User's Manual

EVO Series

AN MTA COMPANY
www.edngroup.com

Legal notice

Publisher	**EDN SRL** **Via Monfalcone 41** **20092 Cinisello Balsamo (MI)** **Italy** **Internet:** www.edngroup.com **Support:** support@edngroup.com **Sales:** sales@edngroup.com
Date of issue	18/05/2018
Updates	Given our continuous technology development and commitment to facilitate the use of our products, the EDN Group SRL reserves the right to review the User's Manual when deemed appropriate.
Writer	Mauro Scupilliti

Document revision

Revision	Date	Author	Validator	Change
A	18/05/2018	Daniele Prataviera	Mauro Scupilliti	First Release
B	22/05/2018	Daniele Prataviera	Mauro Scupilliti	Modified 3.2 paragraph and 3.3 Paragraph inserting the new code SUB12892-B
C	29/07/2019	Daniele Prataviera	Mauro Scupilliti	Modified paragraphs 5.9.4.2, 5.9.4.5 and 5.11
D	13/01/2020	Roberto Tagliabue	Daniele Prataviera	Modified paragraph 3.3 Modified paragraph 5.1 (added 400Hz explanation) Modified paragraph 5.9.1
E	26/07/2022	Daniele Prataviera	Roberto Tagliabue	Modified paragraphs 5.1 and 5.1.2
F	14/12/2022	Daniele Prataviera	Roberto Tagliabue	Added paragrapfh 7.4 (Possible oxidation of the bottom cover) and 7.5 (Coolant liquid residual inside the coolant liquid circuit). Upgraded the product coding adding the prefix related to the hardware and/or software and/or setup customization.
G	23/06/2023	Daniele Prataviera	Luca Mascetti	Upgraded paragraph 5.1.2

Document validity

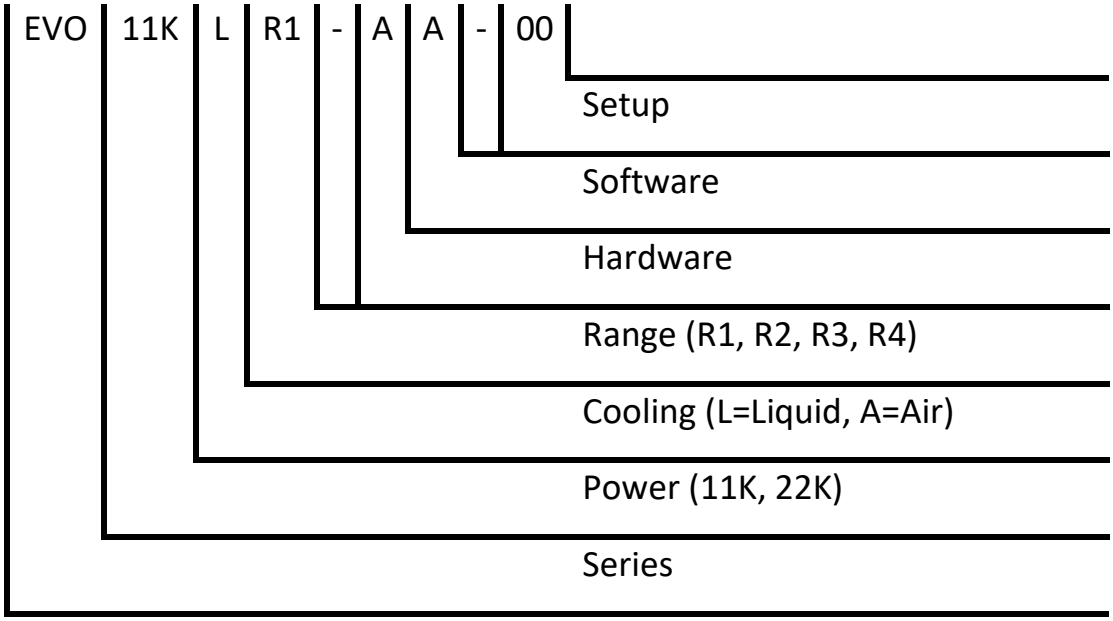
EVO11KL

EVO11KA

EVO22KL

Product coding

EVO Series



Range	**R1**	**R2**	**R3**	**R4**	
Output Voltage range	100—420	125—500	160—670	210—840	Vdc
Output Current MAX	40	33	25	20	Adc

Table of contents

Table of figure

1. List of acronyms, abbreviations and terms

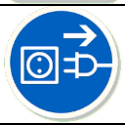
Throughout this manual, some specific technical abbreviations are used. In the table you can find an overview of the main abbreviations and their meanings:

BMS	**B**attery **M**anagement **S**ystem	**GND**	**Grou**n**d**
CAN	**C**ontroller **A**rea **N**etwork	**HVDC**	**H**igh **V**oltage **D**irect **C**urrent
CEE	**C**ommission for **E**lectrical **E**quipment	**HVIL**	**H**igh **V**oltage **I**nterlock **L**oop
CP	**C**ontrol **P**ilot	**IP**	**I**ngress **P**rotection
De-rating	**De-rating** is the operation of a device at less than its maximum rated power in order to protect and prolong its life	**LV Battery**	Service **LV Battery** inside vehicle
EMI	**E**lectro**m**agnetic **I**nterference	**PE**	**P**ower **E**arth
EMC	**E**lectro**m**agnetic **C**ompatibility	**PI**	**P**ower **I**ndicator
EVSE	**E**lectric **V**ehicle **S**upply **E**quipment	**PP**	**P**roximity
RCD	**R**esidual **C**urrent **D**evice	**PT1000**	**P**lat**i**num resistance temperature sensor **1000**Ω@0°
GFD	**G**round **F**ault **D**etector	**THD**	**T**otal **H**armonic **D**istortion
GFI	**G**round **F**ault **I**nterrupter	**VP**	**V**ehicle **P**ilot

2. Safety and warning instruction

For your safety, please read this chapter carefully. These instructions refer to assembly, start-up and running operations in the vehicle. Before using the battery charger, read all instructions and cautionary markings on the charger, battery, and battery product.

2.1. Symbols and their meaning

Symbol	Meaning	Symbol	Meaning
	General prohibition		Warning high voltage, don't touch
	General hazard warning		Hot surface warning
	High voltage warning		High pressure warning
	Disconnect device from Connector		Important information for the good using and avoidance damage to the device

2.2. Danger levels

Danger: to describe anything that can potentially cause serious harm.

Warning: to describe anything that can potentially cause harm.

Instruction and Information: Important information to properly apply the product and avoid damage to the device.

2.3. Generally applicable safety measures

The security measures mentioned in this manual are based on the knowledge of the manufacturer. They can be supplemented by country-specific safety instructions and guidelines for accident prevention!

Follow the instructions!

Failure to install and failure to use the charger in accordance with this manual and data may impair the protection provided by the charger and void the manufacturer's warranty.

2.3.1. Safety instruction for cooling water system

Leaking coolant!

Check the sealing of the cooling system, in particular pipes, screw joints and pressure tanks.

2.3.2. Safety instruction for mechanical system

Hot surfaces!

The operating charger produces heat. Touching the hot charger can lead to injuries and burns.

If the charger failure or malfunction could cause personal injuryor material damage, use additional safety and operational measures, such as limit switches, guards, etc.

2.3.3. Safety instruction for Handling and Operation

Damage to the HV Battery:

Make sure the battery pack is compatible with the charger’s technical data.
Before starting the first charging process, ensure that the charging profile of the device is compatible with the HV battery!
Never disconnect the battery Connector without breaking the battery pack connection first.

Damage to the Charger:

Make sure the mains AC power characteristics are compatible with the charger's technical data.

For Liquid cooled units: cool the device with proper cooling liquid and within the temperature range specified in Chapter 5.7.

For Air cooled units: mount the device in a well ventilated location and apart from other surfaces as is described in Chapter 5.11.

Keep it far from heat sources and direct sunlight.

Although the device has high IP protection, if possible, avoid placing it in direct contact with water (rain, high pressure water).

2.3.4. Safety instruction for Electrical System

Don't open the charger!

Do not attempt to open the charger. There is risk of electric shock even if the charger is unplugged. No user serviceable components inside.

High voltage!

The High voltage may be dangerous and/or lethal. The lack of installation or compliance with these instructions may cause injury to the operator or damage to the charger.

Never touch the charger battery connector when it is disconnected from the unit without removing the battery safety disconnect.

The charger should be installed and made operational by a skilled technician.

The charger cannot operate without a safety ground connection. The use of a Ground Fault Interruption circuit is mandatory.

Remove the AC mains/AC charging Connector from the mains inlet before breaking the battery pack circuit.

If safe operation can not be ensured, STOP and disable the charger from operating.

2.4. Safety Installation / Protection Installation

2.4.1. Control Pilot (CP)

The Control Pilot is part of a standard safety system, introduced by SAE J1772 and EN 61851, which increases the reliability of the process of charging an electric vehicle. It is an electrical signal provided by the Electric Vehicle Supply Equipment (EVSE).

The Control Pilot, with Proximity, is the primary control signal; it is connected to the equipment ground through control circuitry on the vehicle and performs the following functions:

a. verifies that the vehicle is present and connected

b. permits energization/de-energization of the supply

c. transmits supply equipment current rating to the vehicle

d. monitors the presence of the equipment ground

e. establishes vehicle ventilation requirements

When SAE J1772 is enabled, the charger is fully compliant with SAE J1772 Power Station (EVSE SAE J1772 compliant, level 1 and 2).

When EN 61851 is enabled, the charger is fully compliant with EN 61851 Power Station.

2.4.2. Proximity (PP)

The Proximity is part of a standard safety system, introduced by SAE J1772 and EN 61851, which increases the reliability of the process of charging an electric vehicle. It is an electrical signal provided by the Electric Vehicle Supply Equipment (EVSE).

Proximity, with The Control Pilot, is the primary control signal; it is connected to the equipment ground through control circuitry on the vehicle and performs the following functions:

a. verifies that the vehicle is present and connected with SAE J1772 or EN 61851.

b. defines the capacity of the charging cable (for EN 61851 only)

When the function SAE J1772 is enabled, the charger is fully compliant with SAE J1772 Power Station (EVSE SAE J1772 compliant, level 1 and 2).

When the function EN 61851 is enabled, the charger is fully compliant with EN 61851 Power Station.

2.4.3. Interlock (HVIL)

In order to guarantee the safety for DC High Voltage, an interlock system, connected in series to EVO's interlock, has to be implemented. The Interlock allows to verify if the charger's HVDC connector is firmly connected. The HVIL pins of the control connector (chapter 5.9.4) are directly connected with the HVIL pins of the HVDC output connector (chapter 5.9.2). They are available to be used in an external HVIL loop.

When the output connector is plugged in the output stage, the two HVIL pins of the control connector are short-circuited.

The Electronic control unit (ECU) inside the vechicle has to monitor the HVIL continuity. ECU should disconnect the AC mains and the DC power to the Battery when an HVIL failure is detected.

Before 25 July 2016 (serial number ME292830152203) the HVIL signal management was active (see chapter 9).

2.4.4. Over-voltage protection and Neutral disconnection

The charger, in order to ensure a safe operation, senses the presence of the neutral connection and AC grid Over-voltage.

The protection detects if there is a disconnection of the Neutral during the powering up or during charger operation.

Moreover protection detects if an undervoltage occurs.

In case of overvoltage or undervoltage, the charger turns off (stops providing output power) and, after 30 seconds, it verifies the possibiltity to turn on.

2.4.5. Reverse polarity protection

In order to prevent damage at the device during installation, a Internal Diode protects the charger from reversing the output polarity.

In order to provide protection, an external fuse (chapter 5.1) must be installed on positive of HVDC output.

For EVO22KL, two fuses must be installed on each positive of HVDC output or one post the union of positive.

2.5. Power limiter (De-rating)

The charger, in order to ensure safe operation, controls: input current, output current, output voltage, power, heatsink and internal temperature. The charging power is reduced if critical limits are reached.

2.6. Requirements of the Start-up Personnel

The service information provided in this instruction manual is intended only for qualified staff with proper training, knowledge and experience in the field of electronics as well as knowledge of relevant requirements and dangers associated with High Voltage systems. An electric shock can be fatal. Please do not carry out any activities other than those referred to in the documentation.

3. General

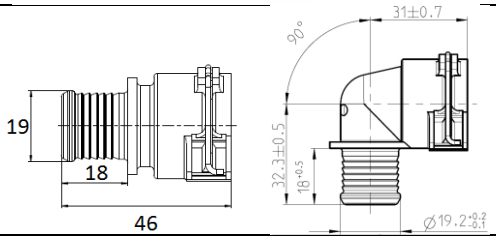
3.1. Content and Scope of this Manual

This User's Manual provides directions to help users operating devices safely and effectively.

Moreover, you can find technical and handling information, a basic description of the charger and information about its specific components.

The operation and safety instructions should be strictly adhered to ensure the optimum function of the charger and to meet the warranty requirements of the manufacturer.

3.2. Delivery Contents

1.	Charger	1	EVO11KL	
			EVO11KA	
			EVO22KL	
2.	Cooling water connector piece (NOTE: It is provided in the straight and 90° version)	2		
3.	Protective cap for cooling water connector piece*	2		

*Only for EVO11KL and EVO22KL

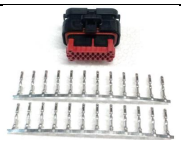
3.3. Optional Delivery Contents

These accessories can be obtained optionally from EDN Group.

For EVO11K chargers, in case of PCA connector kit:

1.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC input mating connector + N.7 pins + cable gland (chapter 5.9.1) Qty:1 - HVDC output mating connector and 2x6mm² cable assembly 2 m (chapter 5.9.2) Qty:1 - superseal connector + N.2 superseal pins + N.1 cable gland (only for air cooled version) (chapter 5.10)	PCA11K-02	  
2.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC input mating connector + N.7 pins + cable gland (chapter 5.9.1) Qty:1 - HVDC output mating connector and 2x6mm² cable assembly 3 m (chapter 5.9.2) Qty:1 - superseal connector + N.2 superseal pins + N.1 cable gland (only for air cooled version) (chapter 5.10)	PCA11K-03	
3.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC input mating connector + N.7 pins + cable gland (chapter 5.9.1) Qty:1 - HVDC output mating connector and 2x6mm² cable assembly 4 m (chapter 5.9.2) Qty:1 - superseal connector + N.2 superseal pins + N.1 cable gland (only for air cooled version) (chapter 5.10)	PCA11K-04	
4.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC input mating connector + N.7 pins + cable gland (chapter 5.9.1) Qty:1 - HVDC output mating connector and 2x6mm² cable assembly 5m (chapter 5.9.2) Qty:1 - superseal connector + N.2 superseal pins + N.1 cable gland (only for air cooled version) (chapter 5.10)	PCA11K-05	

For EVO11K chargers, in case of FCC connector kit:

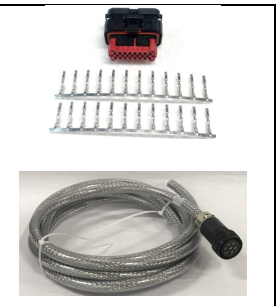
1.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC Input cabled mating connector (5m length) (chapter 5.9.1) Qty:1 - HVDC output mating connector and 2x6mm² cable assembly 3 m (chapter 5.9.2) Qty:1 - superseal connector + N.2 superseal pins + N.1 cable gland (only for air cooled version) (chapter 5.10)	FCC11K-03	 
2.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC Input mating cabled connector (5m length) (chapter 5.9.1) Qty:1 - HVDC output mating connector and 2x6mm² cable assembly 4 m (chapter 5.9.2) Qty:1 - superseal connector + N.2 superseal pins + N.1 cable gland (only for air cooled version) (chapter 5.10)	FCC11K-04	

3.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC Input mating cabled connector (5m length) (chapter 5.9.1) Qty:1 - HVDC output mating connector and 2x6mm² cable assembly 5m (chapter 5.9.2) Qty:1 - superseal connector + N.2 superseal pins + N.1 cable gland (only for air cooled version) (chapter 5.10)	FCC11K-05	

For EVO22K chargers, in case of PCA connector kit:

