Installation guide

EPC SERIES
Bidirectional DC-DC converter

epic power

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Version 1.18 en

March 2020

Epic Power Converters S.L.

1. PREFACE

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1.1. ABOUT THIS MANUAL

This manual is copyright of Epic Power Converters S.L. All Rights Reserved.

This manual is subject to change without prior notice.

This manual gives you the necessary information about the installation, commissioning and operation of EPC Series Bidirectional DC-DC converter. We encourage that you read carefully these instructions before the first power-up of the unit.

If you have any doubts regarding any procedure, please contact immediately with the support team of Epic Power Converters.

2. SAFETY

This manual contains warning and cautions, which are identified with safety symbols. The warnings and cautions give important information on how to prevent not only injury and damage to the equipment or your system but also personal injuries.

Read the warnings and cautions carefully and obey their instructions.

Safety precautions are classified into the following two categories in this manual.

 **WARNING**	This symbol indicates information that, if ignored, lead to dangerous conditions , personal injuries or even death due to incorrect handling.
 **CAUTION**	This symbol indicates information that, if ignored, lead to dangerous conditions , personal injuries or physical damage due to incorrect handling.

2.1. SAFETY PRECAUTIONS

Installation and application

 **CAUTION**	The converter should be attached to a vertical surface, with the fans pointing upwards in a dry area with no condensation.
 **CAUTION**	Make room in front of both ventilation grills, at least 250 mm.
 **CAUTION**	The system has been designed for pollution level 2. Consult epic power in any other circumstances.

 **WARNING**	It is essential to strictly follow installation and/or maintenance steps in order. Failure to do so may result in overvoltage or overcurrent occurrence, increasing the risk of shock or causing damage to the drive.
 **CAUTION**	In case of malfunction, or doubt, contact epic power. **NEVER OPEN EPC**. It is an extremely complex electronic system. Reparation must only be undertaken by epic power. Any unskilled handling may damage the system or may cause a serious accident.

Wiring

 **WARNING**	Before wiring the system, ensure that the main switch of the converter is switched off during the installation.
 **CAUTION**	Connection cable must have bullet style connectors, to prevent wires from fraying.
 **WARNING**	In case of deliberate electric supply disruption, the “ENABLE” connection must be opened, disabling EPC power conversion. If not, HVDC link will keep being supplied, and maintenance staff may receive an electrical shock.

Earthing

 **WARNING**	Ensure that earth is connected in both available connections (see page 17) with a conductor of minimum 2.5 mm^2 section before energizing the converter.
 **WARNING**	The protective conductor connection (PE) must not be removed since the protection against electric shock provided by the converter would be lost.
 **WARNING**	The protective conductor connection (PE) must be low-inductance and as short as possible.

High Voltage Side

 **WARNING**	Supply must be shut down, and HVDC link must be disconnected from three-phase mains or any source of energy before making any connections. Failure to do so creates risk of electrocution for the operator. The EPC system may also become damaged.
 **WARNING**	Before starting high side connection of the VVVF, ensure that there is no voltage left in the nodes about to be handled.
 **WARNING**	**DO NOT TOUCH THE HVDC LINK WITHOUT BEING SURE EPC SYSTEM IS SHUT DOWN, CONNECTOR (5) UNPLUGGED AND PROTECTIVE DEVICES OPENED.**

Low Voltage Side

 **WARNING**	Low side connection MUST be protected in both conductors. Keep the protective device opened during wiring operation.

Contents of the Guide

3. EPC GENERAL DESCRIPTION

The EPC is a new generation of DC/DC Converters with a wide range of voltage levels in both sides. The system is capable of managing power in both directions. As an ideal application, you can connect the low side voltage to batteries and feed any drive (VVVF) directly through the DC link. It can also be used for off-grid applications where there is no three-phase mains available or, for example, in automatic warehouses where shuttles/AGVs are moving off-grid. Different supply sources (solar, wind, etc.) can be connected to have multiple generator systems.

