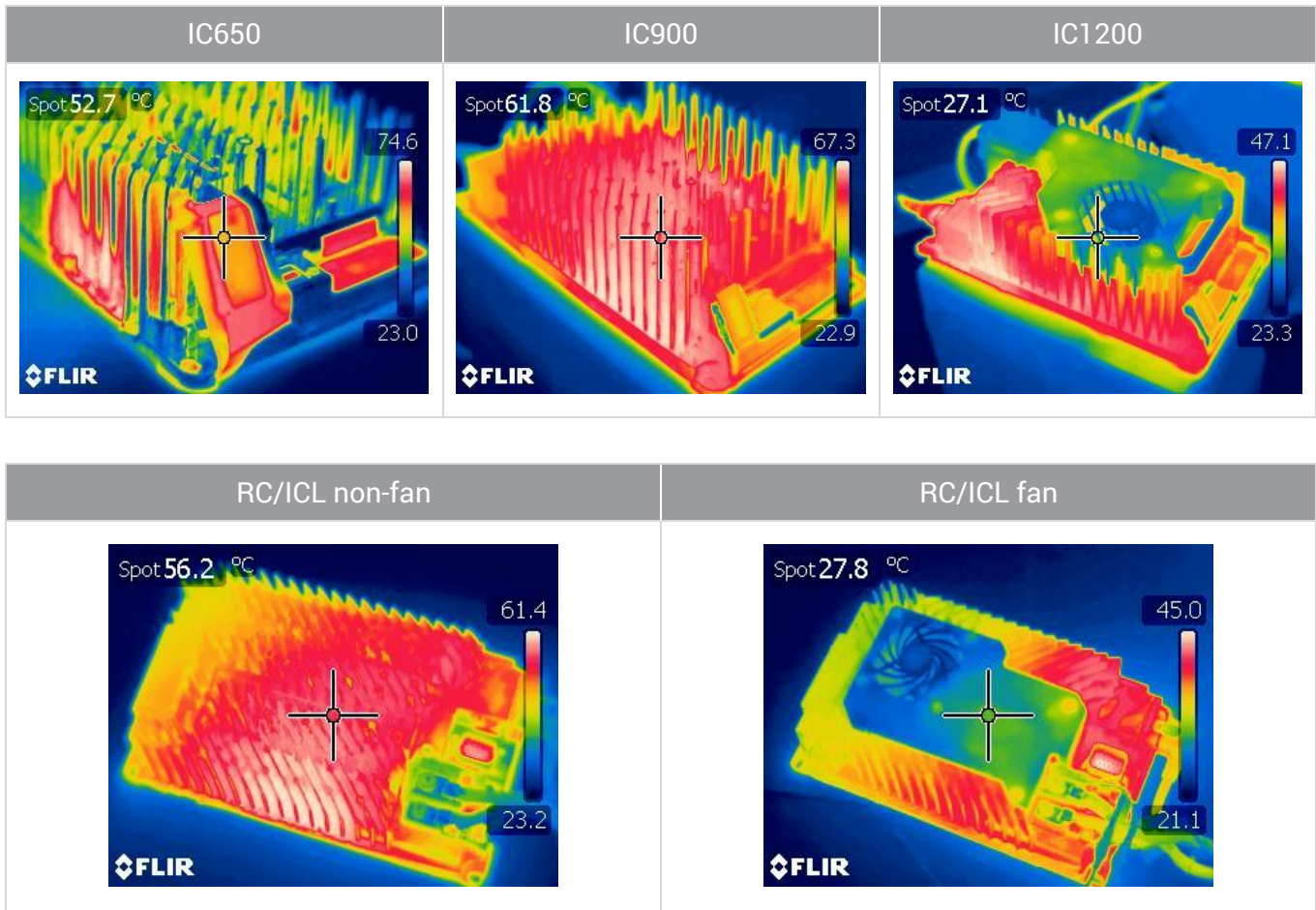
3.2 General Cooling

3.2.1 Ventilation

There must be a path to allow for heat to escape from an enclosed location. Placement of vents/openings above and below the charger will allow cold air to enter at the bottom of the charger and hot air to release from the top.

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:



3.3 Fan Cooling

3.3.1 Fan Details

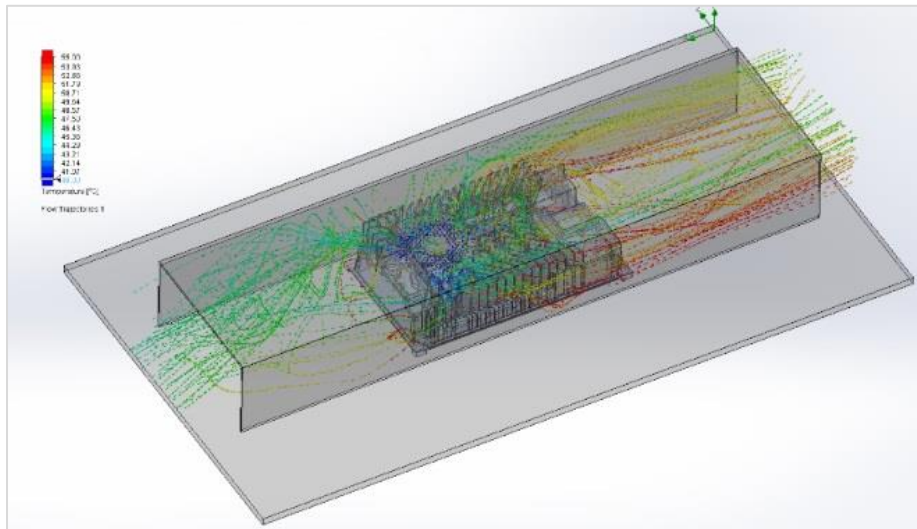
Note: Charger fan only runs during start up as a self-test, then only on demand.

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

Replacements available from Delta-Q.

3.3.2 Air Direction and Clearance

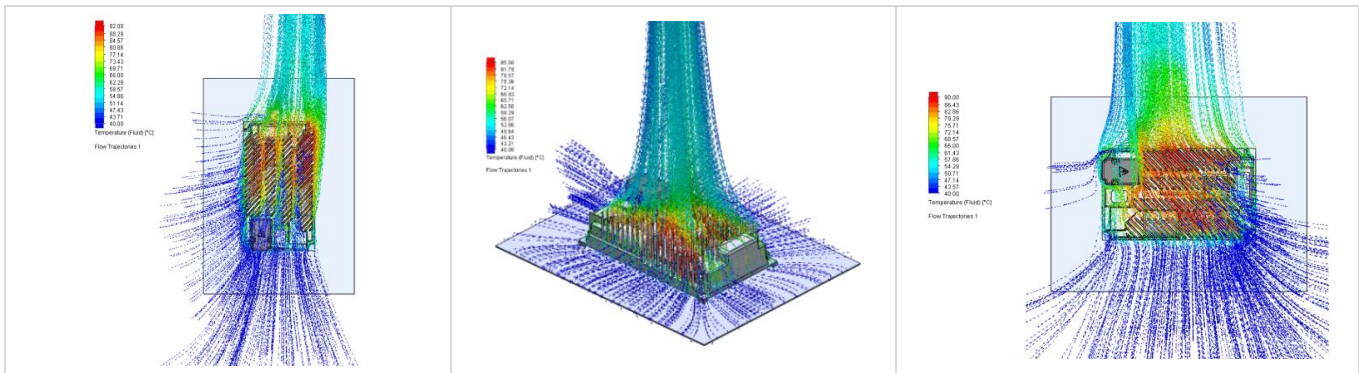
Fans direct exhaust air to the rear (connector) side of the charger. Minimum 1” air gap around the sides of the charger is recommended. See simulation below:



3.4 Convection Cooling

3.4.1 Air Direction and Clearance

Fins are designed to bring in air from any direction and exhaust upwards. Minimum 2” air gap around the sides of the charger is recommended. See simulations below:

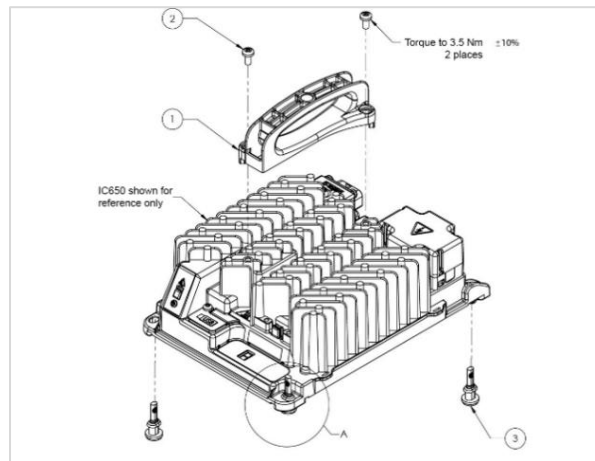


3.5 Handle and Feet

Fan-cooled chargers are available with molded-in handles (standard on IC1200 series).