1.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC input mating connector + N.7 pins + cable gland (chapter 5.9.1) Qty:2 - HVDC output mating connector and 2x6mm² cable assembly 2 m (chapter 5.9.2)	PCA22K-02	
2.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC input mating connector + N.7 pins + cable gland (chapter 5.9.1) Qty:2 - HVDC output mating connector and 2x6mm² cable assembly 3m (chapter 5.9.2)	PCA22K-03	
3.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC input mating connector + N.7 pins + cable gland (chapter 5.9.1) Qty:2 - HVDC output mating connector and 2x6mm² cable assembly 4m (chapter 5.9.2)	PCA22K-04	
4.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC input mating connector + N.7 pins + cable gland (chapter 5.9.1) Qty:2 - HVDC output mating connector and 2x6mm² cable assembly 5 m (chapter 5.9.2)	PCA22K-05	
5.	Sub assembly called “ASS. CONNESS. LIQUIDO EVO22KL” used in order to connect the coolant liquid circuit of two paralleled chargers	SUB12892	

For EVO22K chargers, in case of FCC connector kit:

1.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC Input cabled mating connector (5m length) (chapter 5.9.1) Qty:2 - HVDC output mating connector and 2x6mm² cable assembly 3m (chapter 5.9.2)	FCC22K-03	
2.	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC Input mating cabled connector (5m length) (chapter 5.9.1) Qty:2 - HVDC output mating connector and 2x6mm² cable assembly 4m (chapter 5.9.2)	FCC22K-04	
3..	Qty:1 - 23-pole control mating connector + N.24 pins (chapter 5.9.4) Qty:1 - AC Input mating cabled connector (5m length) (chapter 5.9.1) Qty:2 - HVDC output mating connector and 2x6mm² cable assembly 5 m (chapter 5.9.2)	FCC22K-05	
4.	Sub assembly called “ASS. CONNESS. LIQUIDO EVO22KL” used in order to connect the coolant liquid circuit of two paralleled chargers	SUB12892	

TE connectivity 23-pole control mating connector,
Code: 770680-1
Pins, Code: 770520-1

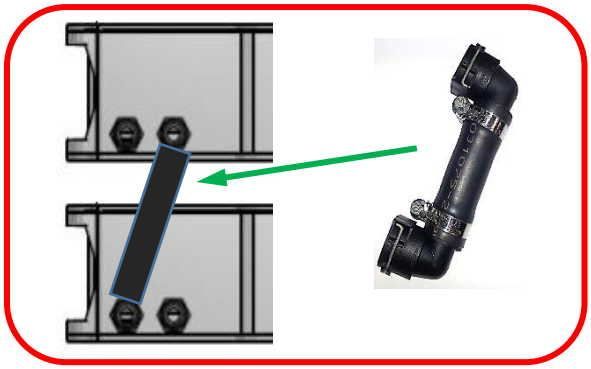
VAN SYSTEM AC input mating connector + Pins,
Code: CVB 96DA 24-10S M32 CR F16
LAPP Cable gland, Code: 53112677

VAN SYSTEM AC 90° elbow with cable gland
Code: CU1801-24F16 CVB-CVBS + 3057-16C.
EDN code: 520000281

AC Input cabled mating connector
EDN code: HAR12941 (5m length)

TE connectivity HVDC output mating connector,
Code:
1-2282291-2 (2m length)
1-2282291-3 (3m length)
1-2282291-4 (4m length)
1-2282291-5 (5m length)

COPAT KIT, Code: 6597
AMP Superseal connector, Code: 282080-1
Pins, Code: 183025-1
AMP Cable gland, Code: 281934-2

 "ASS. CONNESS. LIQUIDO EVO22KL" used i order to connect the coolant liquid circuit of two paralleled chargers. EDN code: SUB12892	
 VAN SYSTEM AC Connector female pins for 6mm^2 wires Code: ST485 8 -38S	 VAN SYSTEM AC Connector female pins for 8mm^2 wires Code: ST485 8S

3.4. EU/US Guide lines

This manual has been prepared in accordance with and in consideration of the Guidelines, and national harmonized standards (EN) in force at the time of production relevant to the EVO charger product.

3.5. Contact Information of the Manufacturer

EDN Group SRL

Via dell'Artigianato 8

20835 Muggiò (MB) Italy

Internet: www.edngroup.com

Support: support@edngroup.com

Sales: sales@edngroup.com

4. Use and limits of the products

4.1. Proper use

The EVO charger is designed for the uses described in this manual. In case of operation in other applications, please contact the EDN Group SRL beforehand at the manufacturer address as given in chapter 3.5.

Properly programmed, the device can charge different types of batteries: NiCd batteries, Pb batteries, Li-Ion batteries and Sodium batteries, etc.

The user must ensure that during the entire charging process the specific operating limits of the connected battery is never exceeded.

The charger can be used only within the limits specified in chapter 5.3.

4.2. Improper Use / Limitation of the Product

The using of the product in applications that do not comply with the conditions and requirements stated in the technical documents and manufactur's datasheets is viewed as improper use.

The operation outside the limit values defined in chapter 5.3 can endanger the user and the device!

5. General specification

5.1. Technical Data

AC Input (J1)		1-phase	3-phase Δ	3-phase Y	Unit
Input voltage range		100 – 265	100 – 265	175 – 460	V
Input frequency range		47 – 63			Hz
AC current THD		< 10			%
Power factor		> 0.98			
Efficiency		> 90 @ from 50% to Max load			%
Pre-charging		internal			
for EVO11K only					
	Max. input current (eff)	48	28	16	A
	Max input power	11			kVA
	External fuses	20 Aac fast acting, Diode I^2t: <1130 A^2s @ 50Hz, <1030 A^2s @ 60Hz			
	INRUSH current	< 20 @ 240 Vac			A
	Y capacity L → PE ****	75	50	25	nF
	Y capacity N → PE ****	75	–	75	nF
for EVO22K only					
	Max. input current (eff)	96	56	32	A
	Max input power	22			kVA
	External fuses	40 Aac fast acting, Diode I^2t: <1130 A^2s @ 50Hz, <1030 A^2s @ 60Hz			
	INRUSH current	< 40 @ 240 Vac			A
	Y capacity L → PE	150	100	50	nF
	Y capacity N → PE	150	–	150	nF

DC output (J3)			R1	R2	R3	R4	Unit
Voltage programmable range			100 – 420	125 – 500	160 – 670	210 – 840	Vdc
Min. voltage Constant Power range			250	300	400	500	Vdc
Charging voltage accurancy			±1	±1	±0.5	±0.5	%
Charging current accuracy			±2				%
Charging current ripple amplitude			±0.5	±0.5	±0.5	±0.5	%
for EVO11K only							
	Max. output power		10				kW
	Max. charging current		40	33	25	20	Adc
	Output capacitance		20 (film capacitors) + 110 (electrolitic capacitors)				µF
	External fuses		50*	40*	30**	25**	Adc
for EVO22K only							
	Max. output power		20				kW
	Max. charging current		80	66	50	40	Adc
	Output capacitance (for each module)		20 (film capacitors) + 110 (electrolitic capacitors)				µF
	External fuses	Each***	2x50*	2x40*	2x30**	2x25**	Adc
		Union***	100*	80*	60**	50**	

* Fast acting, min 600 Vdc, Diode I^2t: <2310 A^2s @ 50Hz, <2250 A^2s @ 60Hz

** Fast acting, min 1000 Vdc, Diode I^2t: <2310 A^2s @ 50Hz, <2250 A^2s @ 60Hz

*** See Chapter 2.4.5

**** Leakage current < 3.5mA

Thermal / Cooling system	EVO11KL	EVO11KA	EVO22KL	Unit
Amount of coolant in device	1.2	-	2.4	l
External diameter of cooling water connection pieces	19	-	19	mm
Minimum coolant temperature at inlet	-25	-	-25	°C
Maximum coolant temperature at inlet	50*	-	50	°C
Coolant pressure drop @ 10l/min, Tcoolant = 25°C (with a water to glycol mixture ratio of 50 / 50)	<0.2	-	<0.4	bar
Maximum cooling system pressure	1	-	1	bar
Cooling water flow rate	6 to 20	-	6 to 20	l/min
Ambient temperature range for storage	- 40 to + 95	- 40 to + 95	- 40 to + 95	°C
Ambient temperature range for extreme storage (less than 12 hours at a time)	- 40 to + 125	- 40 to + 125	- 40 to + 125	°C
Ambient temperature range in operation	- 40 to + 85*	- 40 to + 85	- 40 to + 85	°C
Power stage temperature range full operation	- 40 to + 110	- 40 to + 110	- 40 to + 110	°C
Control stage temperature range full operation	- 40 to + 80	- 40 to + 80	- 40 to + 80	°C

*In case of EVO11KLR4-CC08 model, the maximum coolant temperature at inlet is 33.5°C @ 72°C of ambient temperature.

Basic mechanical data	EVO11KL	Unit
Weight	24*	kg
IP protection	IP67 & IP6K9K	
Height	100	mm
Width	550	mm
Length	354 (383)	mm

*without coolant

Basic mechanical data	EVO11KA	Unit
Weight	24	kg
IP protection	IP67 & IP6K9K**	
Height	105 (166)	mm
Width	550	mm
Length	354 (383)	mm

**fan IP68

Basic mechanical data	EVO22KL	Unit
Weight	49*	kg
IP protection	IP67 & IP6K9K	
Height	100	mm
Width	550	mm
Length	354 (383)	mm

*without coolant

CAN interface	EVO11KL	EVO11KA	EVO22KL	Unit
CAN 2.0 b (11 STD/29 EXT)	STD as default			bit
CAN baud rate (125/250/500/1000)	500 as default			kbit/s
Max. CAN input voltage (ESD protection)	±24			V
CAN input capacity	47			pF
Termination resistor	Not present			

Warranty and durability		
Warranty		See limited warranties document
Lifetime	duty 40%	15 years
MTBF	Gm (Ground Mobile), @ +50°C coldplate temperature	50'000 hours

5.1.1. AC supply with 400Hz Generator

In case of a 400Hz AC supply is required, it is available a customized version of EVO chargers that can work at the standard AC grid frequency (50Hz – 60Hz) and with a 400Hz generator too. To understand in deep this charger model features, its User's manual is available on request.

5.1.2. Thermal dissipation information

The charger works providing full output power when the inlet coolant temperature is included in the range -38°C to +50°C. When the inlet coolant temperature increases above +50°C, the charger works in derating condition. It means that from that temperature the charger decreases the output power from 100% up to 0% (switched off). There are four thresholds from 100% to 0% (100% → 75% → 50% → 25% → 0%).
If the temperature come back to the previous values, the charger restarts automatically to increase output power up to 100% if the inlet coolant temperature returns to be less than 50°C.

The charger doesn't directly monitor the inlet coolant temperature.
The charger measures the power stage temperature (the temperature of the active component present in the power modules) and the temperature of the control stage (the temperature present over the control logic board close to the microcontrollers).

The information regarding these temperatures is present in the CAN BUS Manual:

- **Act1.Temp** is the variable that contains the highest value of the power stage active components.
- **Act2.TempLogLV** is the variable that contains the highest value of the control logic stage temperatures.

The thermal power that has to be dissipated is equal (more or less) to 0,8kW because the efficiency of the charger is approximately equal to 92% (see the efficiency curves in the Charger efficiency paragraph).

The difference between the inlet and output temperature is at maximum equal to 2,5°C with 6l/min and inlet temperature equal to 50°C.

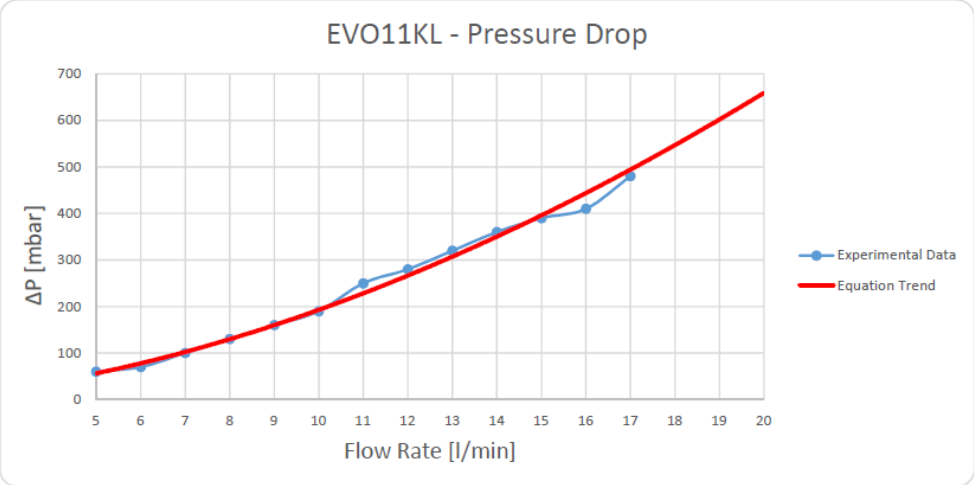
In case of EVO11KLR4-CC08 model, the maximum coolant temperature at inlet must be maintained at 33.5°C @ 72°C of ambient temperature in order to guarantee the operation of the charger in the operative conditions defined by the UL certification.

The derating is a safe mode to prevent damages. This mechanism doesn't allow the charger usage outside the limits indicated for the cooling system. Use of the charger out of limits above indicated avoid warranty.

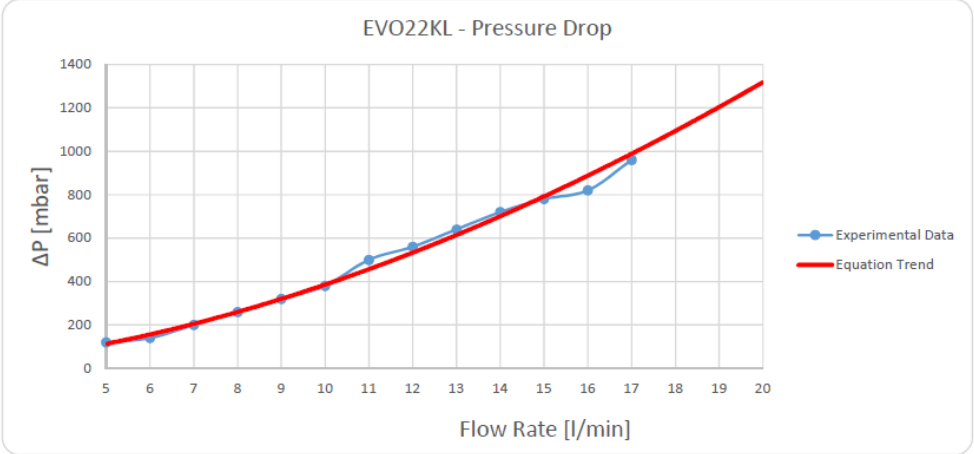
5.1.3. Pressure drop characterization

Below you can see the pressure drop vs coolant flow rate diagram for the EVO11K chargers and EVO22K chargers.

EVO11KL	
Flow [l/min]	ΔP [mbar]
5	60
6	70
7	100
8	130
9	160
10	190
11	250
12	280
13	320
14	360
15	390
16	410
17	480

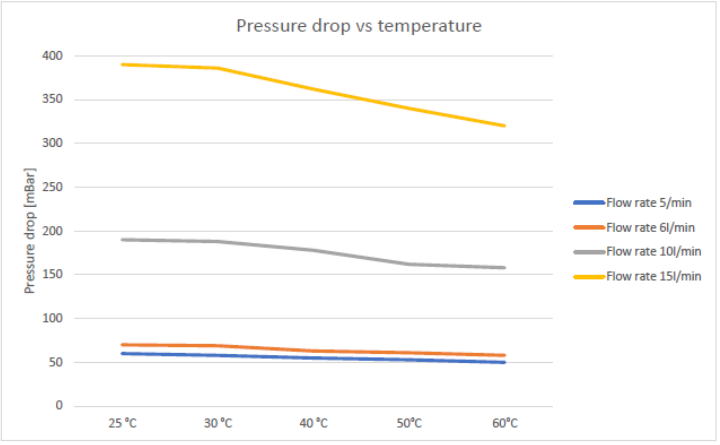


EVO22KL	
Flow [l/min]	ΔP [mbar]
5	120
6	140
7	200
8	260
9	320
10	380
11	500
12	560
13	640
14	720
15	780
16	820
17	960



Below the variation of the pressure drop vs the temperature.