4. EPC EXTERNAL DESCRIPTION

Size 1

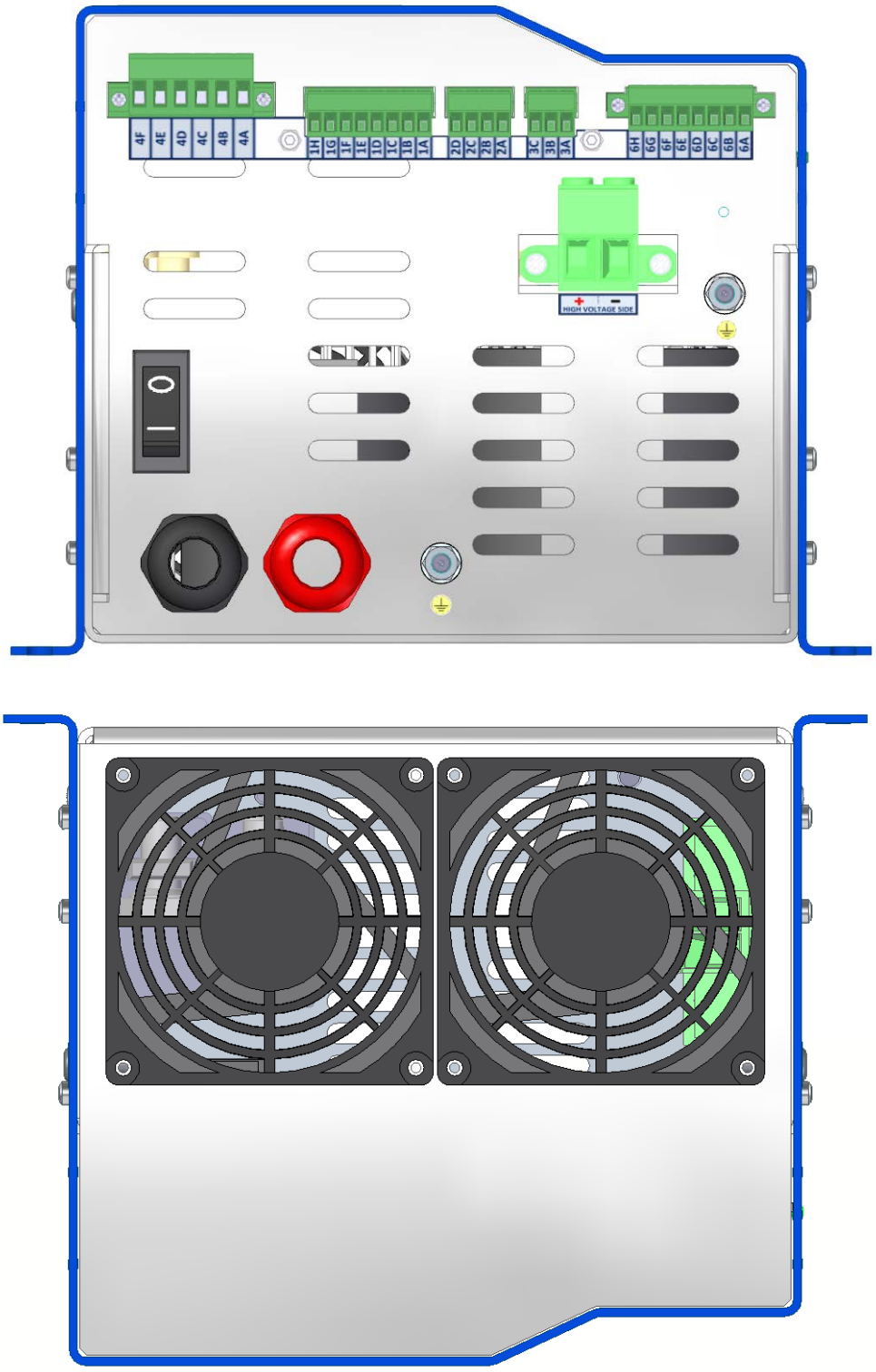


Fig. 1 DC/DC converter Size 1

Size 2

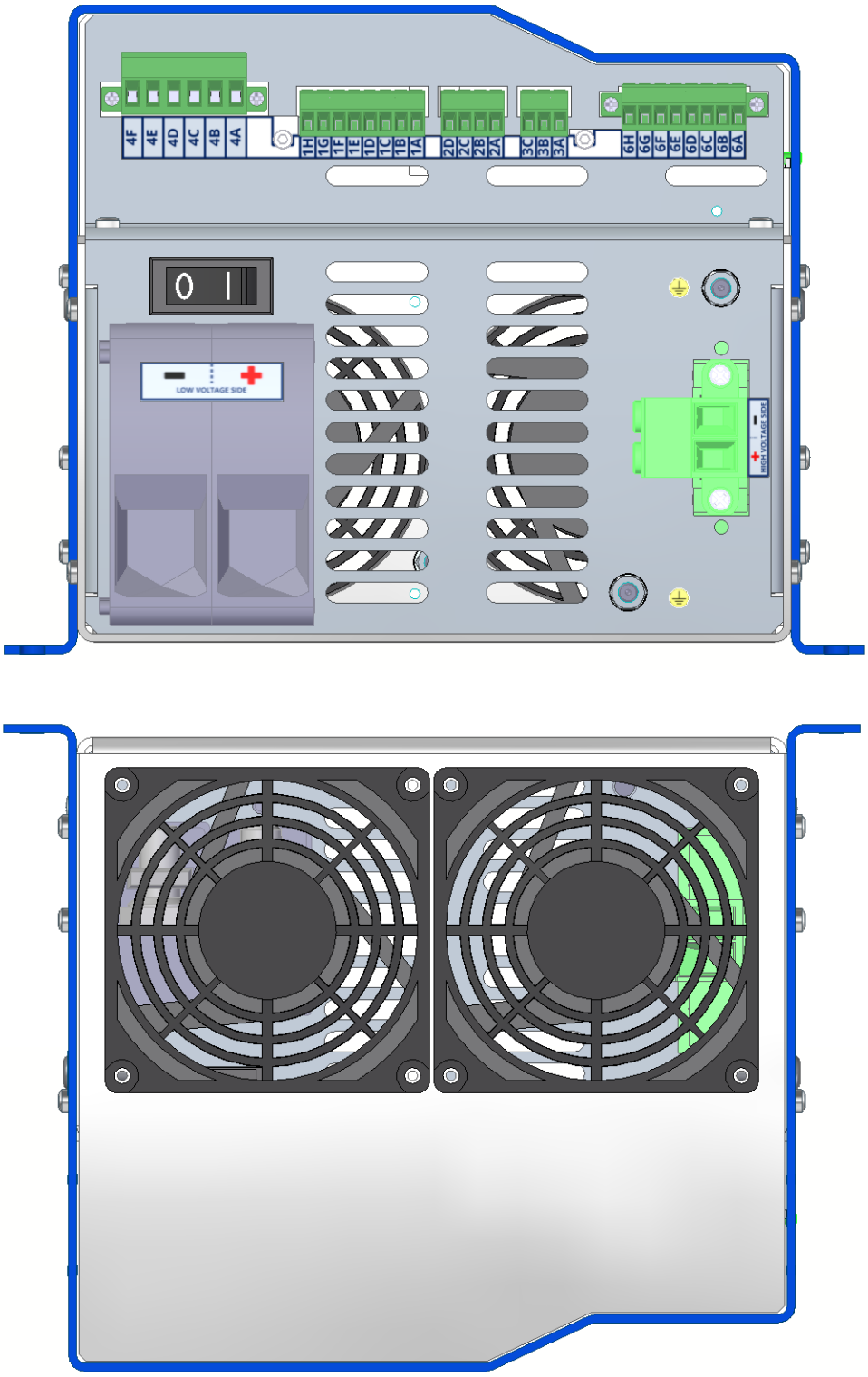
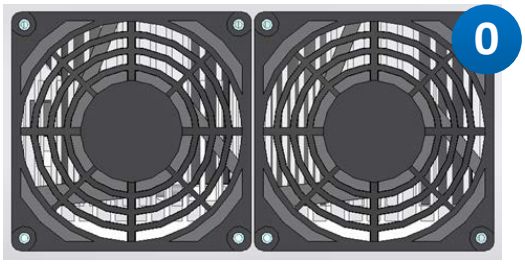
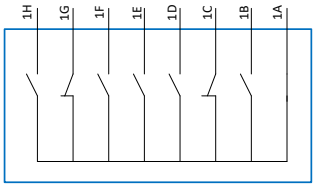