Convection-cooled chargers can have a handle installed as below.

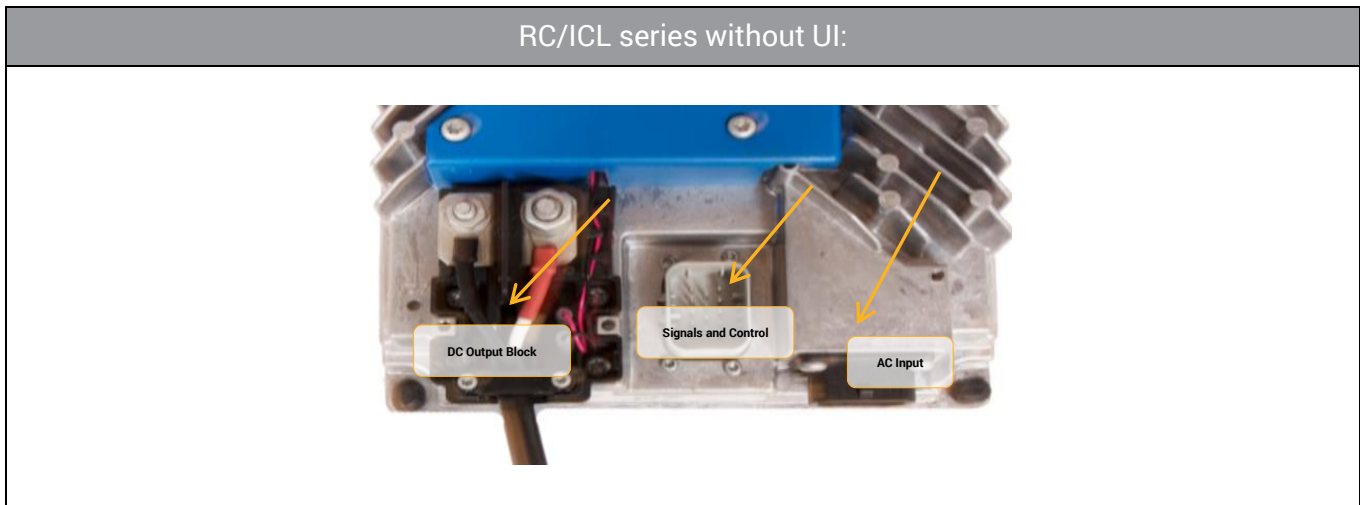
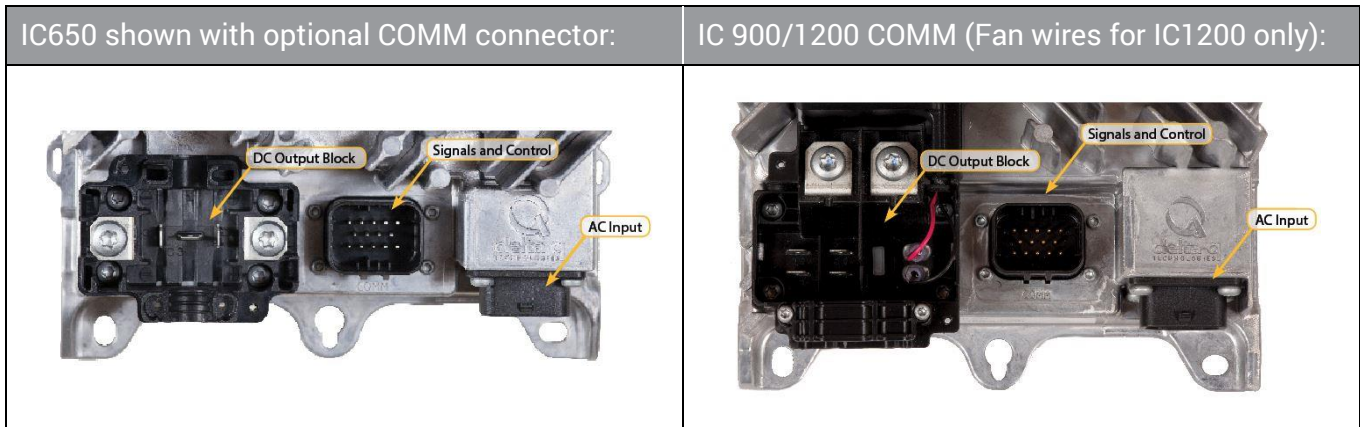
Rubber feet shown below are common to all IC/RC/ICL series chargers:



4. ELECTRICAL CONNECTIONS

4.1 Connector Layouts

All chargers have DC output block on the left, signal connector centre, and AC input on the right.

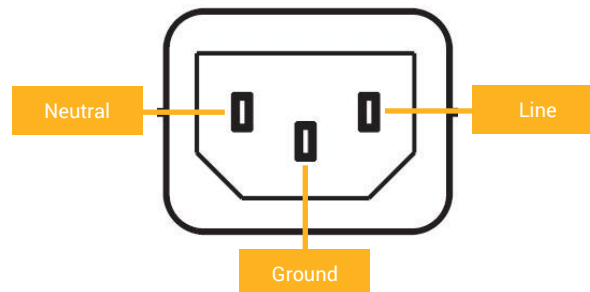


4.2 AC Input

Connector Type: Standard IEC60320/C14

Recommended Connector Type: Delta-Q IP66 Sealed AC cord

Alternate Mating Connector: Standard IEC60320/C13



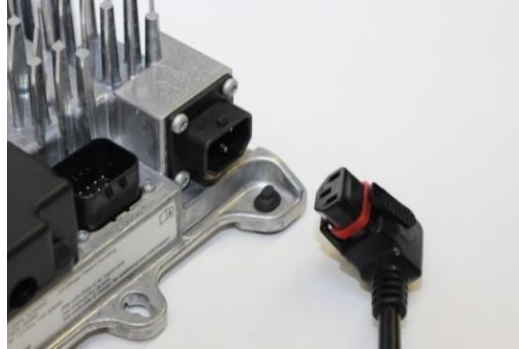
Pin	Wire Colour Code	Description
L	Brown	AC Line
G	Green/Yellow	AC Ground
N	Blue	AC Neutral

4.2.1 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 1.0mm² w/ 250V 10A connector with ground plug

4.2.2 Delta-Q IP66 Sealed, Locking AC Cord

Clamps and seals to IC/RC/ICL series chargers



4.2.3 AC Cable Bend Radius Recommendations

475-0350 OD7.1mm (~30mm min bend radius)

475-0496 OD8.5mm (~35mm min bend radius)

4.3 DC Output

4.3.1 Torque Value Tables

IC Series

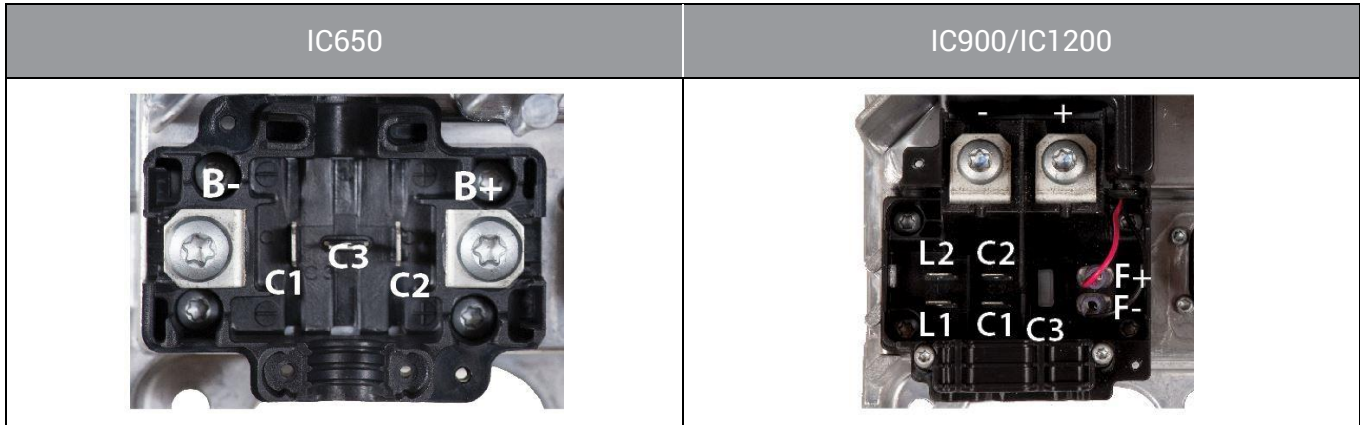
Battery Negative (B-) and Positive (B+)	Torx T30 screws (x2)	4.5Nm +/-5%
DC Cord Cable Clamp	Torx T10 screws (x2)	0.6Nm +/-6%
DC Terminal Block Cover	Torx T10 screw	0.6Nm +/-6%

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.