EDN group srl					
Pressure drop vs temperature					
Flow [l/min]	ΔP [mbar] @ T = 25 °C	ΔP [mbar] @ T = 30 °C	ΔP [mbar] @ T = 40 °C	ΔP [mbar] @ T = 50°C	ΔP [mbar] @ T = 60°C
5	60	58	55	53	50
6	70	69	63	61	58
10	190	188	178	162	158
15	390	386	362	340	320



5.1.4. Constant power

When the charger feeds a voltage greater than 60% of its maximum, the device operates at constant power.

In the constant power mode, the charger decreases output current with increasing voltage to maintain constant charging power to optimize the charging time.

In this way it uses the maximum power for more time during the charging cycle reducing the recharging time up to 25%.

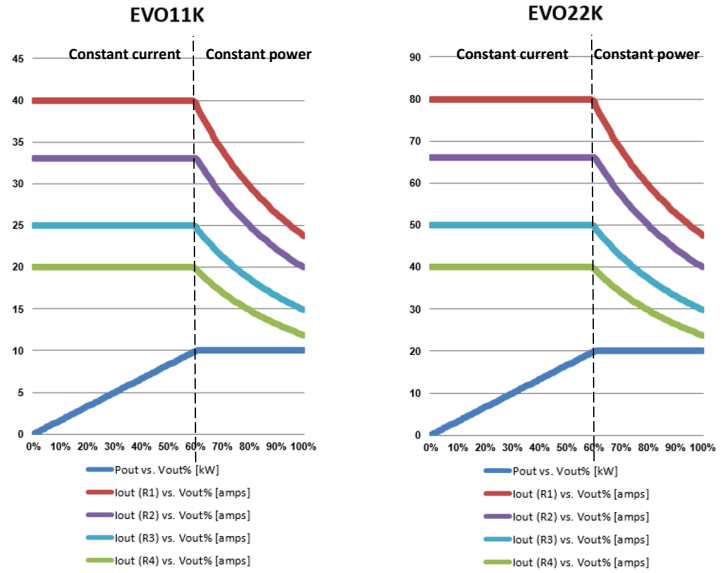
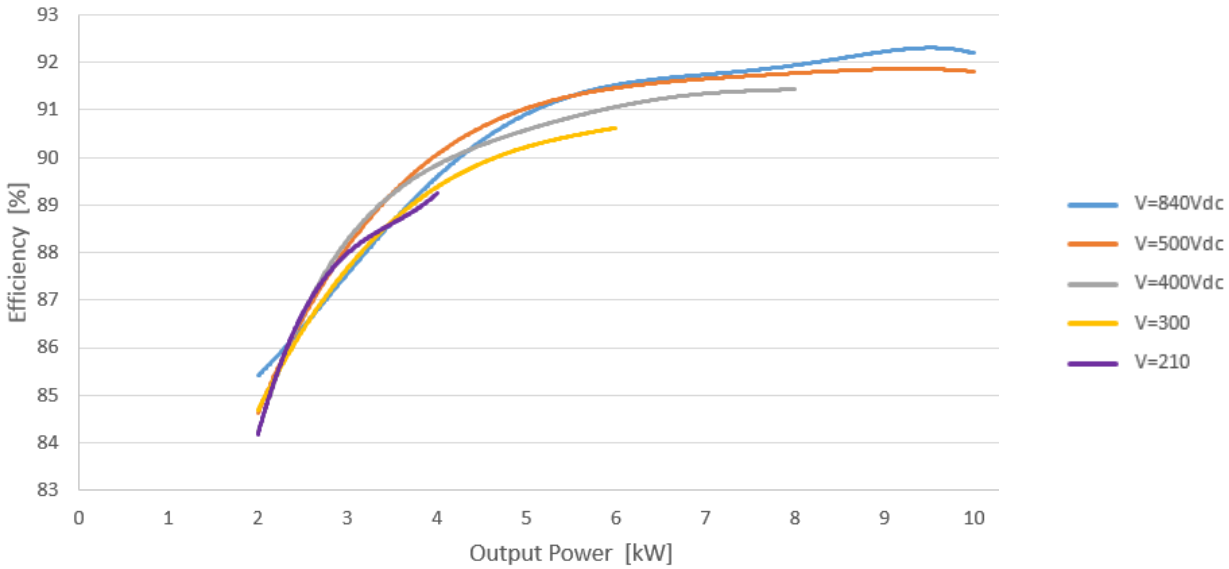


Fig. 1 *Costant power.*

5.1.5. Charger efficiency

Is shown below the efficiency curve of a EVO11KAR4 with variable voltage and output power.



The other charger ranges (liquid or air cooled version) present the same trend.

5.1.6. Start-up

During power up, the device monitors AC parameters and connections for protect itself from AC mains problems.

In the meantime, to avoid inrush current on the AC mains, the device performs an automatically pre-charge. The device finish the monitoring and it is ready for use after forty-five seconds from switching on.

Below the startup sequence:

If the charger is compliant with SAE J1772 or EN61851:

0. Provide LV Battery always hot
1. Proximity and Pilot check
2. S2 close
3. AC main provided to the charger
4. Bootload timeout (10s)
5. Charger starts to communicate (Main CAN messages) (charger must have CAN communications to vehicle)
6. BMS Wake-up output is enabled
7. Wait 12s for internal check
8. Precharge (22s)
9. All the error flags are reset
10. Charger starts to communicate (Service CAN messages) (charger must have CAN communications to vehicle)
11. Starts providing output power with a ramp (it takes less than 45s from AC Mains is provided)

If the charger is <u>NOT</u> compliant with SAE J1772 or EN61851:

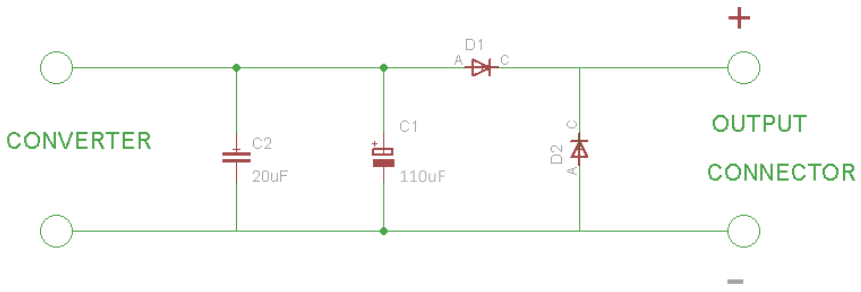
0. Provide AC Mains
1. Provide Enable Key signal
2. AC main provided to the charger
3. Bootload timeout (10s)
4. Charger starts to communicate (Main CAN messages) (charger must have CAN communications to vehicle)
5. BMS Wake-up output is enabled
6. Wait 12s for internal check
7. Precharge (22s)
8. All the error flags are reset
9. Charger starts to communicate (Service CAN messages) (charger must have CAN communications to vehicle)
10. Starts providing output power with a ramp (it takes less than 45s from AC Mains is provided)

See the CAN Manual for more details.

5.1.7. Output diode

The device have got an internal output decouple-diode. This diode permit redondant operation with chargers in parallel and to allow the operation even in case of failure.

Moreover, thanks to this, no external pre-charge circuitery is needed.



5.2. Warnings on Device

Warning labels are installed on the device to alert the operator of potential dangers. If any of these warning signs are missing or become illegible due to wear and tear, they must be replaced immediately. To obtain an original label, please contact EDN support at the manufacturer's address given in chapter 3.5.

Fig. 2 *Warning label on Device*

5.3. Technical Properties

- A wide battery voltage range with four voltage ranges available.
- It is be possible to connect several EVO unit in parallel to achieve higher power.
- Provide galvanic isolation between AC mains and HV DC output.
- Compact and lightweight construction.
- Vibration-resistant and sealed construction for on-board use.
- It can be connected to single-phase or three-phase WYE or Delta AC mains.
- Programmable charging profile over CAN bus.
- Firmware upgradable over CAN bus.
- CAN interface integrated as standard.
- Safety installation programmable over CAN bus (SAE J1772, EN 61851).
- Meets International Standard requirements (EMI, harmonics, etc.).
- DC High Voltage Interlock Loop (HVIL) protection.
- Precise and efficient charging power.
- Costant power charging capable.
- Programmable digital I/O signal.
- Digital output programmable for external LED.

5.4. Basic function of the EVO charger

The EVO series has been designed for use in off-highway, bus, marine, mining, commercial truck and automotive applications and can withstand harsh environments (vibration, thermal shock and extreme temperature ranges).

The EVO series is characterized by 11kW and 22kW power levels and comes available air cooled (EVO11KA) or liquid cooled (EVO11KL and EVO22KL); It is possible to connect several EVO in parallel to achieve higher power with a high degree of environmental protection, such as IP67 and IP6K9K (pressure wash) and with four output voltage ranges from 100VDC to 840VDC with constant power operation.

The chargers can be connected to single-phase AC mains and star or delta three-phase (100, 120, 208, 203, 240, 380, 400, 415, 420VAC) around the world in full compliance with international standards such as SAE J1772 and EN61851.

The focus is to realize a cost effective, compact and lightweight design to ensure the use in several applications and installation positions.

The processor-driven charging algorithms provides optimal results in efficiency and it contributes to a longer life of the battery charger and the HV battery.

The EVO series is programmable and can therefore be adapted to the individual needs of customers. With the included software, the charger can be adapted to the operating environment.

Safety and intelligent system design guarantees the immediate reaction of the charger in case of failure (eg over voltage, short circuit, overheating).

5.5. Main Structural Components Overview of the Liquid Cooled Charger

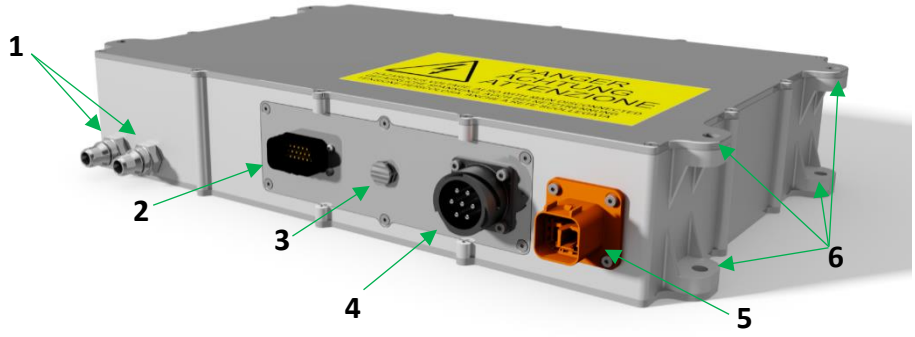


Fig. 3 *Main Structural EVO11KL*

1.	Cooling port	4.	AC input connector (J1)
2.	I/O control connector (J2)	5.	HVDC output connector (J3)
3.	Pressure equalization membrane	6.	Mounting holes (⌀ 10 mm)

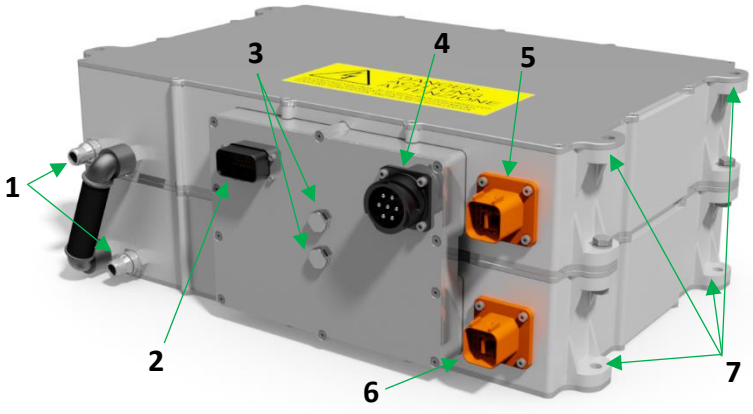


Fig. 4 *Main Structural EVO22KL*

1.	Cooling port	5.	HVDC output connector (J3a)
2.	I/O control connector (J2)	6.	HVDC output connector (J3b)
3.	Pressure equalization membrane	7.	Mounting holes (⌀ 10 mm)
4.	AC input connector (J1)		

5.6. Main Structural Components Overview of the Air Cooled Charger

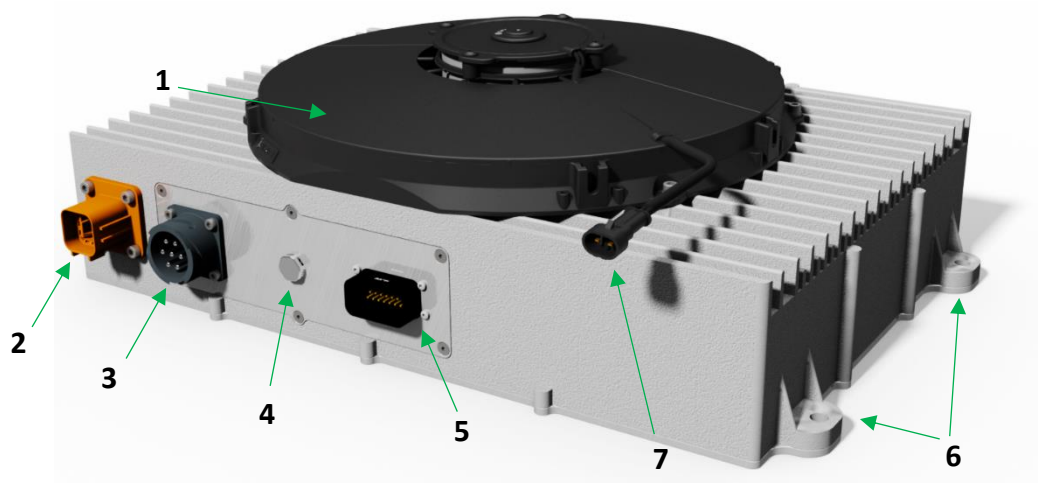


Fig. 5 *Main Structural EVO11KA*

1.	Fan	5.	I/O control connector (J2)
2.	HVDC output connector (J3)	6.	Mounting holes (⌀ 10 mm)
3.	AC input connector (J1)	7.	FAN connector (J4)
4.	Pressure equalisation membrane		

5.7. Liquid Cooling System Connections

The charger's baseplate has an Aluminium pipe used as water cooling loop.

The coolant requirements is: 50% ethylene glycol and 50% of demineralized water and the water flow rate must be about 10lt/min;

It is recommended to use glycol with aluminum corrosion inhibitor and establish a good grounding fixing to avoid corrosion process. In particular we suggest to use an OAT Glycol (organic acid technology).

If this inhibitor is not present in the coolant, the cooling system could be damaged.

The pressure drop of the charger's pipe is about 0,2bar@10lt/min for EVO11KL and 0,4bar@10lt/min for EVO22KL.

In the charger are already screwed the quick connector cooling ports. The cooling ports can be used interchangeably as inputs or outputs. The mating connections are used in order to connect to the cooling ports. As standard is provided te straight version but on request it is also available the 90° version.

For the input and output mating connections you can use a hose with a nominal internal diameter of 18 mm.

Fig. 6 *Cooling System EVOxxKL*

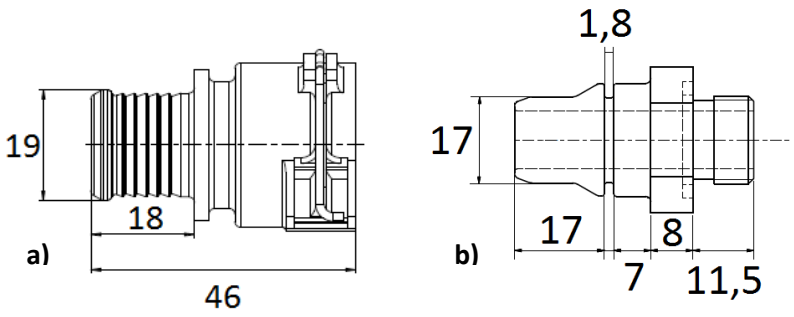


Fig. 7 *a) Mating connection b) Quick connector already screwed on the charger (cooling port)*

1.	Cooling port (extern ⌀ 17 mm)

Make sure that the coolant system design ensures a vent sufficient to eliminate air pockets. Air pockets in the cooling system can cause the device to overheat! When installing the vent can also be done in pressure or vacuum-filling. Please note the maximum allowable pressure of the system.