Fig. 2 DC/DC converter Size 2

0) COOLING FANS



1) CONNECTOR 1: OUTPUTS TO CONTROLLER



This connector has potential-free relay contacts.

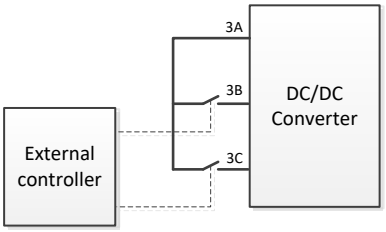
Output	Type*	Description
1A	[CM]	**Common**
1B	[NO]	**STATUS OK**: When this terminal is short-circuited, it indicates that the DC/DC converter is in operation.
1C	[NC]	**TEMPERATURE WARNING NC:** Open circuit indicates that there is a warning due to high temperature inside the converter.
1D	[NO]	**TEMPERATURE WARNING NO:** Short-circuit indicates that there is a warning due to high temperature inside the converter.
1E	[NO]	**Reserved**
1F	[NO]	**Reserved**
1G	[NC]	**EARTH LEAKAGE DETECTION**
1H	[NO]	**Reserved**
(*) [CM] = Common; [NO] = Normally open; [NC] = Normally close		

CAUTION	These outputs should never withstand voltages higher than 24VDC or 250VAC and currents higher than 3A, otherwise, the converter may result damaged.

2) CONNECTOR 2: CONTROL OUTPUTS

Output	Type*	Description
2A	Relay [CM]	**Reserved**
2B	Relay [NO]	**Reserved**
2C	Opto [+]	**RC Charger + (Optional)**
2D	Opto [-]	**RC Charger – (Optional)**
(*) [CM] = Common; [NO] = Normally open; Opto = Opto-isolated output		

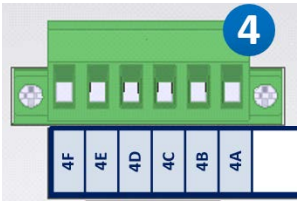
3) CONNECTOR 3: INPUTS FROM CONTROLLER



Input	Description
3A	**GND:** Common ground for 3B and 3C
3B	**ENABLE/DISABLE DC/DC:** - **ENABLE**: DC/DC Converter enabling is done by short-circuiting terminals 3A and 3B - **DISABLE**: DC/DC Converter is disabled by opening terminals 3A and 3B.
3C	**Safety disconnection:** - **ACTIVATE**: DC/DC Converter will stop immediately if 3C input is left open. - **DEACTIVATE:** Short-circuiting terminals 3A and 3C will enable the converter.
Note: Safety disconnection has priority over the rest of the signals of the converter. In order to have the converter in a ready to operate state, safety disconnection must be deactivated.	

4) CONNECTOR 4 LVDC LINK ACCESS FOR OPTIONAL ACCESORIESS

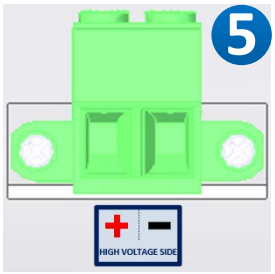
Terminal	Description
4A	**Load +** (Optional)
4B	**Load –** (Optional)
4C	**AC + Charger** (Optional)
4D	**AC – Charger** (Optional)
4E	**Solar charger +** (Optional)
4F	**Solar charger –** (Optional)



WARNING	These outputs are connected to the LVDC link. Maximum current of each terminal is **20 Amp**. External protective devices such as fuses must be used. Failure to do so creates risk of electrocution for the operator and/or the EPC converter may become damaged.

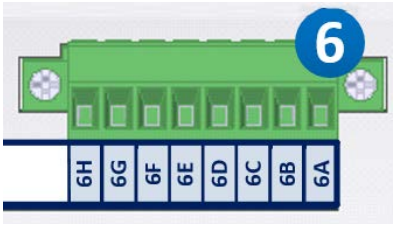
5) CONNECTOR 5
HIGH VOLTAGE SIDE POWER CONNECTION
Output to the High Side of DC bus

- Overcurrent internally protected.
- The impedance between DC+ and EARTH is approx. 170 kΩ
- The impedance between DC- and EARTH is approx. 170 kΩ

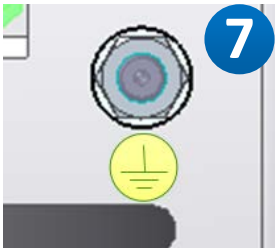


WARNING	Minimum wire section is specified in technical data in page **38**. Failure to do so creates risk of electrocution for the operator, risk of fire in the installation and/or the EPC converter may become damaged.