4.3.2 IC-Series DC Terminal Block

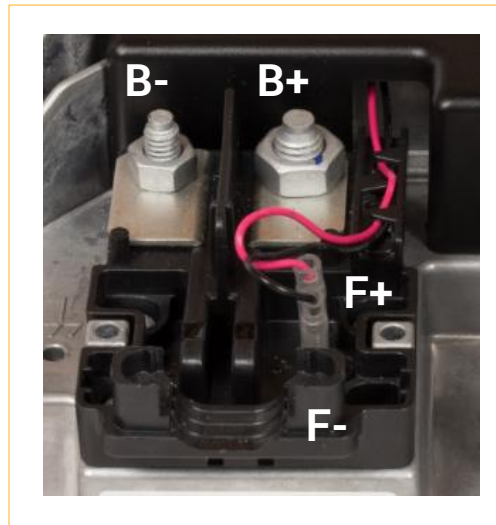


Pin	Description	Notes
B-	Battery negative	Each accepts a M6 (1/4") or larger ring terminal Fastener: Torx T30 screw, M6 nut
B+	Battery positive	
C1	Battery temperature sense negative	Each is a 6.35mm (1/4") quick-connect terminal.
C2	Battery temperature sense positive	See 4.5.2 Battery Temperature Sensing
C3	Power Interlock Signal	6.35mm (1/4") quick-connect terminal; normally closed to battery positive. Open when the charger output is active.
L1	Remote LED red anode/green cathode	IC900/1200 only
L2	Remote LED green anode/red cathode	Each is a 6.35mm (1/4") quick-connect terminal.
F+	Fan power/control positive; 0-12 VDC (fan-equipped models only)	IC1200 only
F-	Fan power/control return; 0-12 VDC (fan-equipped models only)	6.35mm (1/4") quick-connect terminals

WARNING:

Be careful not to allow battery voltage to be applied to the blade terminals (C1, C2, C3), as it will result in permanent damage to the charger.

4.3.3 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
F-	Fan power/control return; 0-12 VDC (fan-equipped models only)	2.8mm (0.110") quick-connect terminals

4.3.4 Recommended DC Cable Size and Maximum Lengths

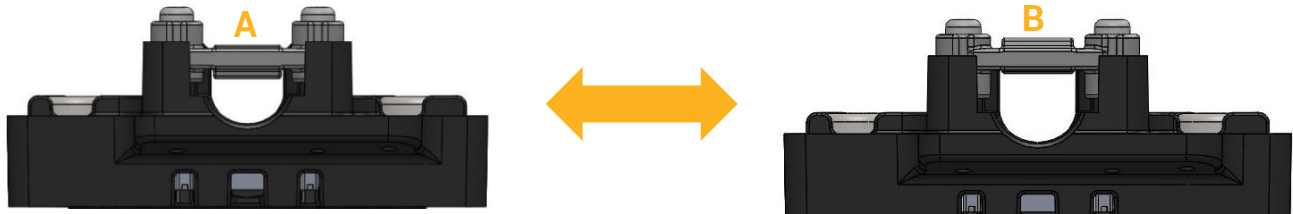
- For compliance with CEC and US DoE
- Total length from charger terminal to battery terminal (assuming B+ and B- same length)
- **Important:** DC connectors and termination must be rated above the maximum current of the charger!

Maximum DC Cable Length (in meters)		AC Cable: 3m, 16 AWG (1.5mm ²)					AC Cable: 2m, 14 AWG(2.5mm ²)				
		Wire Gauge (AWG/mm ²)					Wire Gauge (AWG/mm ²)				
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
IC650	24		2.0					2.0	3.0	5.0	8.0
	36		2.0					2.0	3.0	5.0	8.0
	48	2.0	3.0				2.0	3.0	5.0	8.0	
IC900	24		1.2	2.0	3.1	4.8		1.4	2.2	3.4	5.5
IC900/RC900	36	1.4	2.4	3.7			1.6	2.6	4.0		
	48	1.6	2.5	4.0			1.8	2.8	5.0		
IC1200	24			1.3	2.0	3.2			1.5	2.4	3.7
IC1200/RC1200	36		1.8	3.0	4.5			2	3.2	5	
	48	1.4	2.4	3.7			1.6	2.6	4.0		
RC1000	24			1.6	2.6	4.2			1.9	3.0	4.8
ICL900	57	1.2	1.8	2.9	4.7		1.2	1.8	2.9	4.7	
ICL1200	57		1.5	2.4	3.8			1.5	2.4	3.8	
	85	1.6	2.5	4.0			1.6	2.5	4.0		
	120	2.1	3.3	5.2			2.1	3.3	5.2		
ICL1500	58			1.6	2.6	4.2			1.9	3.0	4.8
	85	1.2	2.0	3.2	5.1		1.2	2.0	3.2	5.1	
	120	1.7	2.7	4.3			1.7	2.7	4.3		

4.3.5 DC Cord Clamps

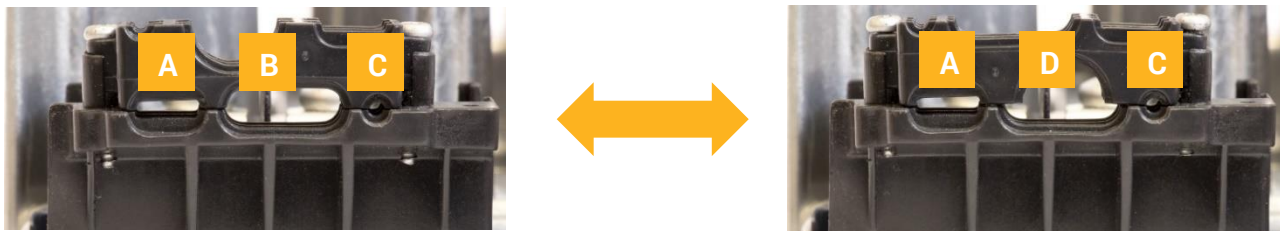
IC, RC, and ICL-series DC Cord clamps are reversible to support different wire sizes.

IC650



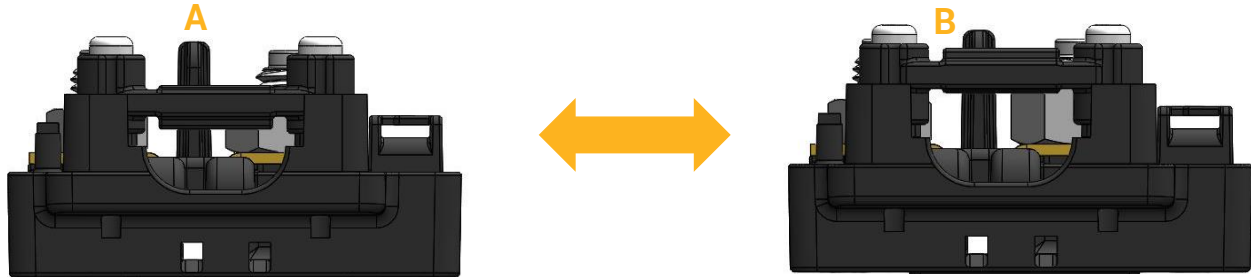
Ref	Min O.D.	Max O.D.
A	8.0 mm	14.0 mm
B	11.0 mm	16.0 mm