5.8. Air Cooling System Connections

In the air cooled version the Fan is supplied from the charger itself. In order to do this the pins 16 and 17 of the Control connector (J2) have to be connected to the Fan connector (J4).

In particular, the connections to be implemented are the following:

Control connector (J2)	**Fan Connector (J4)**
Pin 16 (Negative)	Pin 1 (Negative) (Black wire connected)
Pin 17 (Positive)	Pin 2 (Positive) (Blue wire connected)

The Fan is supplied depending from the internal temperature of the charger.

Four internal temperature operative ranges are defined:

Thermal range	Fan Voltage supply
-40 °C – 0 °C	0 V
1 °C – 30 °C	6 V
31 °C – 70 °C	6 V – 16 V
71 °C – 85 °C	16 V – 24 V

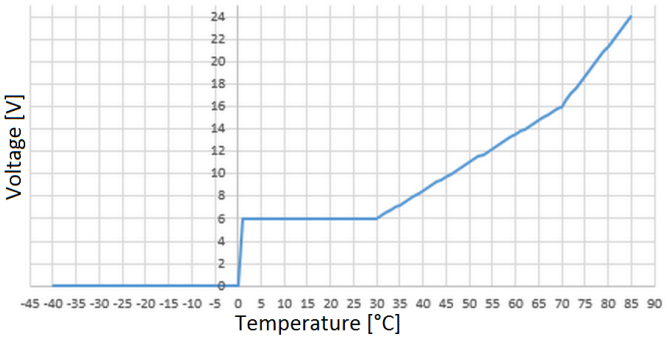


Fig. 8 *Supply FAN voltage*

The Fan draws air from the top and directs it to the heatsink.

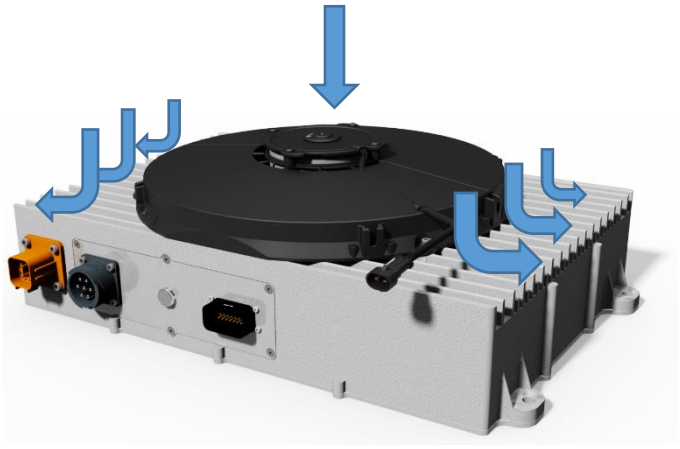


Fig. 9 *Air flux of the EVO11KARx*

5.9. Electrical Connections

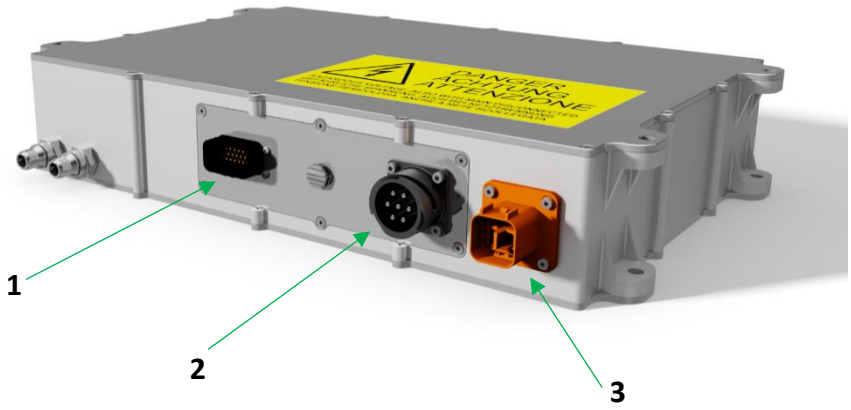


Fig. 10 *Electrical Connections EVO11K*

1.	23-pole control connector (J2) (Chapter 5.9.4)	3.	HVDC output connector (J3) (Chapter 5.9.2)
2.	AC input connector (J1) (Chapter 5.9.1)		

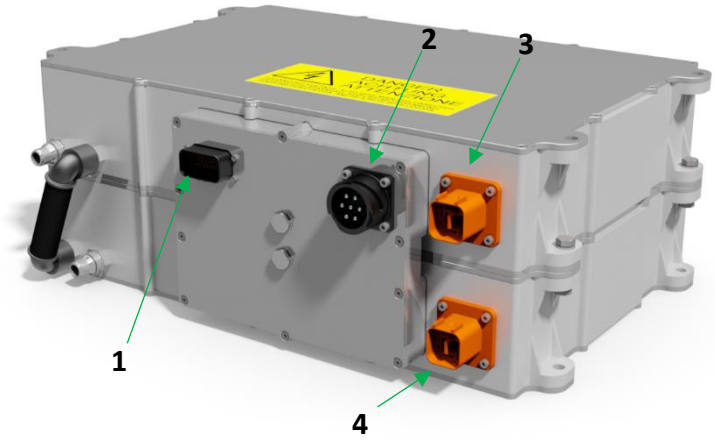


Fig. 11 *Electrical Connections EVO22KL*

1.	23-pole control connector (J2) (Chapter 5.9.4)	3.	HVDC output connector (J3a) (Chapter 5.9.2)
2.	AC input connector (J1) (Chapter 5.9.1)	4.	HVDC output connector (J3b) (Chapter 5.9.2)

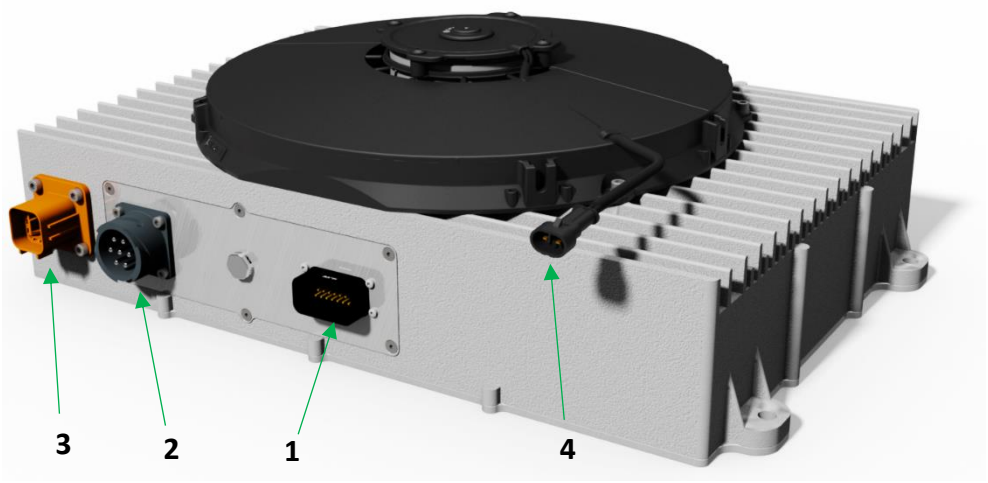


Fig. 12 *Electrical Connections EVO11KA*

1.	23-pole control connector (J2) (Chapter 5.9.4)	3.	HVDC output connector (J3) (Chapter 5.9.2)
2.	AC input connector (J1) (Chapter 5.9.1)	4.	Fan connector (J4) (Chapter 5.9.5)

5.9.1. Pin Assignement AC Input connector (J1)

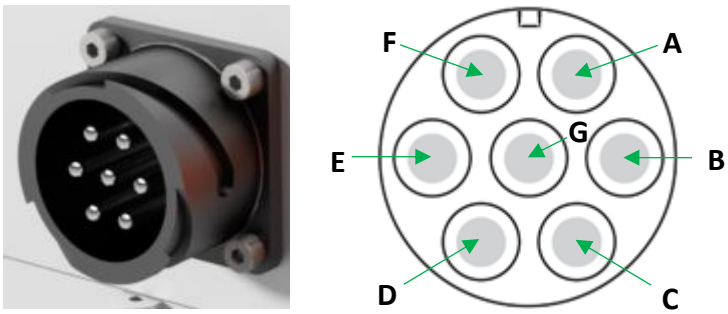


Fig. 13 *Particular of AC input Connector*

A.	Phase 1	E.	Phase 3
B.	Neutral 1	F.	Neutral 3
C.	Phase 2	G.	Ground (KL31)
D.	Neutral 2		

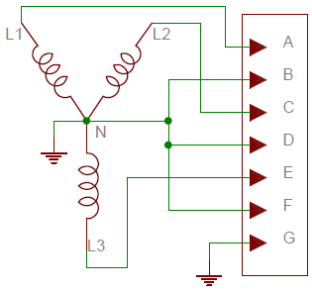


Fig. 14 *Y 3-phase configuration*

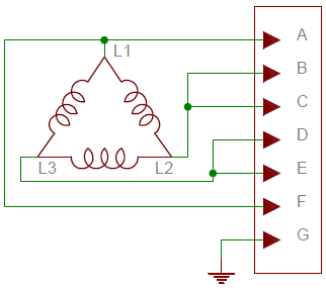


Fig. 15 *Delta 3-phase configuration*

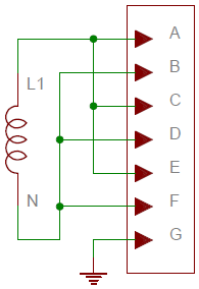


Fig. 16 *1-phase configuration*

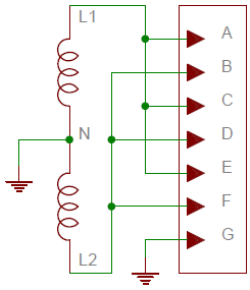


Fig. 17 *1-phase split configuration*

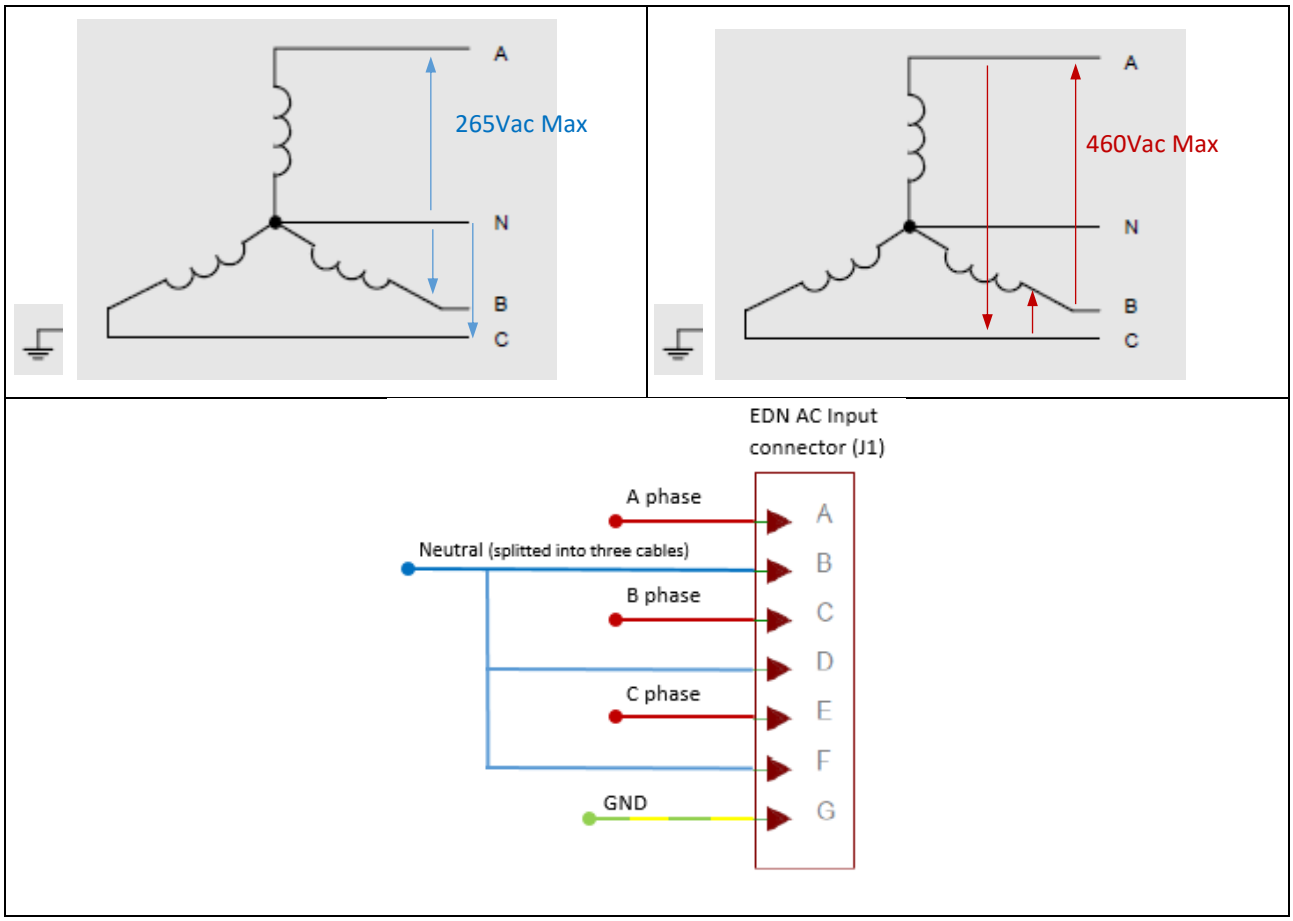
The VAN SYSTEM AC input connector has code CVB 02A 24-10P CR F16 G and its mating connector has code CVB 96DA 24-10S M32 CR F16. With the PCA are included 7 pins of 8mm^2 and the LAPP cable gland code 53112677 (on request they are available also female pins of 6mm^2; if this is the case, indicate it in the order). On request it is available also the 90° shell for the AC circular connector with its cabla gland. If this is the case, please indicate it in the order.

All ungrounded (hot) legs need to be protected with a external fuse.

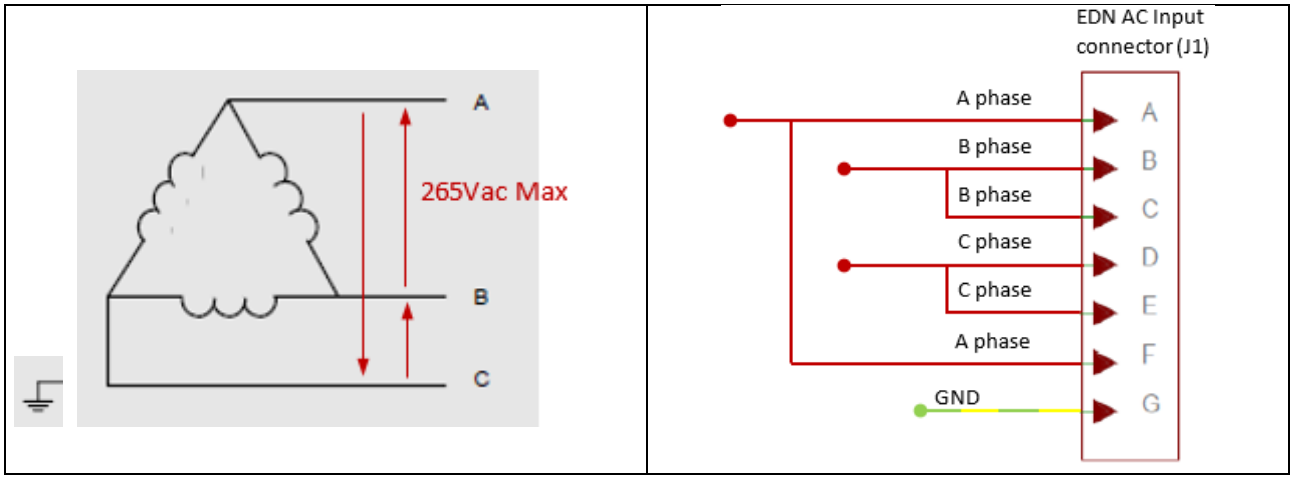
In 1-phase configuration and in Y 3-phase configuration all the neutral pins (B,D,F) must be connected, otherwise the charger will not work.