6) CONNECTOR 6
COMMUNICATIONS PORT
CAN Bus interface available through the EPC CAN Interface accessory.



7) Earth connection
8) Earth connection



9) TERMINAL 9

Low Voltage DC Side (LVDC) connection.

Size 1: Cables with cable gland connection.

Size 2: Terminal block available for wiring

Fig. 3 LVDC link Size 1

Fig. 4 LVDC link Size 2

10) SWITCH

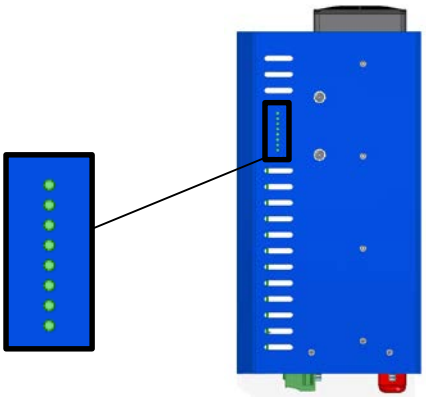
ON/OFF Switch

Main switch of DC/DC converter.

Note: if the converter has the control power input from both sides (optional), this switch operates only on the low side input.

LED STICK:

Located on the side of the converter:

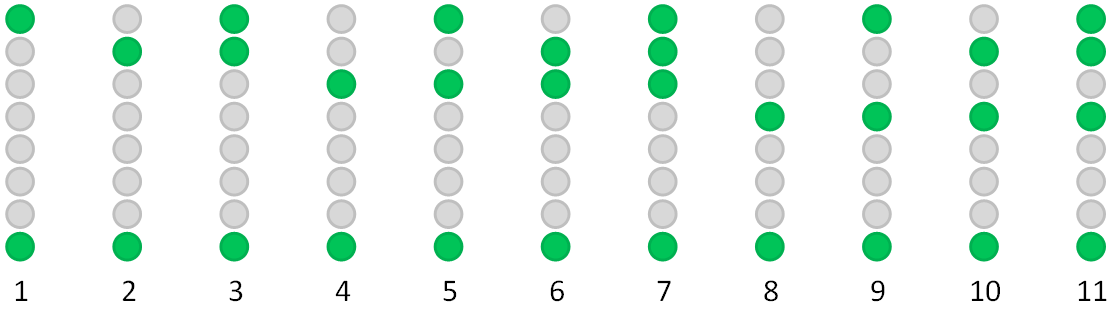


This LED stick will show different codes depending on the situation of the converter

- If the DC/DC converter is **disabled**, the LEDs blink from bottom to top and from top to bottom.
- If the DC/DC converter is **enabled** and it is transferring energy, they show transferred power.
  - In case of Low Side to High Side, the LED stick fills up from bottom to top.
  - In case of High Side to Low Side, the LED stick fills up from top to bottom.

	EPC 2k2-XXX	EPC 3k5-XXX	EPC-5k5-XXX	EPC-4k8-XXXX
Power per LED	315 W	500 W	800 W	600 W

If an error occurs, the LED stick will show one of the following code:



Error number	Description
1	HVDC link voltage error detected by software
2	LVDC link voltage error detected by software
3	HVDC link overcurrent detected by software
4	Internal error 1
5	Overheating error
6	Error when HVDC link is switched ON (for Autonomous Mode)
7	Earth fault in HVDC link
8	Internal error 2
9	HVDC link voltage error detected by hardware
10	LVDC link voltage error detected by hardware
11	HVDC link overcurrent detected by hardware

4.1. CAN interface module (Optional)

CONNECTOR 7.
CAN Bus #1.
Reserved for custom applications

Terminal	Description
7A	GND
7B	CAN Low signal
7C	CAN High signal
7D	5V 0.1A Output

CONNECTOR 8.
CAN Bus #2.
Connection with external controller

Terminal	Description
8A	GND
8B	CAN Low signal
8C	CAN High signal
8D	5V 0.1A Output

CAN 1 and CAN 2 are electrically isolated.

5. EPC Control Modes

EPC converter can be controlled in two different modes. Modes are selectable through CAN communication explained in "*6 Communications*".

5.1. Autonomous Mode (AMode)

In this mode, the DCDC converter is able to supply a load in the HVDC link side.

An example load is a VVVF (Variable Voltage Variable Frequency motor drive). The EPC converter performs a "Soft Start" with a current-controlled ramp-up from 0V to the HVDC target voltage. If the HVDC side is connected incorrectly (HVDC plus and minus wrongly connected or under short-circuit), current-controlled soft start will provide between 1.5 to 2 A and will stop showing an error.

When the load/motor consumes energy, the EPC provides power to the DC link. If the motor generates energy and LVDC is within the limits (*), EPC will transfer exceeding energy to the LVDC (i.e. charge batteries).

(*) contact with epic power if you need further information

5.2. Current Controlled Mode (CCMode)

In this mode, the external controller will set the current reference for the High Voltage DC side (HVDC side).

- **Positive current**: is defined as transferring energy from High Voltage DC side (HVDC side) to Low Voltage DC side (LVDC side).

- **Negative current:** is defined as transferring energy from Low Voltage DC side (LVDC side) to HVDC side.