IC900/1200



Ref	Description	Min O.D.	Max O.D.	Min/Max AWG
A	Remote LED and/or temperature sensor	3.2 mm	5.2 mm	2 Cond, 18-22 AWG (0.34-1.0 mm ²)
B	Battery cable (2x single conductor)	6.5 mm	8.5 mm	6-8 AWG (10-16 mm ²)
C	Interlock wire	2.0 mm	3.5 mm	12-18 AWG (1-4 mm ²)
D	Multi-conductor cable (battery +/-, temp sensor, interlock)	10.0 mm	12.0 mm	Accepts 4 conductor -12 AWG, and 2 conductor -10 AWG cord

RC/ICL Series

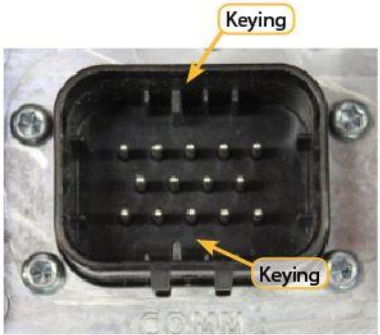


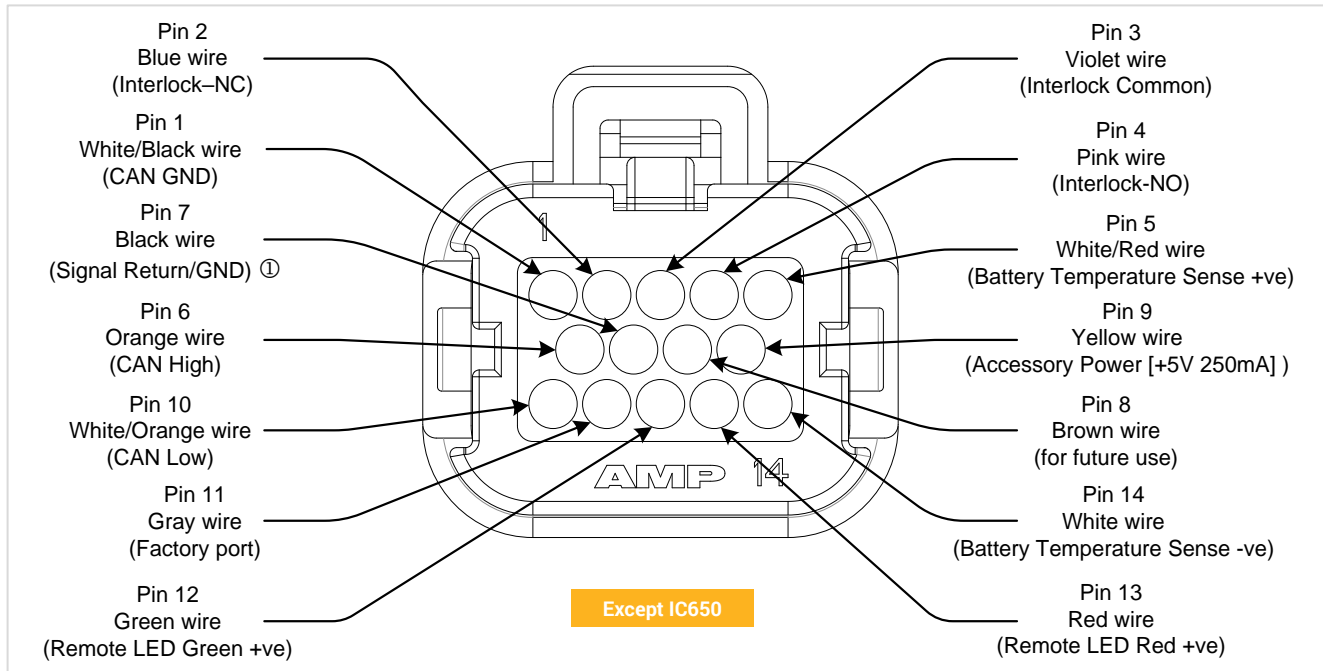
Ref	Min O.D.	Max O.D.
A	8.0 mm	10.0 mm
B	9.0 mm	12.5 mm

4.4 Signals Connector

Delta-Q 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).

4.4.1 IC Series

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



IC-Series COMM Pinout

Wire Colour	Pin	Description	Detail
White/Black	1	CAN GND	Isolated reference ground for CAN
Blue	2	Interlock-NC	Dry Contact Interlock relay: Normally closed contact
Purple	3	Interlock-Common	Dry Contact Interlock relay: Common contact
Pink	4	Interlock-NO	Dry Contact Interlock relay: Normally open contact
White/Red	5	Battery temperature sense +ve	See 4.5.2 Battery Temperature Sensing
Orange	6	CAN High	Isolated CAN High
Black O	7	Signal Ground	Do not connect to Battery Negative
Brown	8	For future use	Can be custom configured. Contact Delta-Q Technologies for more information

Wire Colour	Pin	Description	Detail
Yellow	9	IC650: unused IC900/IC1200: APO	IC650: Pin is unused IC900/IC1200: Accessory Power Output (+5VDC, 250 mA max default, 500mA max optional); not isolated from the DC Output voltage domain
White/Orange	10	CAN Low	Isolated CAN Low
Grey	11	Factory port	Factory use only
Green (White on Remote LED accessory)	12	Remote LED Green +ve (anode) / Red -ve (cathode)	Pin 12 goes high with respect to Pin 13 to light the Remote LED green, and vice versa to light the Remote LED red. See 4.5.1 Remote LED
Red (Black on Remote LED accessory)	13	Remote LED Red +ve (anode) / Green -ve (cathode)	
White	14	Battery temperature sense -ve	

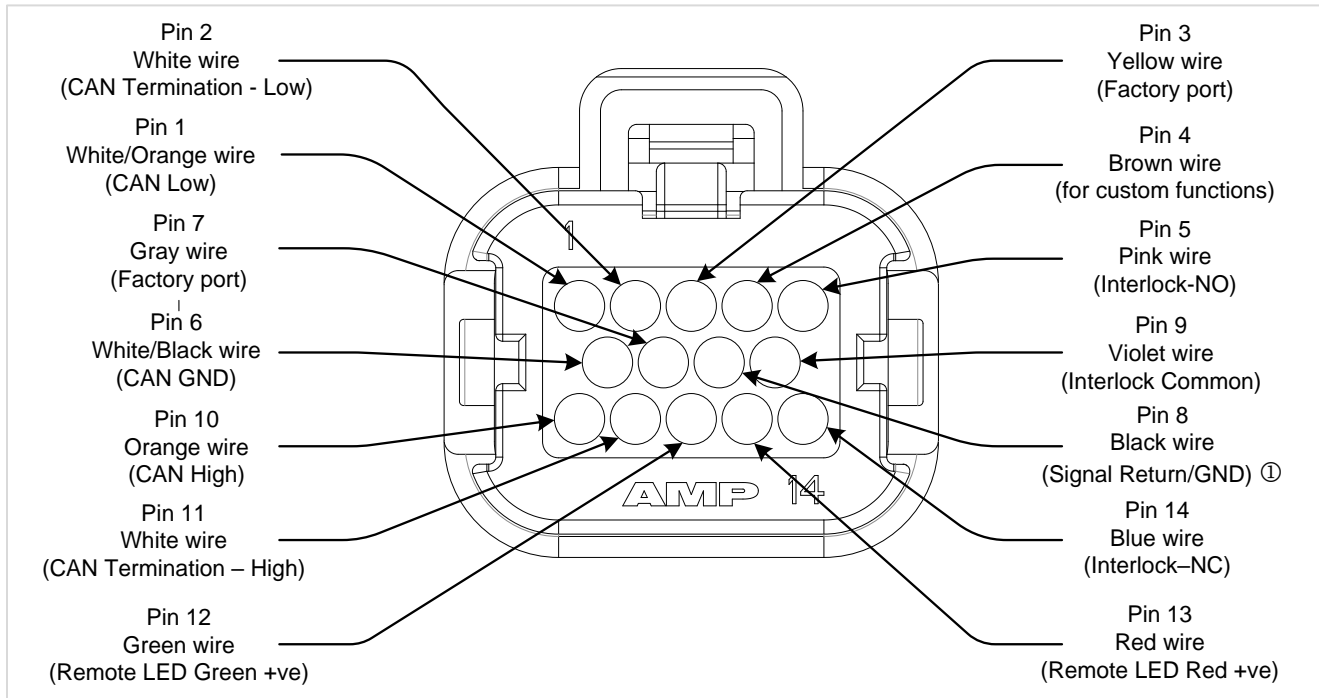
○ **Note:** Pin 7 is the Ground reference for Pins 8, 9, and 11; also for Pins 12 and 13 in some Remote LED installations. It is electrically connected, via a low-impedance resistor/inductor circuit, to the Battery Negative terminal on the DC block.