Below the three phase and single phase AC configuration are showned indicating the maximum AC voltage for each case.

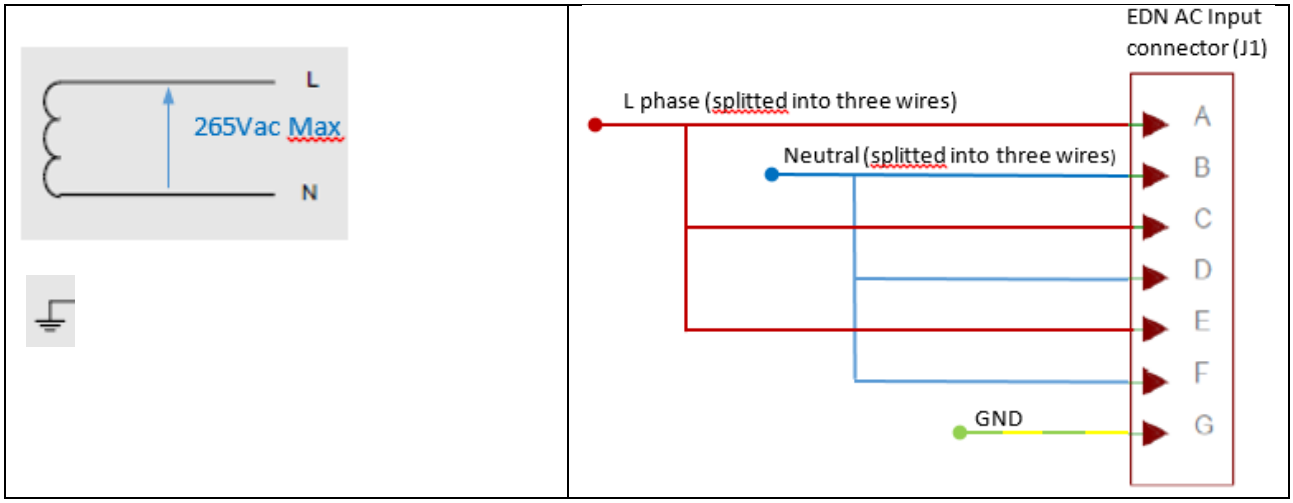
Y 3-phase configuration (example of not-grounded Neutral):



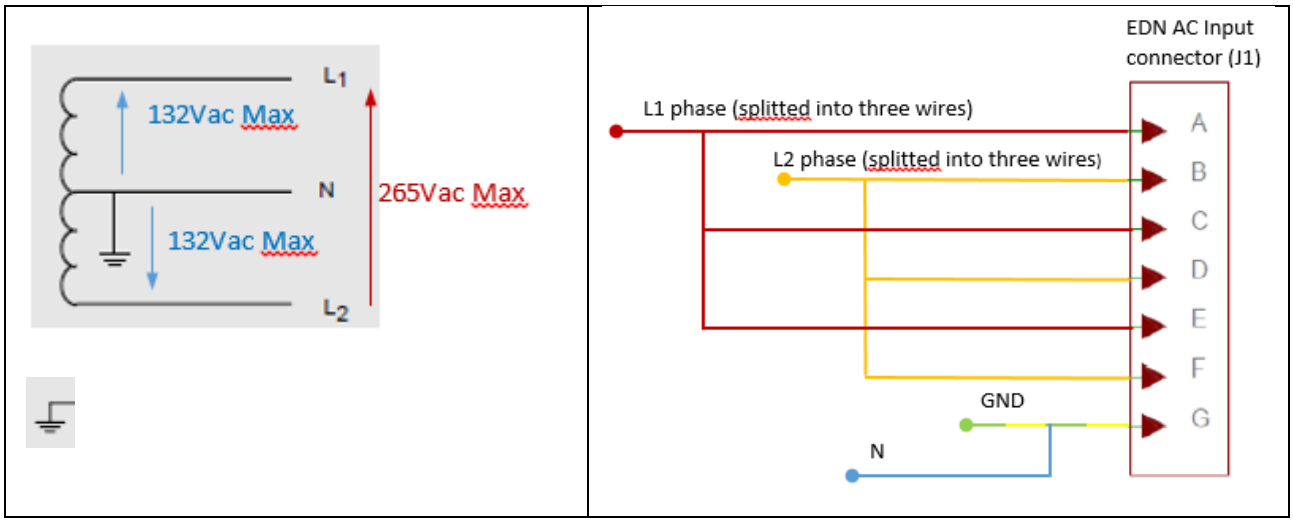
Δ 3-phase configuration: (this configuration is used for the 208/120Vac or 240/120Vac grid)



1-**phase configuration (example of not-grounded Neutral):**



1-**phase split configuration (example of not-grounded Neutral):**



5.9.2. Pin Assignement HVDC Output connector (J3)

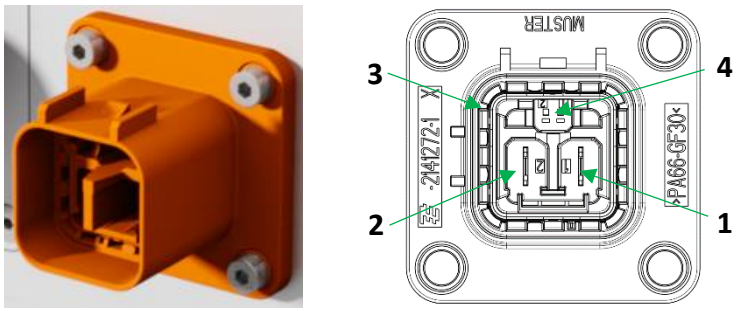


Fig. 18 *Particular of HVDC output connector*

1.	Output Positive pin	3.	Ground shield
2.	Output Negative pin	4.	Interlock pins

The TE connectivity control connector has code 1-2141272-1 and its mating connector has code 1-2282291- with final number depending from the cable length.

5.9.3. Grounding

The device use the fixing point as fixing ground.

Fig.1 *Graunding label*

In case SAE J1772 or EN61851 is enabled, the pins 13, 14 and 15 of the Control connector (J2) has to be connected to chassis ground.

5.9.4. Pin Assignement Control connector (J2)

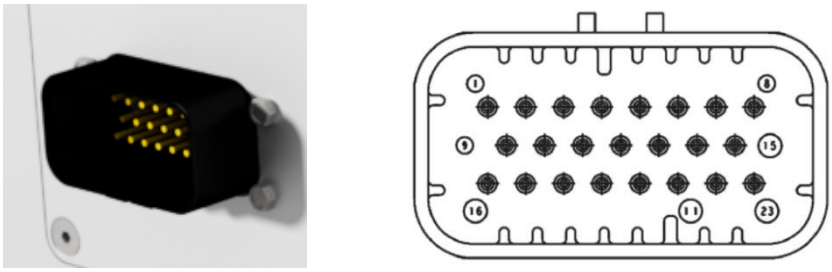


Fig. 19 *Particular of Control connector*

PIN	Description	Voltage	Current
1.	Liquid Pump Control	30 V	≤ 1 A
2.	Liquid Fan Control	30 V	≤ 1 A
3.	Alarm	30 V	≤ 1 A
4.	Enable Key (KL15)	8-30 V	≤ 1 A
5.	Control Pilot (CP)	max 12 V	
6.	Proximity Detection	5 V	10 mA
7.	LV Battery always hot (KL30)	8-30 V	
8.	Digital I/O	5 V	
9.	BMS Wake-Up	15 V	≤ 150 mA
10	Led	max 12 V	≤ 50 mA
11.	HVIL 1	max 12 V	≤ 1 A
12.	HVIL 2	max 12 V	≤ 1 A
13.	Ground (KL31)	—	—
14.	Ground (KL31)	—	—
15.	Ground (KL31)	—	—
16.	Supply Fan - Negative	6-16 V	≤ 4 A
17.	Supply Fan – Positive	6-16 V	≤ 4 A
18.	Temperature sensor	5 V	10 mA
19.	CAN Shield	—	—
20.	CAN L – Service	max 5 V	
21.	CAN H – Service	max 5 V	
22.	CAN L – Main	max 5 V	
23.	CAN H – Main	max 5 V	

The TE connectivity control connector has code 776200-1, its mating connector has code 770680-1 and pin code 770520-1. With the PCA are included 24 pins. It is recommended to use wire AWG 18 or equivalent.

About assembling: pay attention that all the mating connector pins are properly inserted into their seat. The pins must be pushed up to the bottom in order to avoid any contact issue.

5.9.4.1. Pin 1, 2 and 3 – Liquid Pump Control , Fan Control and Allarm

Three open drain outputs connected to GROUND.

Liquid Pump signal actives the pump when an internal temperature is above 35°C. Only for EVO**KL.

Fan out signal actives the fan when an internal temperature is above 40°C. Only for EVO**KL.

Allarm indicates when a charger's fault is detected. It rapresents an hardware output warning.

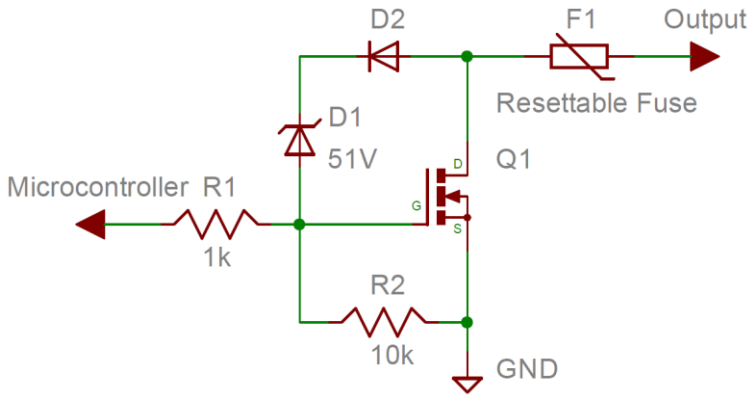
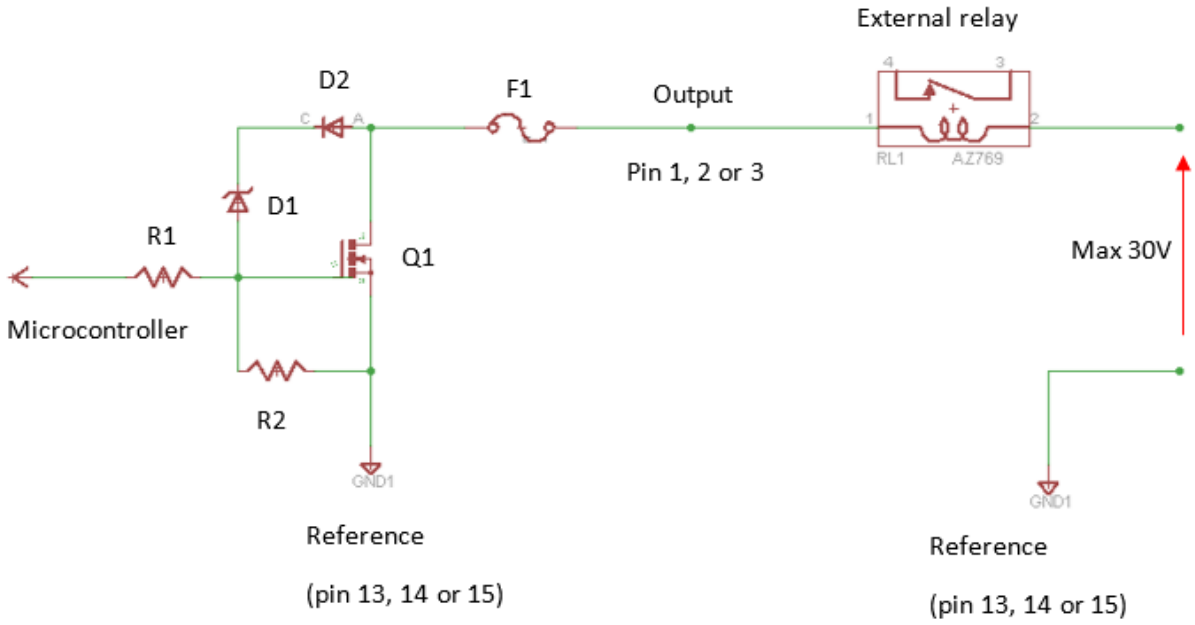


Fig. 20 *Schematic of Liquid Pump Control , Fan Control and Allarm*

These pins (1, 2 and 3) are three open drain outputs connected to GROUND and can be used like it is described in the picture below.



When the Q1 internal Mosfet is closed, you can supply and control an external relay. So, for example, you can supply up to 30V between pin 1 and one of pins 13, 14 or 15. When the internal temperature is above 35°C (only for

EVO**KL) Q1 is closed and you can energize the coil of an external relay. In this way you can control the activation of an external Liquid Pump.

So, this functionality allow you to activate automatically an external Fan or Liquid pump when the condition above described occurs.

The Alarm signal is similar. When a fault is present, it can be reported in hardware way using an external LED that can be supplied only when Q1 is closed.

5.9.4.2. Pin 4 – Enable key

The Enable Key signal wakes up the charger from SLEEP.

Only if SAE J1772 or EN61851 is enabled there is a feature that reduce the current consumption of the internal Logic when AC mains is not present (sleep mode). When AC Mains is not present the consumption is less than 150mA. During the sleep mode, the maximum consumption is 10mA. In this way, if the Proximity signal (AC Mating plug unplugged) or the Enable key is not present, after 60s the internal Logic goes in a sleep mode.

Starting from this status you can provide the Enable key signal in order to wake up the internal Logic that starts to communicate. Otherwise you can wake up the internal logic providing directly AC Mains (so that the Proximity signal).

But, if you need to start the charge session you have to provide the Proximity, the pilot signal and the AC Mains (in this situation the Enable key signal state is not relevant).

If you want that the charger goes in sleep mode when the charger session is concluded, the Enable Key signal has to be "low" (zero voltage).

If EN6851/J1772 is not enabled, you have always to provide the input Enable key to the charger. Also in this scenario it is set a sleep mode. If the Enable Key is not provided for 5s, the charger goes into the Sleep mode. In order to wake up the charger from this state, you have to provide again the Enable key signal.

In case of EVO22KL, it is always needed to provide the Enable Key to the lower module (EN61851 or SAE J1772 compliant or not). If the Enable key is not provided to the lower module, the lower module goes in Sleep mode in 5s if the charger is not compliant to one of the EVSE standards or if it is compliant with EN61851; then, it goes into Sleep mode in 10s if the charger is compliant with SAE J1772. One trick could be to mount a jumper between the pins 4 (Enable Key) and 9 (BMS Wake up). In this way, when AC is present, the BMS Wake up is provided from the charger that provide, automatically, to itself the Enable key too.

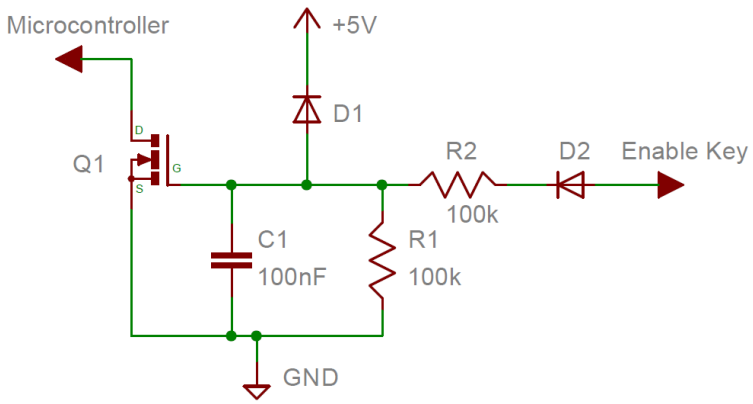


Fig. 21 *Schematic of Enable key*

5.9.4.3. Pin 5 – Control Pilot (CP)

SAE J1772 or EN 61851 compliant Control Pilot signal.