In order to avoid errors during transfer process, there is a security signal that has to be sent to set the current direction.

If the voltage (in high or low side) goes beyond the limits, the DCDC converter will stop and show an error. Once the voltage returns to the nominal range and a reset is performed, current control is re-established. When the EPC is disabled through CAN or hardware enable input, reset of errors is performed.

6. Communications

EPC must be controlled via CAN communication for CCMode.

CAN communication does not override enable input. If communication with the external controller is lost, DCDC converter can be disabled through the enable input.

EPC CAN communication requirements:

- CAN 2.0B compatible hardware
- Data rate: 125 kbps
- Frame format: extended frame (29 bits)
- Endianness: Little Endian

6.1. Message identifiers

In order to let parallel connection of several EPC to the same CAN network, it is possible to configure the identifiers of the unit. A number between 0 and 15 can be chosen to modify the identifiers. This number will be used instead of the "X" in the message descriptions. For example, the 0xEBX0 message will be 0xEB00 for unit 0, 0xEB80 for unit 8, or 0xEBB0 for unit 11.

6.1.1. Message identifiers configuration

The number of unit used to modify message identifiers will be recorded in the unit. The EPC will keep this number when the unit is switched OFF and ON.

Unit number 0 is the factory setting. To modify the number of unit the procedure of *"7.2 Message identifiers configuration"* must be followed.

6.1 Message description

6.1.1 Messages from external controller to EPC

Message ID: 0xEBX0; Message Name: EPC control; Message length: 5 bytes					
Variable Name	Start bit	Bit length	Scaling	Type	Description
Enable	0	1	-	unsigned	This signal enables the EPC to charge or discharge power from/to the HVDC (High Voltage DC) bus connected 0 = EPC disabled 1 = EPC enabled Default value: 0 in CCMode; 1 in AMode
Power direction	1	1	-	unsigned	This signal sets the current direction in CCMode 0 = Charge 1 = Discharge Default value: 1
Current reference High Side	8	16	0.1A/1	signed	HVDC current reference in CCMode Minimum value: -200 = -20.0 A Maximum value: 200 = 20.0 A Default value: 0.0 A
Current reference Low Side	24	16	1A/1	signed	HVDC current reference in CCMode Minimum value: -200 = -200 A Maximum value: 200 = 200 A Default value: 0.0 A

Notes:

- Each time the external controller sends a 0xEBX0 message, EPC will answer with a 0xFBX0 message.
- If the EPC bus is disabled (through CAN or hardware enable) errors are cleared.
- To transfer energy from HVDC to LVDC, *Enable* must be 1, *Power direction* must be 0 and *Current reference* must be positive.
- To transfer energy from LVDC to HVDC, *Enable* must be 1, *Power direction* must be 1 and *Current reference* must be negative.
- Only one current reference can be used at the same time, the other MUST be 0.

Message ID: 0xEBX1; Message Name: EPC configuration; Message length: 8 bytes					
Variable Name	Start bit	Bit length	Scaling	Type	Description
Mode	0	2	-	unsigned	With this signal control modes can be chosen: 0 = Autonomous Mode 1 = Current Controlled Mode 2 = Reserved 3 = Reserved Default value: 0 This signal can be changed only if *Enable* signal of *EPC control* message is 0.
High side maximum voltage**	2	10	1V/1	unsigned	Default value for EPC-XkX-3XX models: 450 = 450 V Default value for EPC-XkX-6XX models: 800 = 800 V Minimum value*: 0 = 0 V Maximum value*: 900 = 900 V
High side minimum voltage**	12	10	1V/1	unsigned	Default value for EPC-XkX-3XX models: 290 = 290 V Default value for EPC-XkX-6XX models: 510 = 510 V Minimum value*: 0 = 0 V Maximum value*: 900 = 900 V
Low side maximum voltage**	22	10	0.1V/1	unsigned	Default value for EPC-XkX-X24 models: 291 = 29.1 V Default value for EPC-XkX-X48 models: 592 = 59.2 V Minimum value*: 0 = 0.0 V Maximum value*: 800 = 80.0 V
Low side minimum voltage**	32	10	0.1V/1	unsigned	Default value for EPC-XkX-X24 models: 210 = 21.0 V Default value for EPC-XkX-X48 models: 420 = 42.0 V Minimum value*: 0 = 0.0 V Maximum value*: 800 = 80.0 V
Charge power limit	42	10	10W/1	unsigned	Default value for EPC-2k2-XXX models: 260 = 2600 W Default value for EPC-3k5-XXX models: 420 = 4200 W Default value for EPC-3k5-XXX models: 480 = 4800 W Default value for EPC-5k5-XXX models: 650 = 6500 W
Discharge power limit	52	10	10W/1	unsigned	Default value for EPC-2k2-XXX models: 260 = 2600 W Default value for EPC-3k5-XXX models: 420 = 4200 W Default value for EPC-3k5-XXX models: 480 = 4800 W Default value for EPC-5k5-XXX models: 650 = 6500 W

(*) Note: maximum and minimum value that can be sent through the CAN bus; the EPC will saturate to its maximum specified in its datasheet.