○ **NEVER** connect Pin 7 directly to the Negative terminal of the battery, nor to the Negative terminal in the DC block. If charging current flows through pin 7 it will cause internal damage.

4.4.2 RC/ICL Series

Description	TE Part Number
Charger Header (<i>for reference only</i>)	776262-4
Cable Plug (<i>body only</i>)	776273-4
Contacts (<i>loose piece</i>)	770854-1
Contacts (<i>strip form</i>)	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	Battery Temperature Sensor +ve / other input	See 4.5.2 Battery Temperature Sensing
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 O	8	Signal Ground	<p>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)</p> <p>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</p>
Violet	9	Interlock-Common	Dry Contact Interlock relay: Common contact
Orange	10	CAN High	Isolated CAN High
Black O	11	Unused or Control Panel Ground	<p>RC Base models: not used</p> <p>RC W/UI models: Control Panel Ground reference</p>
		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)	<p>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</p> <p>W/LED or UI models: for the Panel LED: Same but with respect to pin 11</p>
		AC Present Signal	Pin 12 may be used to signal the presence of AC input power on the charger, by outputting 3.7-4.3V referenced to Pin 8. Max 0.5mA
Red (Black on Remote LED accessory)	13	Remote LED Red +ve (anode) / Green -ve (cathode)	See 4.5.1 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.

Note: It may be the case that the RC/ICL does not require communication with the vehicle. However, the signals connector will still need to be sealed with a blank mating connector.

4.5 Signal Accessory Features

4.5.1 Remote LED

Pre-made harnesses from Delta-Q are available for the Signals or L1/L2 connectors. Contact your Delta-Q Account Manager.



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')

4.5.2 Battery Temperature Sensing

This feature is intended for lead-acid batteries which all benefit, especially sealed batteries, from voltage compensation with temperature. Not all charge algorithms require temperature sensing.



Pre-made harnesses are available from your Delta-Q Account Manager.

Installation:

Recommended to be installed on a battery post.

Sensor Errors:

If the charger detects open circuit or short circuit on the battery temperature sensor, it will assume 25°C. The charger can be configured to prevent charging in this case.

Recommended Sensor:

Vishay BCC 238164063103, NTC 10k 5% Thermistor, B25/85 = 3977K. No other sensors have been tested with Delta-Q chargers.

4.5.3 Output Enable/Disable Input

The chargers can be specially configured to use the temperature sensor input in this way:

- Open circuit (or >20kohm): Disable output
- Short circuit (or <5kohm): Enable output

A specialized lithium algorithm is required.

4.5.4 Interlock

Many applications require a safety mechanism to prevent the machine driving away while plugged in. Delta-Q chargers have two possible signals to enable this feature in the vehicle.

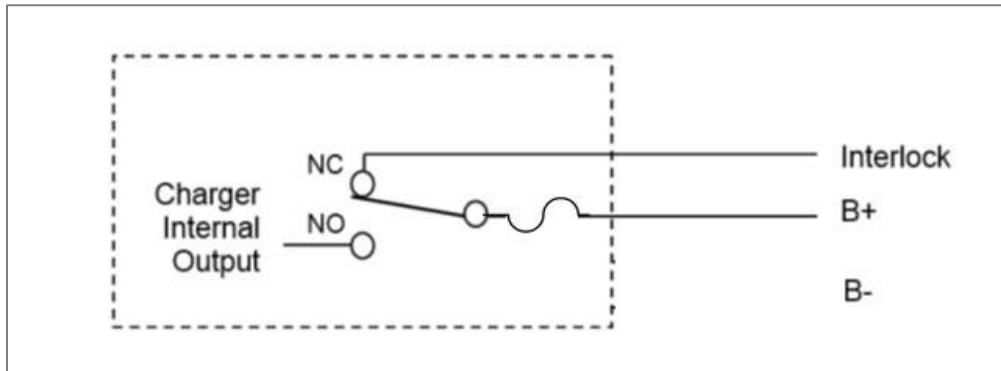
Important: Protect these contacts with an external fuse if there is a risk of overcurrent.

C3 Power Interlock (IC-series ONLY)

Uses the “free” contact of the output relay:

- B+ when not charging
- Open circuit when charging

Do not connect C3 interlock to B-!

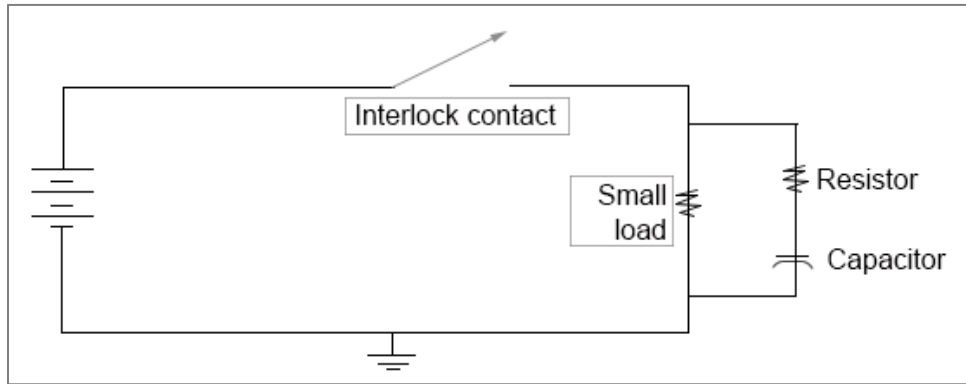


C3 Power Interlock Resistive Current Limits

Model	Voltage	Min	Max
IC650	24V	0.1 A	1.5 A
IC650	36/48V	1.0 A	1.5 A
IC900/1200	24V	0.1 A	10 A
IC900/1200	36V	0.1A	2.0A
IC900/1200	48V	0.1A	0.5A

Minimum Current

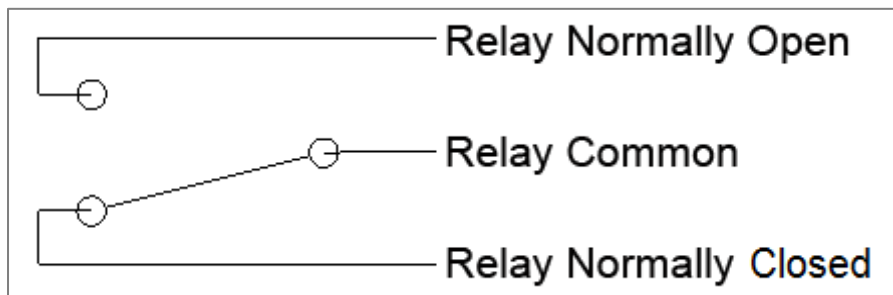
As a power relay is used, the 0.1A minimum must be enforced to prevent oxidation. A surge circuit can be added to ensure the contacts remain clean if less than 0.1A is drawn:



	Minimum Current	Resistor	Capacitor
24 V	1 A	15 Ω	100 μF
36 V	1 A	22 Ω	100 μF
48 V	1 A	30 Ω	47 μF

Dry Contact Interlock (IC-Series “COMM”, All RC/ICL)

These are isolated, non-powered contacts on the signals connector with the below logic:



See pinouts in section 4.4.