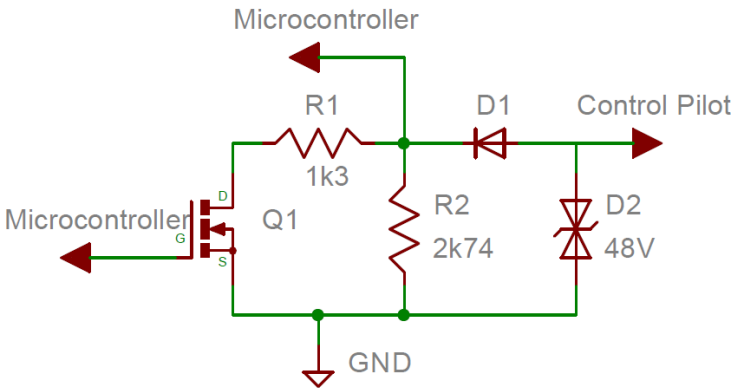


Fig. 22 *Schematic of Control Pilot (CP)*

5.9.4.4. Pin 6 – Proximity Detection

SAE J1772 or EN 61851 Proximity Detection compliant signal.

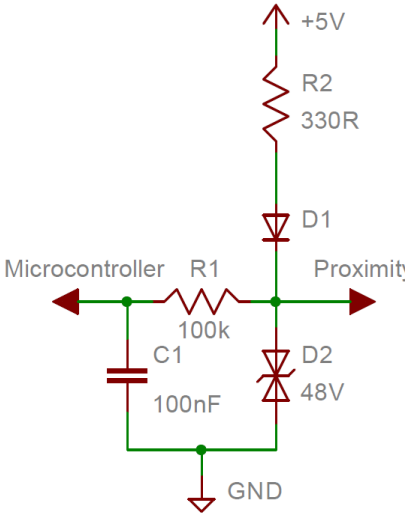


Fig. 23 *Schematic of Proximity Detection*

5.9.4.5. Pin 7 – LV chassis battery always hot

The LV battery always hot input supplies the charger's logic and permits CAN communication when AC power is not present (SAE J1772 & EN 61851 fully compliance). It is suggested to use an external fast resettable fuse in order to protect this input. Here are the ratings suggested: hold current of 250mA and trip current of 500mA.

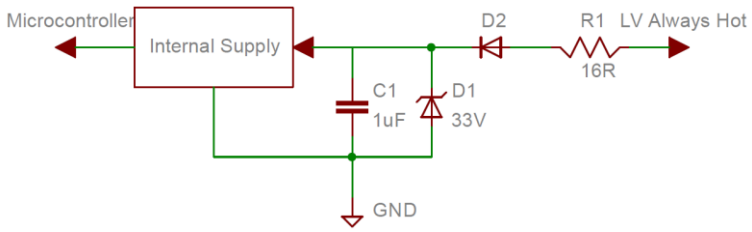


Fig. 24 *Schematic of LV battery always hot*

It is possible to modify the charger's Setup supplying the internal control logic only with the LV battery always hot (for EVO11K Series). Starting from the chargers manufactured in March 2019, this feature can be applied also to the EVO22K chargers (both the modules can be supplied with LV always hot only).

This type of operation is not possible with the EVO22KL charger. In that case the charger's Setup can be modified only suppling the charger with AC Mains (don't provide the LV battery always hot during the setup operation).

5.9.4.6. Pin 8 – Digital I/O

Spare digital I/O port.

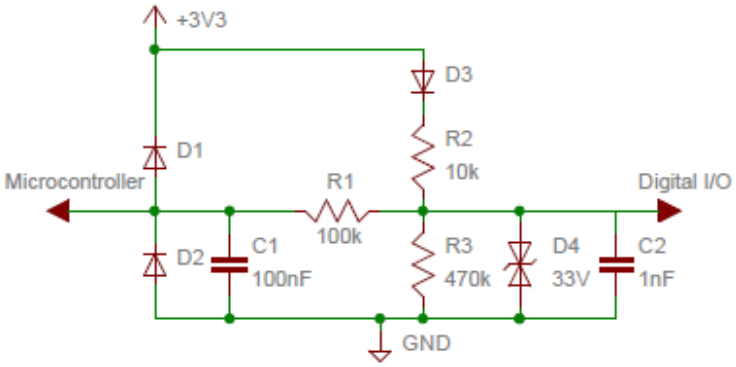


Fig. 25 *Schematic of Digital I/O*

When you start supplying the charger, during the internal check, it verifies the Digital I/O input status. If it is short circuited to one of the GND pins (13, 14 or 15), it means you are defining input AC Configuration as Single-phase.

Otherwise, if the pin 8 (Digital I/O) is left not connected, it means that you are defining input AC Configuration as Three phase.

Each time you start supplying the charger with AC Mains, the charger verifies the Digital I/O input status during the internal check.

Thus, the AC configuration is not defined during the charger setup configuration. This feature allow you to modify rapidly the AC configuration. From the moment the charger starts the internal precharge, it doesn't verify the Digital I/O status anymore.

5.9.4.7. Pin 9 – BMS Wake-up (V02)

The charger has an 15V/0.2A (V02) DC active output that can be used to wake up a BMS unit.

This output should go high as soon as the charger sees AC mains and after a CAN message is transmitted over CAN bus by the charger.

The time when the charger starts communicating is a trigger status to understand when the BMS wake-up signal goes up.

There isn't a CAN message dedicated to the Wake-up signal.

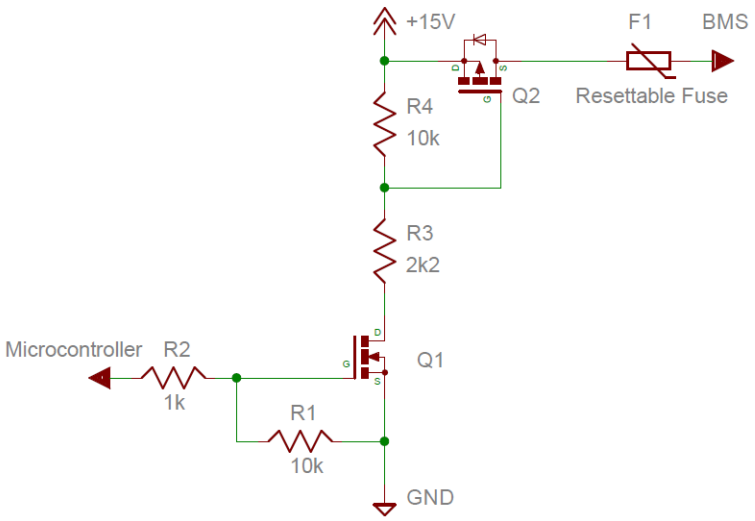


Fig. 26 *Schematic of BMS Wake-up*

5.9.4.8. Pin 10 – Led

Digital programmable output led.

(Fully compliance with mennekes plug)

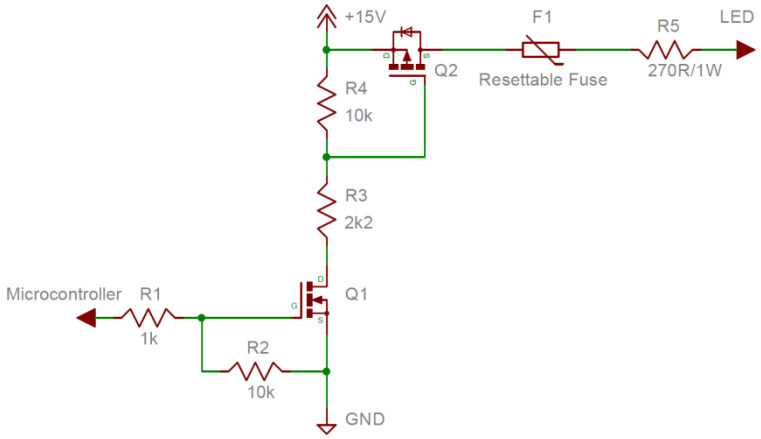


Fig. 27 *Schematic of Led*

The LED state (ON or OFF) is defined over Main Can. The LED has to be powered, providing AC Mains to the charger, in order to make it functional (it is not sufficient provide LV battery always hot only).

A typical usage of this LED could be the following. The LED is switched ON in accordance to the flag on command message (see Can Bus Specification Manual).

5.9.4.9. Pin 11 and 12 – HVIL

In order to guarantee the safety for High Voltage, an interlock system, connected in series to EVO's interlock, has to be implemented. The Interlock is a safety means that allows to verify if the charger's HVDC connector is firmly connected. The HVIL pins of the control connector (chapter 5.9.4) are directly connected with the HVIL pins of the HVDC output connector (chapter 5.8.2). They are available to be used in an external HVIL loop.

When the output connector is plugged in the output stage, the two HVIL pins of the control connector are short-circuited.

The Electronic control unit (ECU) inside the vechicle has to monitor the HVIL continuity. ECU should disconnect the AC mains and the DC power to the Battery when an HVIL failure is detected. This HVIL management is compliant with SAE J2344.

Before 25 July 2016 (serial number ME292830152203) the HVIL signal management was active (see chapter 9).

5.9.4.10. Pin 13, 14 and 15 – Ground (GND)

The GROUND signal is connected to the chassis ground as shown.

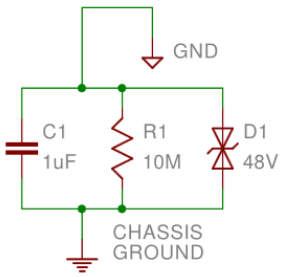


Fig. 28 *Schematic of Ground (GND) for EVOO11K**

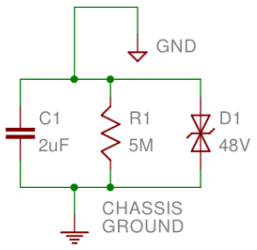


Fig. 29 *Schematic of Ground(GND) for EVO22KL*

For J1772 or EN61851 compliance, GND must be connected to CHASSIS GROUND externally (PIN 13, 14 and 15 should be connected to chassis ground).

5.9.4.11. Pin 16 and 17 – Supply Fan

Only for EVO11KA, this is the supply for the cooling fan.

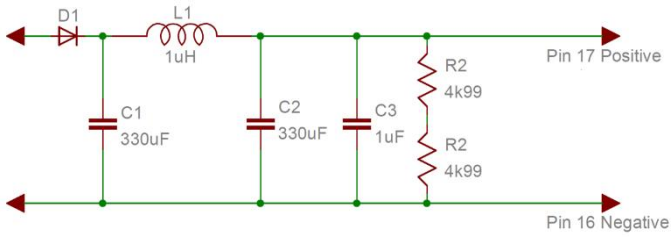


Fig. 30 *Schematic of Supply FAN*

The Fan is supplied from the charger itself. In order to do this the pins 16 and 17 of the Control connector (J2) have to be connected to the Fan connector (J4).

In particular, the connections to be implemented are the following:

Control connector (J2)	**Fan Connector (J4)**
Pin 16 (Negative)	Pin 1 (Negative) (Black wire connected)
Pin 17 (Positive)	Pin 2 (Positive) (Blue wire connected)

The Fan is powered depending from the internal temperature of the charger.

Four internal temperature operative ranges are defined:

Thermal range	Fan Voltage supply
-40 °C – 0 °C	0 V
1 °C – 30 °C	6 V

31 °C – 70 °C	6 V – 16 V
71 °C – 85 °C	16 V – 24 V

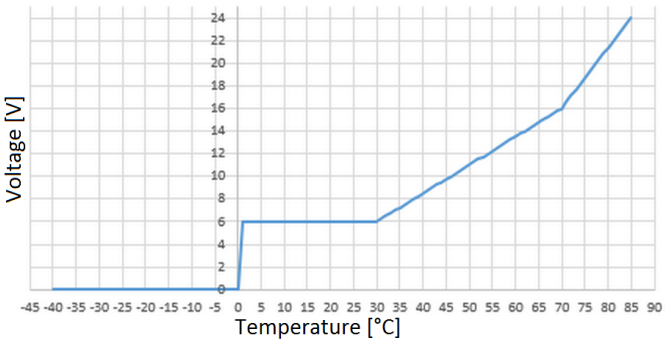


Fig. 31 *Supply FAN voltage*

The alarms worn in case of malfunction, for the maintenance see chapter 7.1.

5.9.4.12. Pin 18 – Temperature sensor

Interface for external PT1000 in order to monitor the external temperature. This feature is available on request.

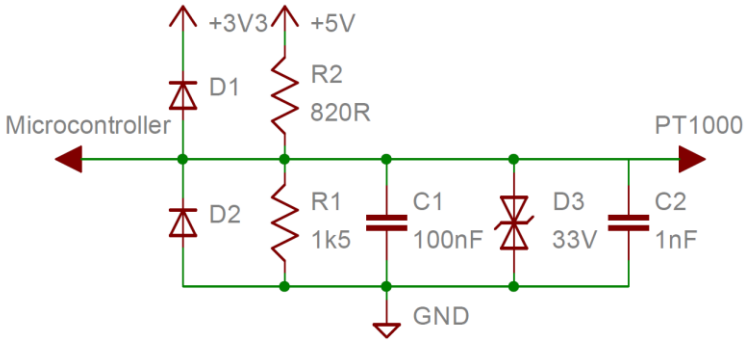


Fig. 32 *Schematic of Temperature sensor*

5.9.4.13. Pin 19 – CAN Shield

The CAN Shield signal is directly connected to the ground of the charger.

Fig. 33 *Schematic of CAN Shield*

5.9.4.14. Pin 20 and 21 – CAN Service

Auxiliary internal measures charger (for details see CAN Manual).

The CAN interface has the following characteristics:

- CAN V2.0B
- Fixed baud rate 500kbit/sec.
- Standard frame.
- Electrically isolated from battery pack potential.
- No terminating resistor is present.

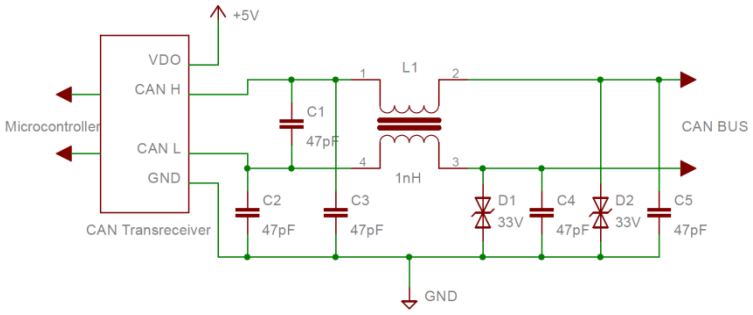


Fig. 34 *Schematic of CAN Service*

No terminating resistor is present. An external 120Ω resitor has to be mounted between CAN H – Service and CAN L – Service. The equivalent resistance between CAN H – Service and CAN L – Service must be 60Ω.

5.9.4.15. Pin 22 and 23 – CAN Main

Communication between the vehicle and charger (for details see CAN Manual)

The CAN interface has the following characteristics:

- CAN V2.0B
- Programmable baud rate.
- Programmable frame (Standard or Extended).
- Electrically isolated from battery pack potential.
- No terminating resistor is present.

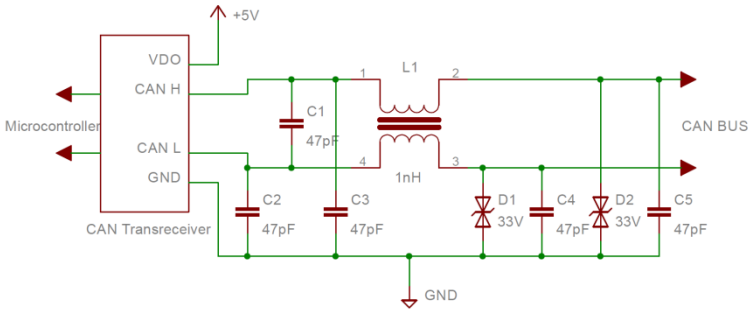


Fig. 35 *Schematic of CAN Main*

No terminating resistor is present. An external 120Ω resitor has to be mounted between CAN H – Main and CAN L – Main. The equivalent resistance between CAN H – Main and CAN L – Main must be 60Ω.