(**) Note: These values are only used in Current Controlled Mode

Message ID: 0xEBX2; Message Name: EPC measurements configuration; Message length: 3 bytes					
Variable Name	Start bit	Bit length	Scaling		Description
Enable 0xFBX1 and 0xFBX2 messages	0	1	-		If this signal is 1, EPC will send 0xFBX1 and 0xFBX2 messages with the period defined in “0xFBX1 and 0xFBX2 message period” signal. Default value: 0
0xFBX1 and 0xFBX2 messages period	8	16	1ms/1		This signal defines the period within the messages 0xFBX1 and 0xFBX2 will be sent. Default value: 250 ms Minimum value: 50 = 50ms Maximum value: 1000 = 1000 ms

Message ID: 0xEFXE; Message Name: EPC info request; Message length: 1 byte					
Variable Name	Start bit	Bit length	Scaling	Type	Description
EPC info request	0	6	-	unsigned	If a 0xEFXE message is received with the number 51 in decimal value, EPC answers with a 0xFFXE message

6.1.2 Messages from EPC to external controller

Message ID: 0xFBX0; Message Name:EPC status; Message length: 6 bytes					
Variable Name	Start bit	Bit length	Scaling	Type	Description
VVVF status (AMode)	0	2	-	Unsigned	0 = HVDC link OFF 1 = HVDC link ON It shows 0 when Current Controlled Mode is selected
Enable hardware enable echo	2	1	-	Unsigned	0 = Hardware input between pin 3A and 3B disabled 1 = Hardware input between pin 3A and 3B enabled
Warning codes	16	8	-	Unsigned	0 = No warning
Error codes	24	8	-	Unsigned	0 = No error 1 = HVDC link voltage error detected by software (voltage out of limits defined in “EPC configuration” message) 2 = LVDC link voltage error detected by software (voltage out of limits defined in “EPC configuration” message) 3 = HVDC link overcurrent detected by software 4 = Internal error 1 5 = Overheating error 6 = Error when HVDC link is switched ON (for Autonomous Mode) 7 = Earth fault in HVDC link (for Autonomous Mode) 8 = Internal error 2 9 = HVDC link voltage error detected by hardware 10 = LVDC link voltage error detected by hardware 11 = HVDC link overcurrent detected by hardware
Error value	32	16	-	signed	This signal contains the variable that triggers the error. When error code = 0, it displays 0 When error code = 1, it displays DC link voltage [1V/1] When error code = 2, it displays battery voltage [0.01V/1] When error code = 3, it displays DC link current [0.1A/1] When error code = 4, it displays 0 When error code = 5, it displays the internal temperature [ºC] When error code = 6, it displays DC link voltage [1V/1] When error code = 7, it displays 0 When error code = 8, it displays 0 When error code = 9, it displays DC link voltage [1V/1] When error code = 10, it displays battery voltage [0.1V/1] When error code = 11, it displays DC link current [0.1A/1]

0xFBX0 message is sent if some variable included in the message has changed or 0xEBX0 message has been received.

Message ID: 0xFBX1; Message Name: EPC measurements 1; Message length: 8 bytes					
Variable Name	Start bit	Bit length	Scaling	Type	Description
LVDC link voltage	0	16	0.01V/1	unsigned	Minimum value: 600 = 6.00 V Maximum value: 8000 = 80.00 V
LVDC link current (average of current during time defined in *"0xFBX1 and 0xFBX2 messages period"*)	16	16	1A/1	signed	Minimum value: -256 A Maximum value: +255 A Positive current transfers from high side to low side Negative current transfers from low side to high side
HVDC link power (average of power during time defined in *"0xFBX1 and 0xFBX2 messages period"*)	32	16	1W/1	signed	Minimum value: -10000 W Maximum value: +10000 W Negative power when the energy is transferred from low side to high side Positive power when the energy is transferred from high side to low side.
HVDC link voltage	48	16	1V/1	unsigned	Minimum value: 0 V Maximum value: 1000 V

Message ID: 0xFBX2; Message Name: EPC measurements 2; Message length: 4 bytes					
Variable Name	Start bit	Bit length	Scaling	Type	Description
HVDC link current (average of current during time defined in *"0xFBX1 and 0xFBX2 messages period"*)	0	8	0.1A/1	signed	Minimum value: -128 = -12.8 A Maximum value: +127 = +12.7 A Negative current when the energy is transferred from low side to high side Positive current when the energy is transferred from high side to low side.
Output current of optional load connection	8	8	0.1A/1	unsigned	Minimum value: 0 = 0 A Maximum value: 255 = 25.5 A
Input current of optional charger connection	16	8	0.1A/1	unsigned	Minimum value: 0 = 0 A Maximum value: 255 = 25.5 A
Input current of optional solar charger connection	24	8	0.1A/1	unsigned	Minimum value: 0 = 0 A Maximum value: 255 = 25.5 A

Message ID: 0xFBX3; Message Name: EPC configuration answer; Message length: 8 bytes					
Variable Name	Start bit	Bit length	Scaling	Type	Description
Mode	0	2	-	unsigned	0 = Autonomous Mode selected 1 = Current Controlled Mode selected 2 = Reserved 3 = Reserved
High side maximum voltage	2	10	1V/1	unsigned	High side maximum voltage selected
High side minimum voltage	12	10	1V/1	unsigned	High side minimum voltage selected
Low side maximum voltage	22	10	0.1V/1	unsigned	Low side maximum voltage selected
Low side minimum voltage	32	10	0.1V/1	unsigned	Low side minimum voltage selected
Charge power limit	42	10	10W/1	unsigned	Charge power limit selected
Discharge power limit	52	10	10W/1	unsigned	Discharge power limit selected

0xFBX3 message is sent if 0xEBX1 message has been received.