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
IC650	<5s
IC900/1200	<10s
RC/ICL Series	<5s

Dry Contact Interlock Resistive Current Limits

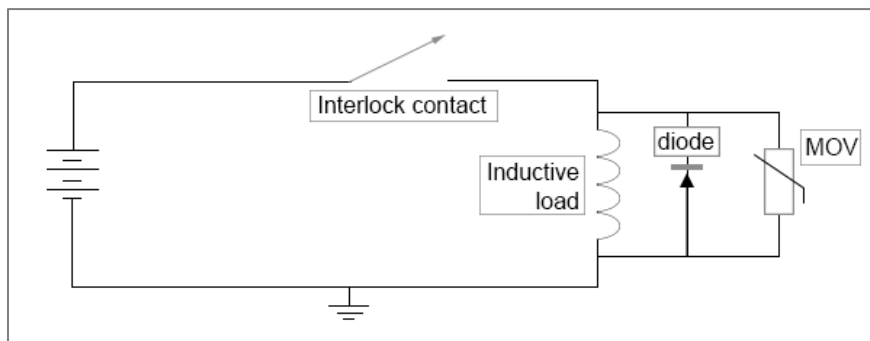
Voltage Range	Min	Max
0 - 30VDC	0.1mA	1000mA
30 - 110VDC	0.1mA	500mA
110 - 125VDC	0.1mA	300mA

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. SOFTWARE

5.1 CAN Communications

Delta-Q chargers support both CANopen and J1939 protocols as well as customizations. Up-to-date reference documents below are available from your Delta-Q Application Engineer:

CANopen References

- *CAN in Automation (CiA) 301, 418, 419 (copyright CiA)*
- *Delta-Q CANopen Glossary*
- *Delta-Q CANopen “Simplified” Tutorial*

SAE J1939 References

- *J1939 Digital Annex (copyright SAE)*
- *Delta-Q J1939 “Simplified” Tutorial*
- *Delta-Q J1939 Interface*

5.1.1 CANopen Defaults

Item	Configuration
Charger Role	Slave
Identifier Bits	11 bits
Bitrate	125 kbps (up to 1000kbps supported)
Charger Node ID	10 (configurable)
Battery Node ID	1 (configurable)
PDO Map	configurable

5.1.2 J1939 Defaults

Item	Configuration
Charger Address	73
Identifier Bits	29 bits

Item	Configuration
Bitrate	250 kbps (default)
Default PGNs	BCH1, HVES1D5, HVES1D7

5.2 Charger Data Log

All IC/RC/ICL chargers record charge data. There are three types of data. Examples are shown below:

Cumulative Data (lifetime)

- Total Amp-hours
- Total charge cycles
- Total maintenance cycles
- ...and more

Cycle Data (last 255 cycles; accessible via CAN)

- Charge hours
- Charge Amp-hours
- Max voltage
- Min voltage
- Time between charges
- ...and more

Detailed Charge Cycle Plottable Data (~3 months; must be downloaded)

- Battery voltage
- Charge current
- Battery temperature
- AC voltage
- ...and more

5.3 Reprogramming and Data Retrieval

5.3.1 Via CAN (IC-series COMM, all RC/ICL)

Over CAN interface

Contact Delta-Q for details on how to write your own code to reflash and download all charging data using CAN commands. This is contained in the application note “Reprogramming Chargers using CANopen”.

Certain settings can be changed via CAN:

- Charge algorithm
- Enable/Disable Charging
- Control Charge Status Display (Remote mode only)
- ...and more

Certain charger and cycle summary data can be retrieved directly over CAN messages:

- Total Charger Ah
- Data for previous 255 cycles (as per section 5.2) such as
 - a. Cycle Ah
 - b. Cycle Time
- ...and more

With Delta-Q PC Tool

Approved OEM Customers may use the Delta-Q-developed PC tool to reflash chargers or download complete data. A PEAK PCAN-USB is required.

5.3.2 Via USB (IC-series only)

Charger reprogramming is also possible via USB on IC-series equipped with a USB port. Reprogramming files must be obtained from Delta-Q.

See Support Article “How to Reprogram via USB” on Delta-Q Support site (www.support.delta-q.com) for more details.

Charge data can also be retrieved via USB. See Support Article “How to Retrieve Data via USB”. Two data viewers are available for OEM Use:

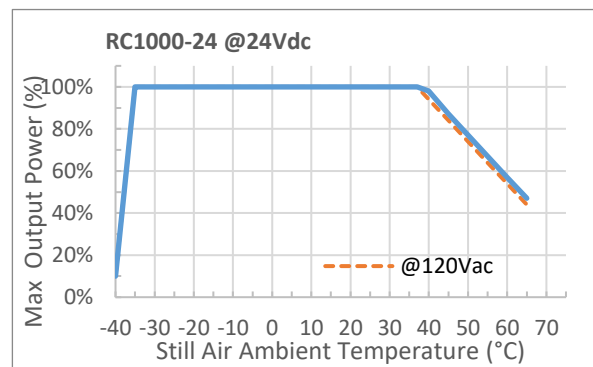
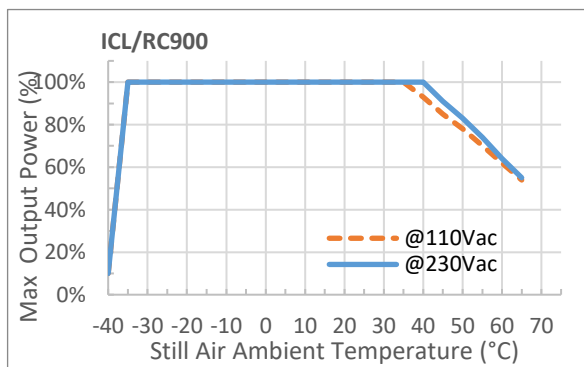
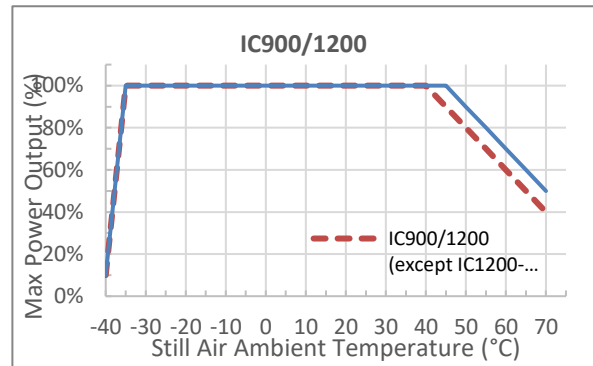
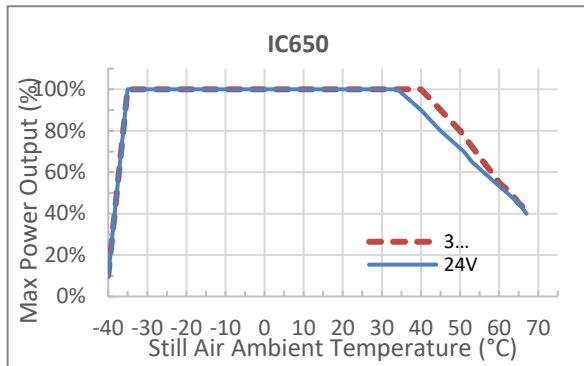
- **Simple IC Data Analysis** (at www.delta-q.com)
- **IC Data Analysis Tool** (full version – Contact Delta-Q)

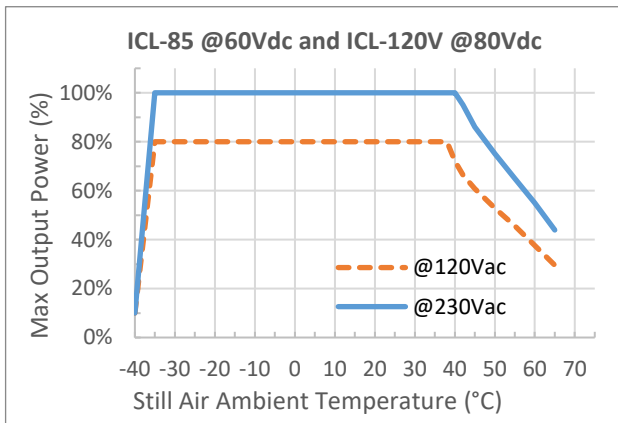
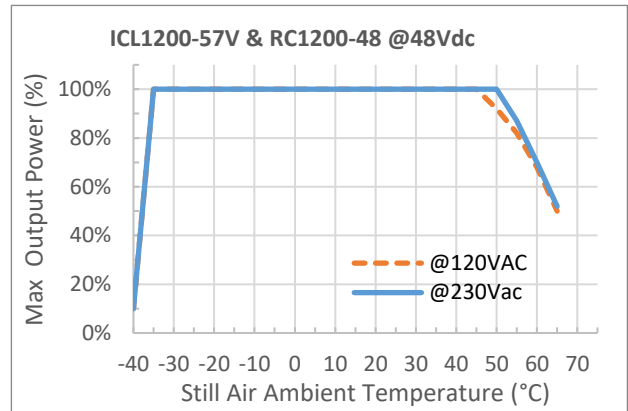
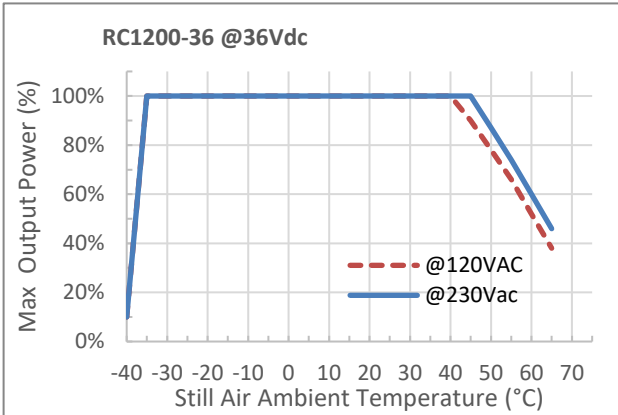
6. OPERATION IN ADVERSE CONDITIONS

6.1 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:





Note: Charts refer to operation with charger in horizontal orientation. Results may vary for different orientations.