5.10. Pin Assignement for FAN connector (J4) (only for EVO11KA)

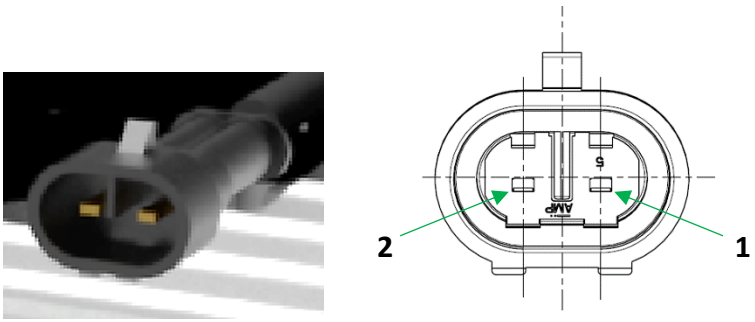


Fig. 36 *Particular of Fan connector*

1. Supply Fan – Negative pin (black wire connected)	2. Supply Fan – Positive pin (blue wire connected)

The AMP connector has code 282104-1, its mating connector has code 282080-1.

5.10.1. Summary

AC Input Connector (J1) (chapter 5.9.1)			
A.	Phase 1	E.	Phase 3
B.	Neutral 1	F.	Neutral 3
C.	Phase 2	G.	Ground (KL31)
D.	Neutral 2		
HVDC Output Connector (J3) (chapter 5.9.2)			
1.	Output Positive	3.	Ground shield
2.	Output Negative	4.	Interlock (already wired in the connector)
Control Connector (J2) (chapter 5.9.4)			
1.	Liquid Pump Control (only with EVOxxKL)	13.	Ground (KL31)
2.	Liquid Fan Control (only with EVOxxKL)	14.	Ground (KL31)
3.	Alarm	15.	Ground (KL31)
4.	Enable Key	16.	Supply Fan – Negative (only with EVO11KA)
5.	Control Pilot (CP)	17.	Supply Fan – Positive (only with EVO11KA)
6.	Proximity Detection	18.	Temperature sensor
7.	LV Battery always hot	19.	CAN Shield
8.	Digital I/O	20.	CAN L – Service
9.	BMS Wake-Up	21.	CAN H – Service
10	Led 3	22.	CAN L – Main
11.	Led 2	23.	CAN H – Main
12.	Led 1		
FAN Connector (J4) (chapter 5.9.5)			
1.	Supply Fan – Negative pin (only with EVO11KA)		
2.	Supply Fan – Positive pin (only with EVO11KA)		

5.11. Dimensions and Installation Information

For the installation of charger, the following points must be strictly adhered to:

- Despite the IP protection provided, the charger should be installed in a dry location, protected from splashing water.
- EVO11kA must be installed maintaining 15 cm between the fan and any object above. This has a direct influence on the power of the device (derating).
- The mechanical mounting must used at least 4 points and arranged so that the device is fitted firmly and in a manner to minimize vibration.
- The cable feeds and cooling liquid pipes should have sufficient space for routing and should not come into contact with sharp-edged components.
- the mounting bolts must be tightened to a torque setting of 10 Nm.
- The device can be mounted with any orientation.

5.11.1. Dimensions and Mounting Points EVO11KL

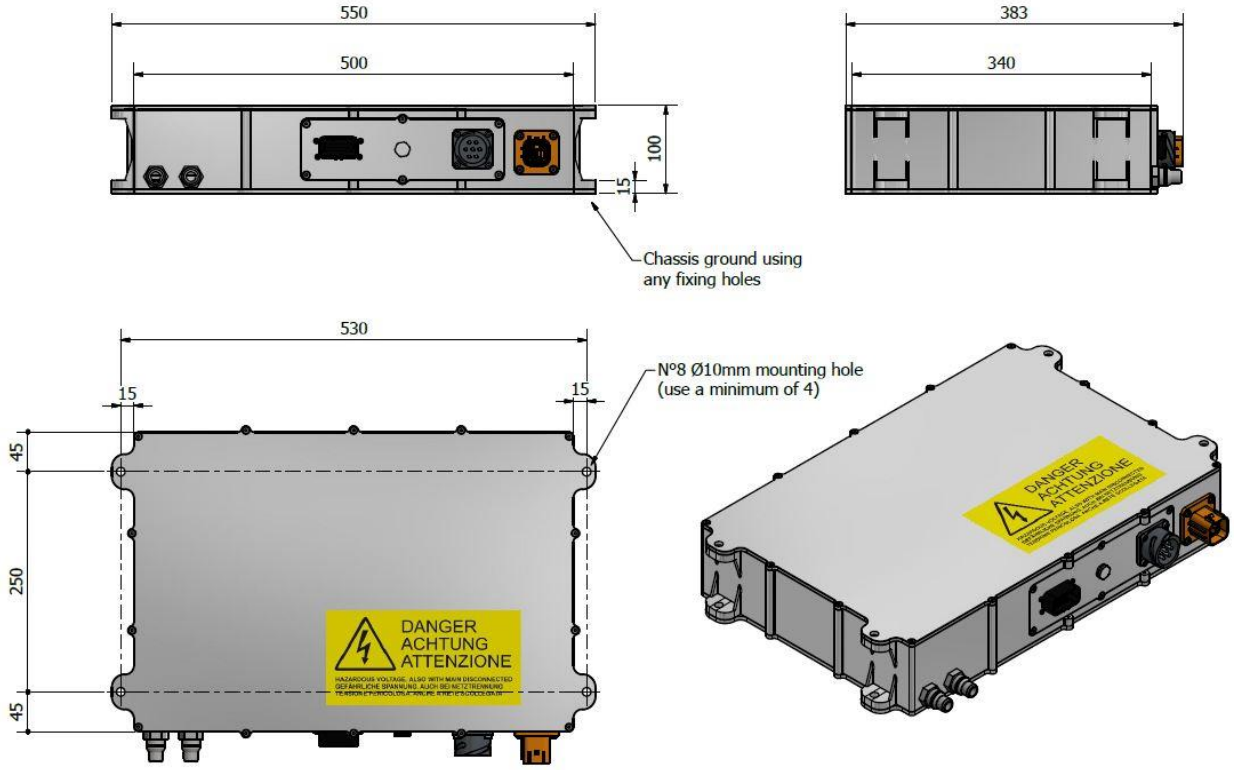


Fig. 37 *Mechanical data of EVO11KL*

5.11.2. Dimensions and Mounting Points EVO22KL

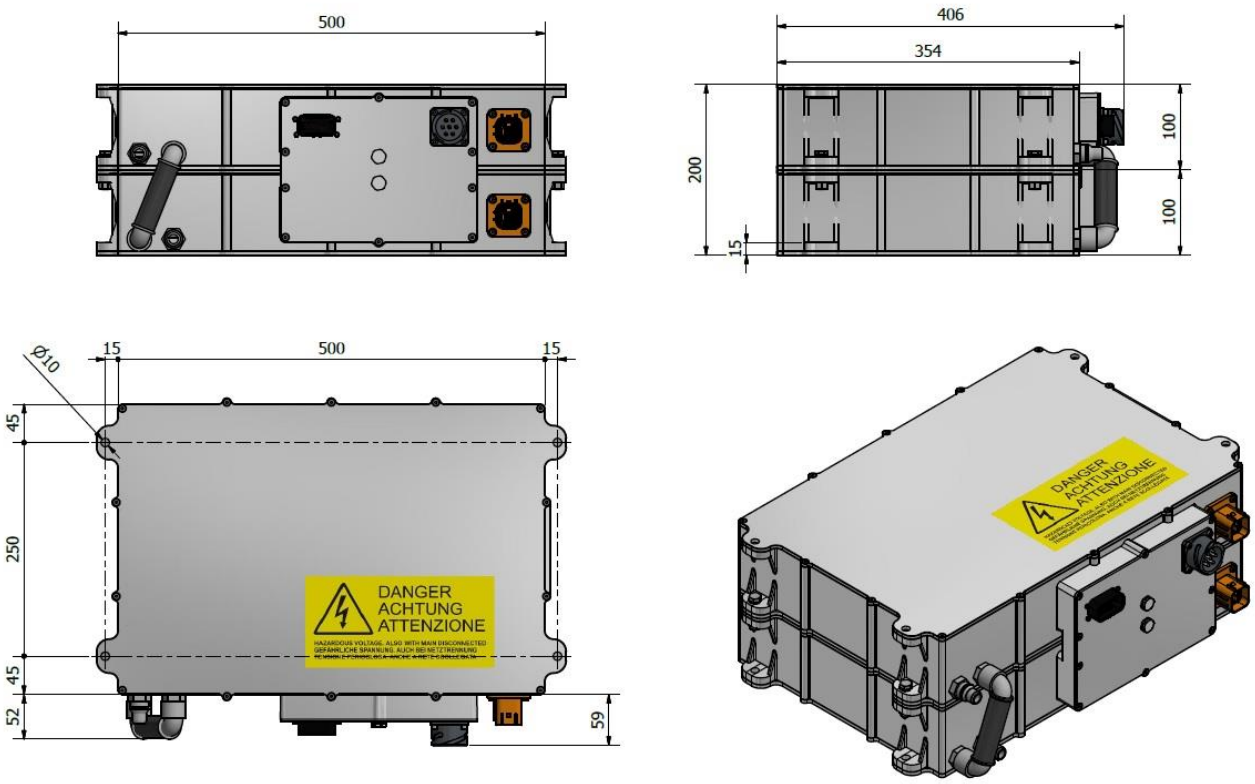


Fig. 38 *Mechanical data of EVO22KL*

5.11.3. Dimensions and Mounting Points EVO11KA

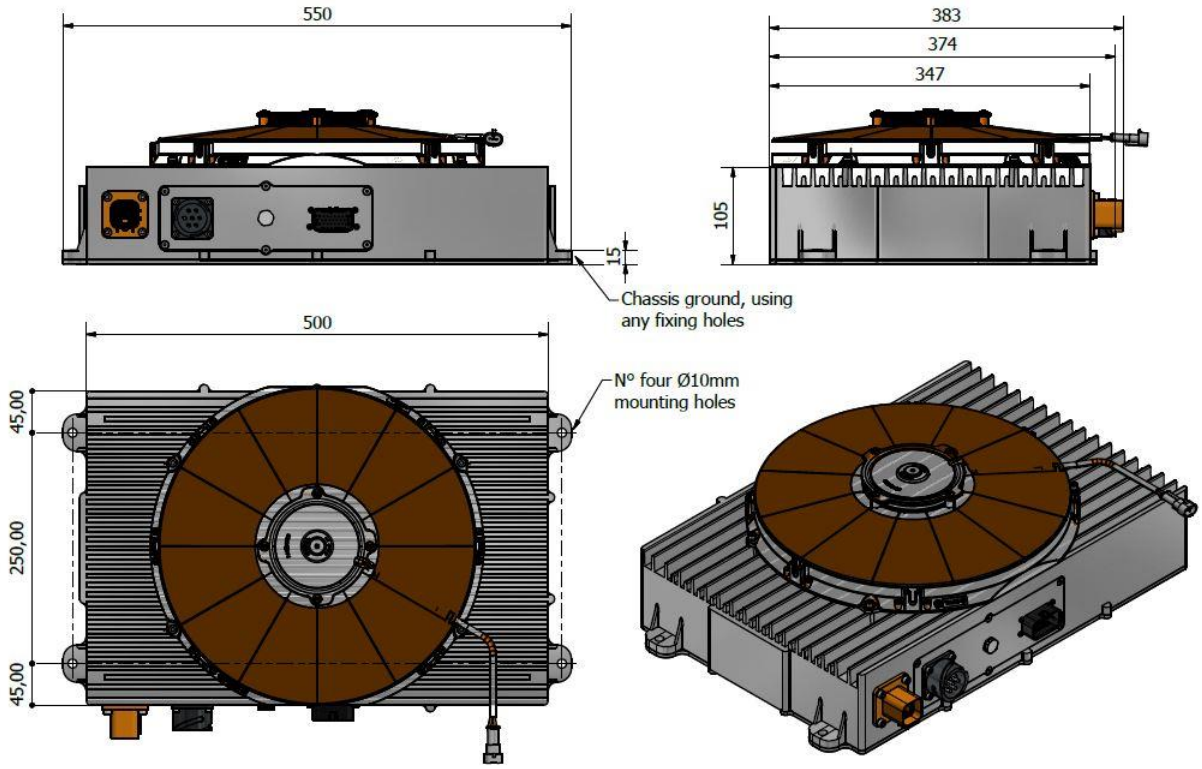


Fig. 39 *Mechanical data of EVO11KA*

5.10. Minimum connections for setting

Fig. 40 *Minimum connections for setting*

1. Control Connector (J2)	**Pin**	**Function**
	5.	Control Pilot (CP)*
	6.	Proximity Detection*
	7.	LV Battery always hot
	13.	Ground
	14.	Ground
	15.	Ground
	19.	CAN Shield
	22.	CAN L – Main
	23.	CAN H – Main

* only with SAE J1772 or EN61851 actived.

5.11. Minimum connections for operation

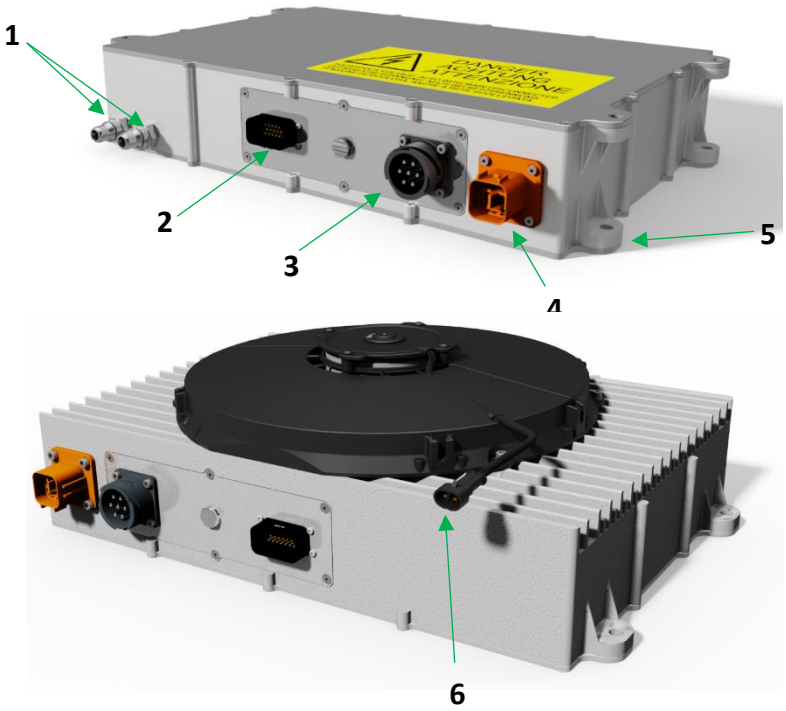


Fig. 41 *Minimum connections for operation*

1.	Cooling port	The device must to be connected to cooling system	
2.	Control Connector (J2)	**Pin**	**Function**
		4.	Enable Key (KL15)***
		5.	Control Pilot (CP)*
		6.	Proximity Detection*
		7.	LV Battery always hot*
		11,12	HVIL 1, HVIL 2 **
		13.	Ground
		14.	Ground
		15.	Ground
		16.	Supply Fan – Negative (only with EVO11KA)
		17.	Supply Fan – Positive (only with EVO11KA)
		19.	CAN Shield
		22.	CAN L – Main
		23.	CAN H – Main
3.	AC input Connector (J1)	Wired in accordance with the AC mains configuration	
4.	HVDC Output Connector (J3)	Connection with a load for power operation(without a load for no load operation)	
		HVIL	
4b.	HVDC Output Connector (J3b)	Second connection with a load for power operation(without a load for no load operation) (only with EVO22KL)	
5.	Gounding point	In accordance with ECE100	
6.	FAN connector (J4) (only for EVO11KA)	Connected to the Control connector (J2)	

* only with SAE J1772 or EN61851 actived. ** in order to be compliant with SAE J2344. *** only with SAE J1772 and EN61851 disabled or in case of EVO22K (it is possible to use a jumper between pin 4 (Enable Key) and pin 9 (BMS Wake-up) in order to make the charger provides to itself the Enable Key).