Message ID: 0xFFXE; Message Name: EPC info; Message length: 8 bytes					
Variable Name	Start bit	Bit length	Scaling	Type	Description
EPC type	0	8	-	unsigned	Type of EPC converter 0x0E for EPC 2k2 624i 0x1E for EPC 2k2 348i 0x2E for EPC 3k5 648i 0x3E for EPC 5k5 648i 0x4E for EPC 4k8 6125i 0x5E for EPC 8k 8380i 0x6E for EPC 2k2 324i
Firmware version	12	20	-	unsigned	
Serial Number	32	32	-	unsigned	

7. Installation

Before beginning the installation, make sure that you have unplugged the connector 3

7.1. Installation procedure:

1. Fixing and attaching EPC to the installation:

To prevent EPC system from water splashes or dust, choose a vertical surface on which to hang it. Be sure that the installation place is a dry area with no condensation.

CAUTION	The converter should be attached to a vertical surface, with the fans pointing upwards in a dry area with no condensation.
CAUTION	Make room in front of both ventilation grills, at least 250 mm.
CAUTION	The system has been designed for pollution level 2. Consult epic power in any other circumstances.

2. Wiring EPC:

WARNING	Before wiring the system, ensure that the main switch of the converter is switched off during the installation. 

a. Earth connection

 **WARNING**	Ensure that earth is connected in both available connections 7 and 8 with a conductor of minimum 2.5 mm^2 section before energizing the converter.
 **WARNING**	The protective conductor connection (PE) must not be removed since the protection against electric shock provided by the converter would be lost.
 **WARNING**	The protective conductor connection (PE) must be low-inductance and as short as possible.

b. Low side voltage wiring:

 **WARNING**	Low side connection MUST be protected in both conductors. Keep the protective device opened and during wiring operation.

Protective devices may be one of the following:

- Fuses with fuseholders (recommended gR curve) for rated nominal current.
- Switch breaker
- Any Regulations & Standards compliant protective device for your application.

If in doubt, please contact epic power

i. Connect DC/DC converter 9 terminal to positive terminal of Low Voltage DC link.

ii. Connect DC/DC converter 9 connector to negative terminal of Low Voltage DC link.

 **CAUTION**	Observe polarity at DC/DC converter 9 cable. A reverse polarity connection may cause permanent damage to the unit and should be sent back to epic power for repair.

c. High side voltage wiring:

Use the connector 5 ("High Side Voltage") to wire to the HVDC link. The female connector is located on the underside of DC/DC converter. The cable must have the supplied male connector.

 **WARNING**	Ensure that there is no voltage left in the nodes about to be handled.
 **WARNING**	DC/DC converter "ON OFF" switch 10 must be in "OFF" position, and "ENABLE DC/DC" must be disabled (not short-circuited 3B and 3A).

NOTE ABOUT "ENABLE" CONNECTION IN AUTONOMOUS MODE

- The controller can decide to turn off the HVDC link for a period of time, with the purpose of saving standby consumption through "ENABLE DC/DC" terminal. This leads to a drastic reduction in energy consumption.
  - ◊ Closed contact, the HVDC link is energized.
  - ◊ Open contact, the HVDC link is not energized (HVDC link is turned off).
- The DC/DC converter accomplishes a soft-start of the HVDC link, so the lifespan of the DC-link capacitor and associated devices will be lengthened.
- When the controller closes the contact again to energize the HVDC link, the DC/DC converter will turn on the HVDC (time depends on HVDC link capacitance) with a controlled-current ramp. In less than 1 second, the HVDC link return to nominal voltage.

IMPORTANT NOTE:

This device can be used in a wide range of applications; the customer is responsible for complying with all regulations that may apply in their final installation, in particular with protective devices. Epic Power Converters is not responsible for any loss or damage caused by the improper installation and/or failure to satisfy required regulations.

At this point, *EPC* system is already installed and ready for the first start up.

7.2 Minimum DC link capacitance required

A minimum DC link capacitance is required to guarantee the correct operation of the EPC converter. The capacitance required depends on the devices used in the HVDC link, If equivalent capacitance is less than the required in the Technical Data (page 38), further capacitance must be added.

A standard capacitance is available from epic power with SKU number F.1001.0009.

7.3 CAN interface module (Optional)

If CAN communication is required, a CAN interface module is available with SKU number F.1003.1002.

Before installing the interface module, ensure the EPC is disconnected, the main switch is switched off, the fuse holders of LVDC link are open and connector 5 is disconnected.

The following steps should be carried out by qualified personnel:

1. Installation

The 8 ways connector of Fig. 5 should be connected to connector 6 of the EPC (only one position is possible). After connecting the module, it must be secured using the M3 screw in the hole specified in Fig. 6.

Fig. 5 Optional CAN interface to EPC connector

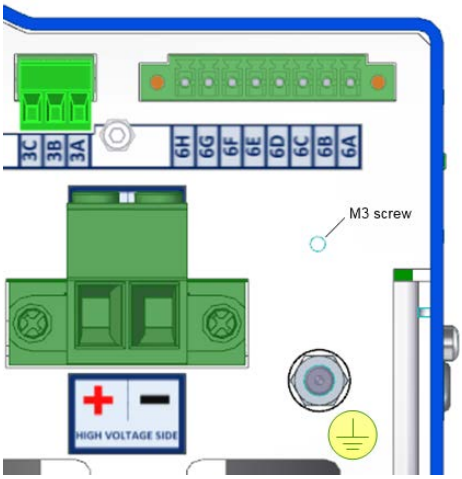


Fig. 6 EPC connector 6

2. Wiring

External controller should be connected to connector 8 as defined in *4.1 CAN interface module (Optional)* . Following this, the module is ready for CAN communication.

7.2. Message identifiers configuration

As explained in *"6.1* Message identifiers", the EPC can be configured with a number in order to modify the message identifiers of the CAN network. This is useful if several EPC converters are connected to the same CAN network.