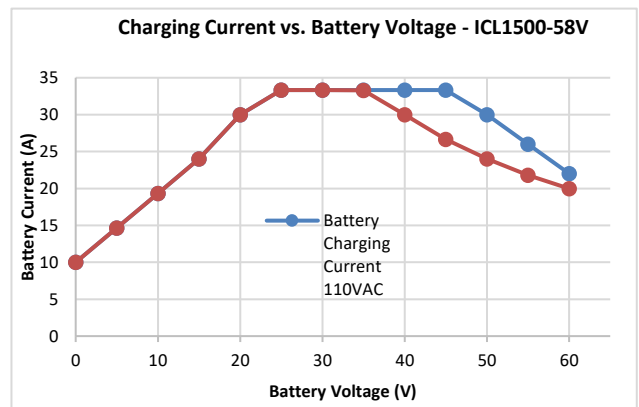
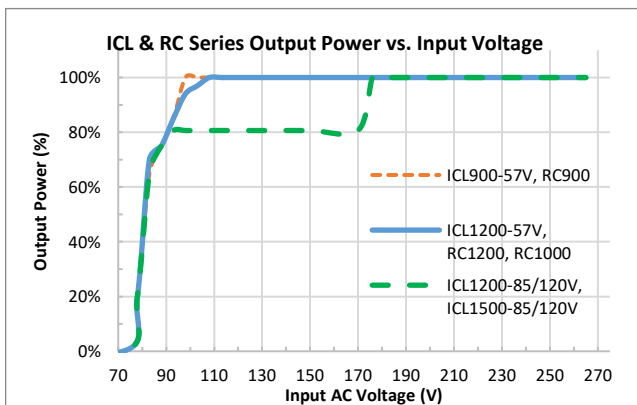
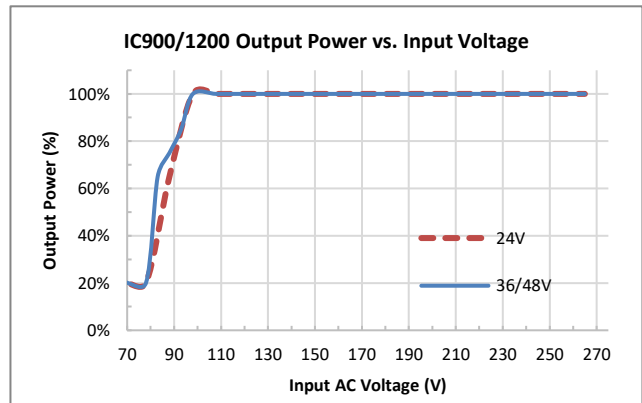
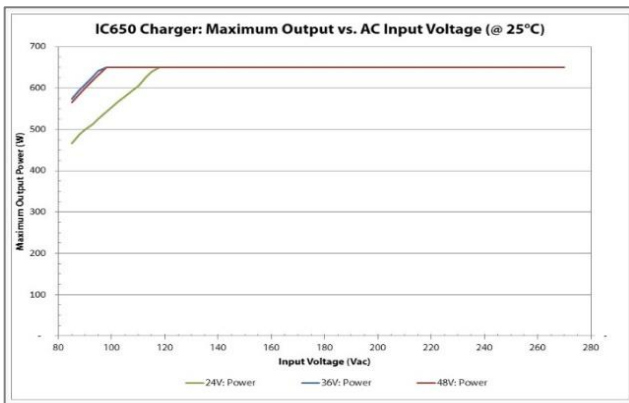
6.2 AC Voltage Extremes

Low AC Voltage

- Derate below ~100VAC (120VAC for IC650-24, see charts below)
- 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 if protection for high AC voltage is required.

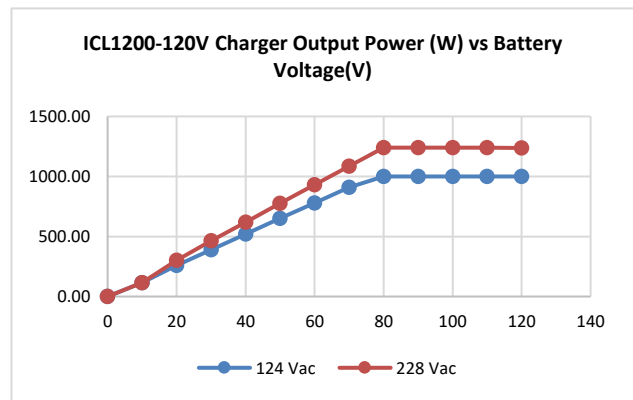
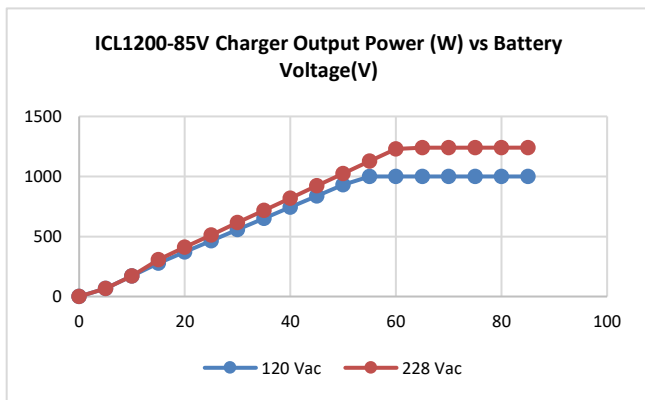


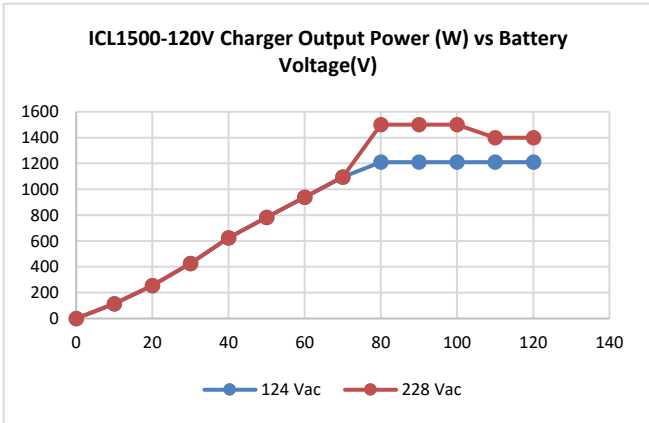
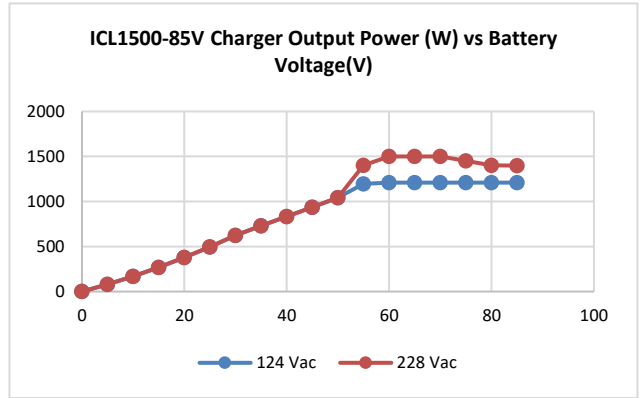
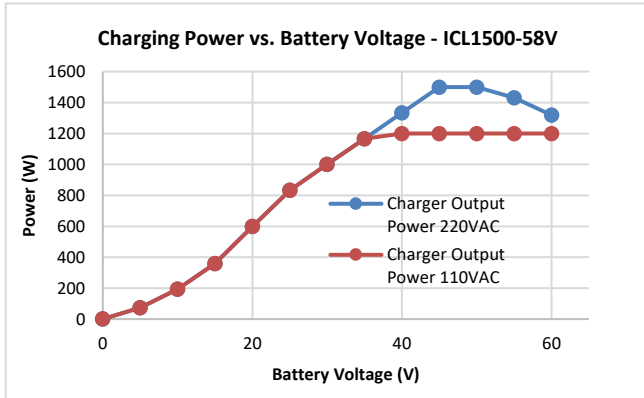
6.3 DC Voltage Extremes

IC, 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.