5.12. Power limitations

The charger, in order to ensure safe operation, controls: input current, output current, output voltage, power, heatsink and internal temperature. The charging power is reduced if critical limits are reached.

In particular the de-rating feature limits the power when:

- Device operating temperature limits are exceeded, the output current is reduced when the heat sink temperature is in the range from +65°C to +85°C.
  For safety and durability a heatsink temperature above +85°C wll cause the unit to switch off.
- In order to prevent the device overheating, the output current is reduced when the internal temperature is in the range from +65°C to +85°C.
  A Higher internal temperature causes the unit to switch off .
- The input voltage falls below the 230 Vac, for maintain the AC input current under the limit.
- The EVSE Proximity (PP) value defines the maximum AC input current.

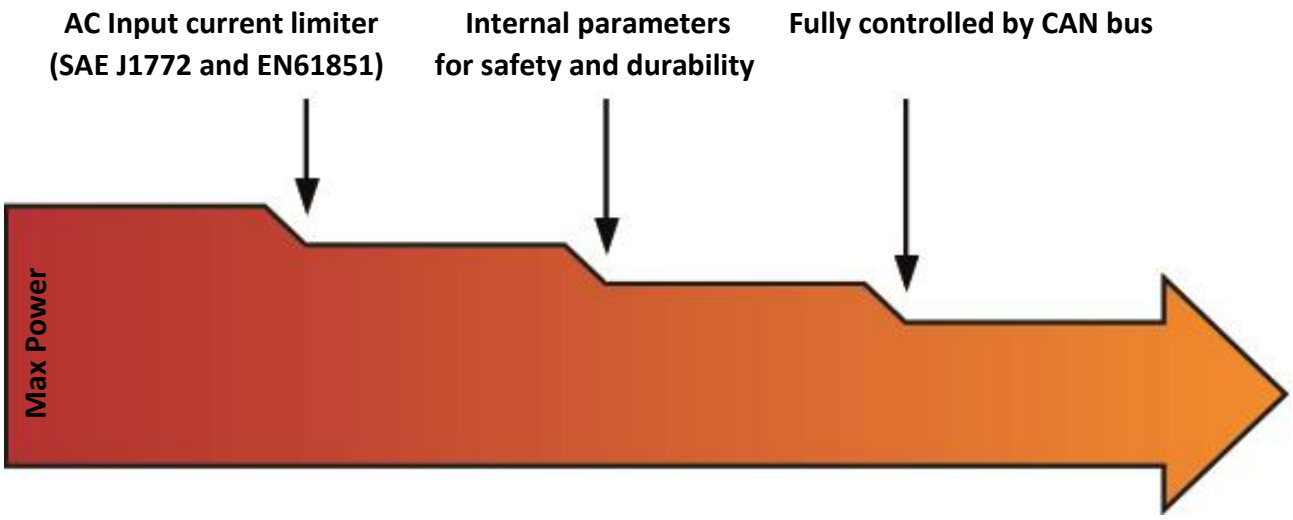


Fig. 42 *Power Limitations*

6. Chargers parallel

The EVO charger is designed with the possibility to connect up to 12 EVO11K or 6 EVO22K in parallel (for more details call the sales).

Each device in parallel must be set with a different CAN ID identification.

Depending on the customer's charging strategy, the parallel operation can be performed in two different ways. The parallel operation can be defined with the setup message.

6.1. A control for several chargers

In this mode, all devices are controlled by a single control message but each device is monitored by indipendent messages.

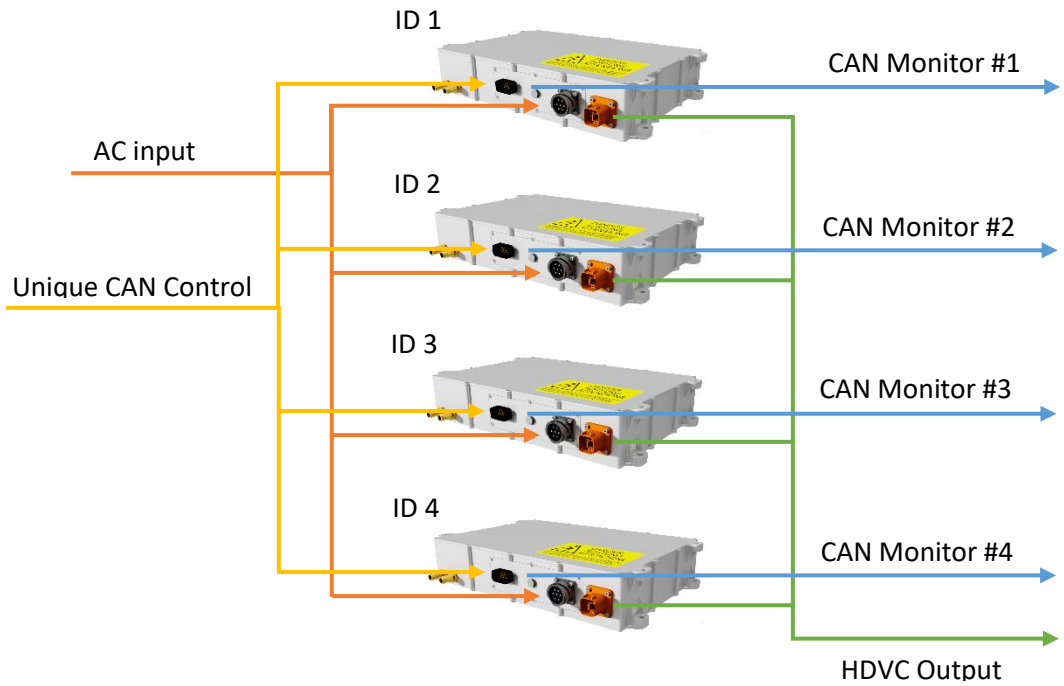


Fig. 43 *Unique control for several chargers*

6.2. A indipendent control for each charger

In this mode, each device is indipendently controlled by a different control message and monitored by an own monitor message.

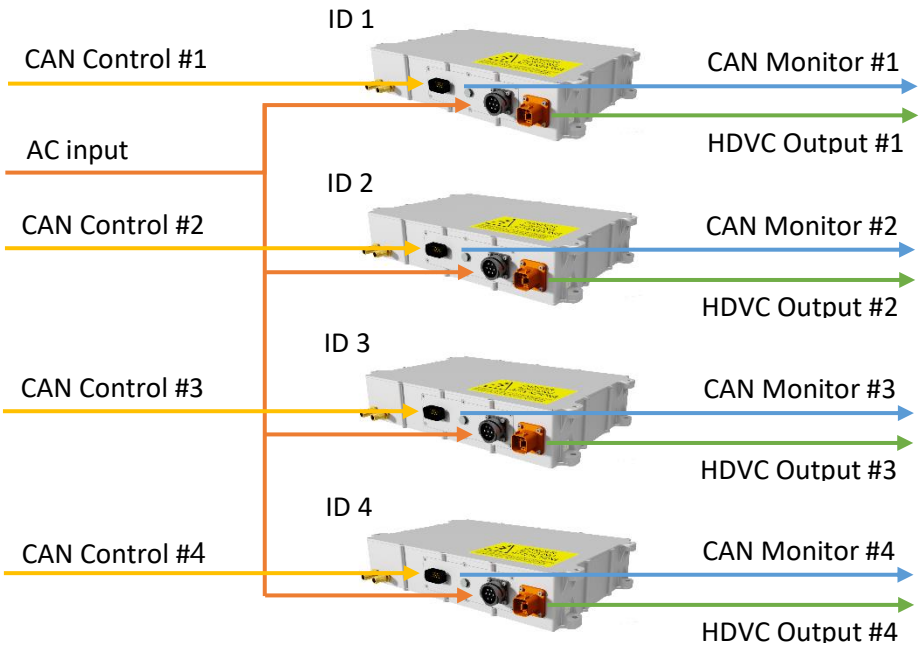


Fig. 44 *A control for each charger*

6.3. EVO22KL working models

The EVO22KL can be used as a unique 22kW charger or as two fully indipendent 11kW output.

Its architecture permits to charge one battery pods or two isolated battery pods, to optimize the charging algoritms and balancing.

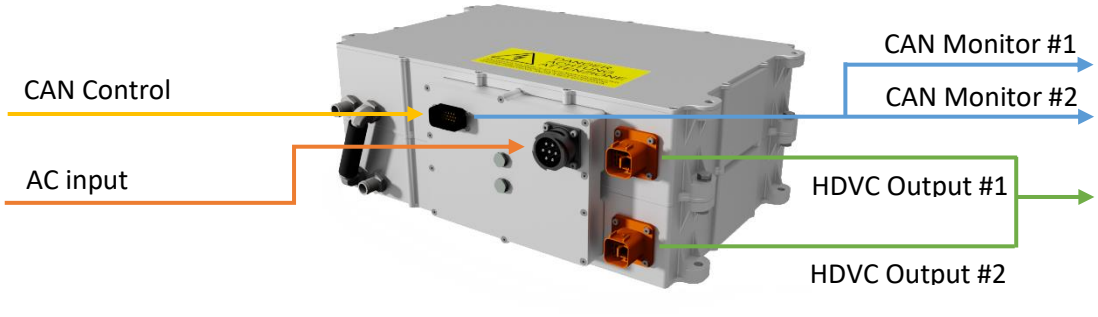


Fig. 45 *One control message for all EVO22KL*

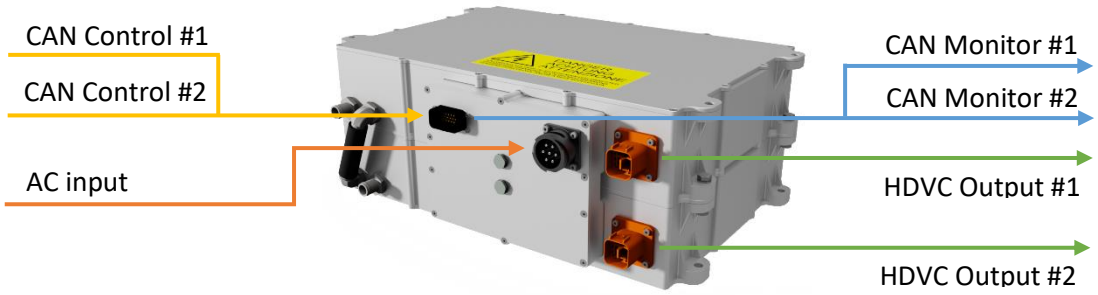


Fig. 46 *One control message for each output of the EVO22KL*

7. Installation / start-UP

7.1. Installing and Connecting the Charger

PROCEDURE STEP	
1.	Open the box, taking care not to damage the charger.
2.	Pull out the charger. Do not take it from the connectors.
3.	Integrate the charger mechanically into the specified position of the vehicle. Use the screws and torques stated, see chapter 5.11.
4.	Connect to the cooling water pipes (only for EVO**KL). See chapter 5.7 Cooling System.
5.	Activate the cooling water system (only for EVO**KL). Make sure that no air pockets are available in the cooling system!
6.	Build the mating control connector. See chapter 5.9.4 for the pin assignment of the Control connector (J2). See chapter 7.3 Precautions for crimping.
7.	Connect the pins 16 and 17 of the Control connector (J2) to the FAN connector (J4) (only fo EVO11KA).
8.	Connect the mating control connector to the charger control connector (J2). Ensure that the mating control connector clicks into place and sits firmly.
9.	Configure the charger. See CAN manual
10.	Wire up the modular plug to the battery cable. See chapter 5.9.2 Pin Assignment HVDV Output Connector.
11.	Place the battery cable in the vehicle. Do not build any of the electrical connections yet!
12.	Connect the HVDC output connector (J3). Ensure that the HVDC output connector clicks into place and sits firmly.
13.	Build the mating AC input connector. See chapter 5.9.1 for the pin assignment AC input connector. See chapter 7.3 Precautions for crimping.
14.	Connect the AC mains cable to the charger. Ensure that the circular connector complate rotate coupling-nut.
15.	Connect the charging cable to the charging socket of the vehicle.
16.	Connect the battery cable to the HV battery.
17.	Proceed when the charger over CAN bus.

Handling and operation

7.2. Maintenance of the Fan

Periodically, the fan and the heat sink must be checked and cleaned avoiding usage of solvents, diesel and gasoline.

In case of fan malfunction it needs to be replaced.

Brand	Mate connector
SPAL	VA13-BP51_C-35S

7.3. Precautions for crimping

For AC input connector (J1) is recommended to consult the document:

"*CVB series*" of the Van- system:

http://www.vansystem.eu/downx12345/cat_baio_2008_1_light2.pdf

For control connector (J2) is recommended to consult the document:

"*Ampseal Automotive Plug Connector and Header Assembly*" code 114-16016 of the TE connectivity

www.te.com/catalog/pn/en/770680-1

The HVDC connector (J3) is supplied already crimped.

7.4. Possible oxidation of the bottom cover

In case the charger is stored for a long time lying over the bottom cover on a metallic surface, it is possible the creation of moisture with consequent oxidation like it is shown in the picture below.

Fig. 47*: Oxidation of the bottom cover*

This oxidation is not corrosion, it is naturally tendency of the material to sustain itself from corrosion. If this oxidation occurs, it is relative only to a superficial film that doesn't have effect on the performance of the charger but, it has only an aesthetics effect.

7.5. Coolant liquid residual inside the coolant liquid circuit

During the Run-in test, part of the EOL, it is used demineralized water to cool the charger.
When the Run-in test is concluded, the coolant liquid circuit is emptied.
Anyway, it is possible that part of the coolant liquid remains inside the circuit.

Be careful that part of the liquid remained in the coolant liquid circuit can escape during the removal of the pipes caps. The coolant liquid used during EOL is demineralized water.

7.6. Malfunctions solved by the customer

7.6.1. CAN bus does not transmit

- Check the wiring control connector (J2).
- Check supply (mains or always hot).
- Check if termination resistor is present on CAN bus.
- Check if CAN-L and CAN-H are swapped.
- Check if CAN-L and CAN shield are swapped.

7.6.2. The device goes into derating after a short time

- Check the cooling system (Fan or liquid system).
- Verify the Ambien temperature Outside the charger
- Check the AC current available from AC grid (Check Pilot and Proximity signal)

7.6.3. CAN bus ok but not charging

- Check the correctness of the messages over CAN:
    - check if command message is present (ID 0x618)
    - check if the charger is enabled (see CtlCANEnable equal to 1)
    - check output Voltage and output Current value in the control message and in the charger configuration message
    - check input Current value in the control message and in the charger configuration message
    - check the value of the charger configuration message (ID 0x616)
- Check the connection of DC output connector for HVIL
- Check the configuration of AC input mating connector:
    - check that all the neutral pins (B,D,F) are connected, otherwise the charger doesn't work

7.6.4. CAN bus parameters value uncorrect

- Check the correctness of the scaling and offset value indicated in the Can Bus Specification document

8. Warranty and guarantee

(See Limited Warranty Document)

8.1. In case of the failure?

PROCEDURE STEP	
1.	Contact Customer Support support@edngroup.com that will provide the authorization code to repair.
2.	In order to reduce repair time please fill the RMA document.
3.	Pack the device possibly in its box or equivalent.
4.	Place the device packed on a pallet sizes appropriate to prevent damage during transportation.
5.	Send the pallet to the address that you can find in RMA file.

9. Appendix A

Below are listed the ECN (Engineering Change Notification) realized by EDN:

ECN #	Issue Date	Description
252	26 October 2016	Introduction of quick connection coolant ports in the EVO liquid cooled series
254	25 July 2016	New HVIL signal management

In order to have the document contact the Customer Support support@edngroup.com.