IC- and 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
57V	36.0V	57.0V
58V	36.0V	58.0V
85V	60.0V	85.0V
120V	84.0V	120.0V





6.4 Charger Power on AC or DC Only

	Power on with AC in Range	DC-Only Off Delay	Power on with DC in Range
IC-Series	Yes (85-270VAC)	Configurable (default 18 days or 1.75Vpc)	Optional (min 24.0V)
RC/ICL-Series		Cannot be powered by DC	

7. OTHER REFERENCES

7.1 Service

7.1.1 Changing Algorithms

See separate support articles:

- *Changing Algorithms on IC Series Chargers*
- *Changing Algorithms on RC Series Chargers*

7.1.2 Troubleshooting Guide

See *IC-Series Troubleshooting and Installation Guide*

7.1.3 Faults and Error Codes

See *Faults and Error Codes - IC/RC/ICL Series*

7.2 Integration / Design-In

7.2.1 Detailed Specifications

See *Extended Specifications* for each series charger.

7.2.2 FMEA

See *Failure Mode Effects Analysis*. Available for all models.

7.2.3 Cable and Accessory Installation

See separate App Notes:

- IC-Series Accessories Instructions
- ICL-RC-Setup Guide

7.2.4 2D and 3D drawings

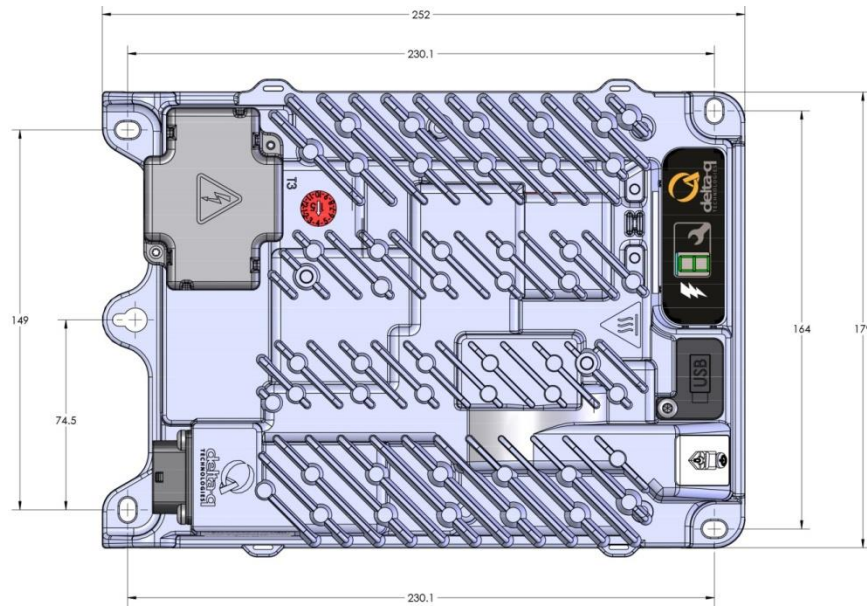
2D drawings and 3D models are available for all chargers and most accessories – contact your Delta-Q representative.

7.2.5 Software

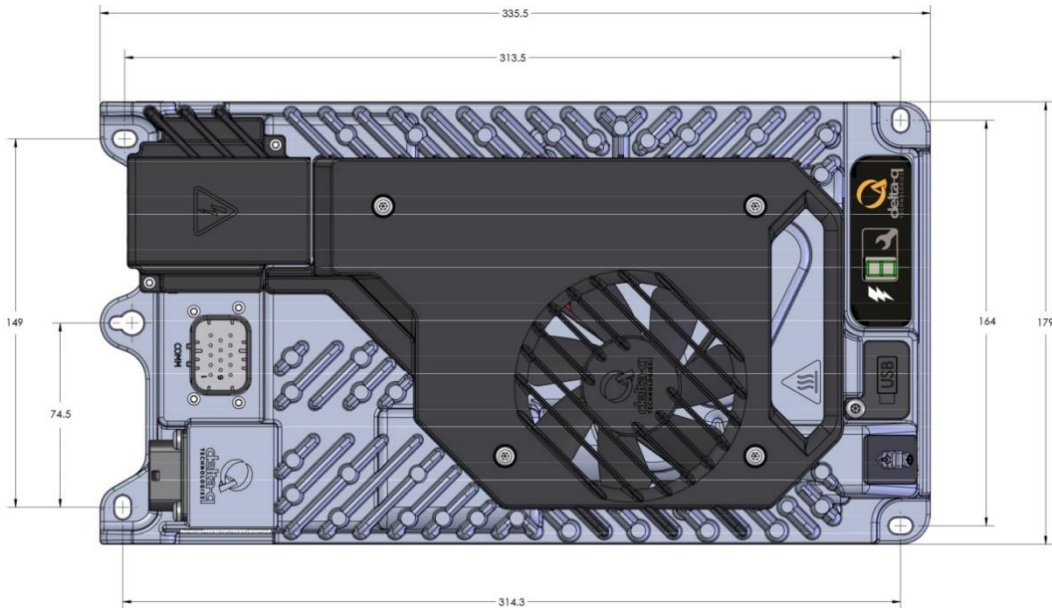
See 5.1 CAN Communications.

APPENDIX A: MECHANICAL DRAWINGS

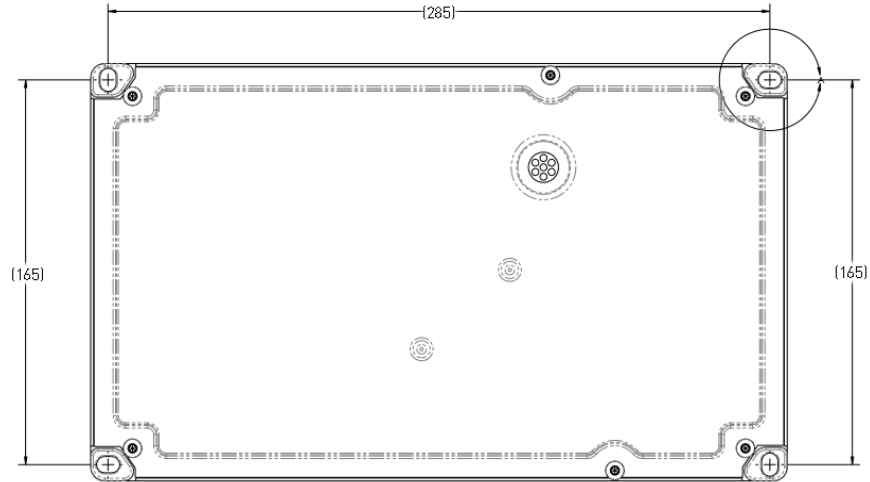
IC650



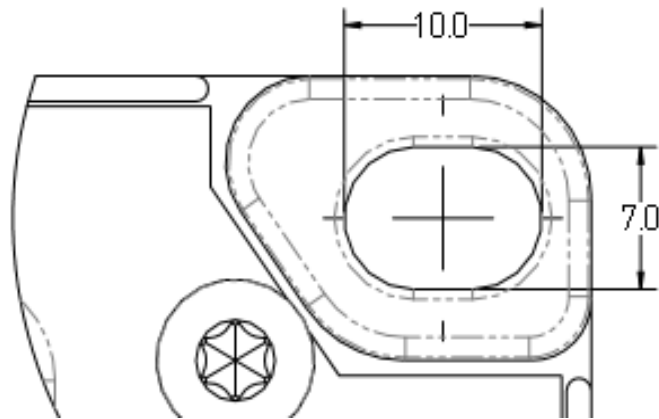
IC900/1200



RC/ICL Series



Mounting Point Detail





IC/RC/ICL SERIES

CONCISE DESIGN GUIDE

710-0256 | Revision 2

Date: December 2020



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