It is recommended to remove any other CAN node from the CAN network in this stage. Only EPC to be configured and the external controller should be connected between them.

After installation procedure, perform the following steps:

1. Disconnect the converter from any power source
2. Disable connections 3A-3B and 3A-3C (open circuit)

3. Power up the unit (HVDC link or LVDC link to correct levels depending on the model)
4. Switch ON the unit
5. Make sure that during the following step that supply of the unit is not interrupted
6. Send the following message:

Size 1 and 2

Size 3

Message ID: 0xFAFA; Message Name: EPC identifiers config; Message length: 1 byte					
Variable Name	Start bit	Bit length	Scaling	Type	Description
Number of unit	0	8	-	unsigned	Minimum value: 0 Maximum value: 15 (decimal) Default value = 0

The LED stick will show the new number of unit in binary code. When programming is performed (after a few seconds), they will move again as in step 4.

7. Wait until LED's are moving again
8. Switch OFF the unit
9. In the next switch ON, identifiers are configured with the new number of unit.

8 UNINSTALLATION

A correct EPC shutdown, as well as ensuring there is no supply in both power ports.

WARNING	Supply must be shut down, and HVDC link must be disconnected from any source of energy before handling any connection. Failure to do so creates risk of electrocution for the operator. The EPC system may also become damaged.
WARNING	Supply must be shut down, and LVDC link must be disconnected from any source of energy before handling any connection. Failure to do so creates risk of electrocution for the operator. The EPC system may also become damaged..

 **WARNING**	Make sure, using a multimeter or a similar instrument, that both the High Side and Low Side voltage has dropped to the safe level (+25 Vdc or below) before touching any part.

Follow the next steps for disconnecting the EPC converter:

1. Turn off EPC system by switching OFF with the Switch 10 and unplugging "ENABLE CONNECTOR" 3 .This way, EPC system will be disabled.
2. HVDC link should not be feed by the converter after the previous step. You must ensure that there is no voltage left due to another power supply connected to the HVDC link.
3. Open the protective device in the LVDC link and turn off any other power supply connected to the LVDC link.
4. Wait until HVDC and LVDC bus voltage lowers to safe level (+25 Vdc or below), for as long as is necessary.
5. Unplug DC/DC converter 5 connector.
6. Remove LVDC wiring.
7. **The EPC Converter is is now disconnected.**

9 MAINTENANCE AND INSPECTION

Perform periodic inspections to avoid trouble and keep reliable operation of the converter.

7.1. Periodic inspection

Before starting periodic inspection:

- Switch off any device connected to connector 4.
- Switch off the EPC converter
- Open the low and high voltage circuit by the use of the switch disconnectors or any other protective device installed.

 **WARNING**	Make sure, using a multimeter or a similar instrument, that both the High Side and Low side voltage has dropped to the safe level (+25 Vdc or below).

Check part	Check item	How to inspect	Evaluation criteria
Environment	Check the ambient temperature, humidity, vibration and atmosphere	Check visually or measure using the right instrument.	Standard specifications must be satisfied
	Check that any foreign material or dangerous objects are not left around the equipment or clogging the fans.	Visual inspection	No foreign or dangerous objects are left or clogging the fans.
Structure and mounting	Check for deformation and breakage of the equipment	Visual inspection	No abnormalities
	Check for fixing loose bolts	Retighten	No abnormalities
Conductors and wires	Check conductors for discoloration and distortion caused by overheat	Visual inspection	No abnormalities
	Check the sheath of the wires for cracks and discoloration	Visual inspection	No abnormalities
Terminal blocks	Check that the terminal blocks are not damaged	Visual inspection	No abnormalities
	Check for loose screws	Retighten	No abnormalities

In order to check the cooling system, following steps are necessary:

- Close the low voltage circuit by the use of the switch disconnectors or any other protective device installed.
- Switch on the EPC converter
- At the time of switching on the converter, fans will blow between 3~5 seconds; ensure that both fans are blowing air; if not, a replacement is mandatory.

9.2 Periodic replacement parts

The EPC converter has been manufactured to avoid replacement parts; however, the cooling system must be replaced for preventive maintenance.

Part name	Standard replacement intervals
Cooling fans	7 years

Notes:

These replacement intervals are based on the EPC converter service life estimated at an ambient temperature of 40ºC and a load factor of 90%. Replacement intervals may be shorter due to ambient factors.

Standard replacement intervals mentioned above are only a guide for replacement, and not a guaranteed service life.

 **WARNING**	**NEVER OPEN EPC**. It is an extremely complex electronic system. Reparation must only be undertaken by epic power. Any unskilled handling may damage the system or may cause a serious accident

10. TECHNICAL DATA, ENVIRONMENT, DIMENSIONS AND WEIGHTS

10.1 Technical data

Model	EPC-3k5-648i	EPC-5k5-648i	EPC-2k2-624i	EPC-2k2-348i	EPC-2k2-324i	EPC-4k8-6125i
Peak power	**4.2 kW**	**6.5 kW**	**2.6 kW**	**2.6 kW**	**2.6 kW**	**4.8 kW**
Max. continuous power	**3.5 kW**	**5.5 kW**	**2.2 kW**	**2.2 kW**	**2.2 kW**	**4.8 kW**
High side voltage (Vdc)	**510 to 848 V**			**280 to 450 V**		**430 to 830 V**
High side current (max)	**6 A (7.5 A)**	**10 A (12 A)**	**4 A (5 A)**	**7 A (9.3 A)**	**7 A (9.3 A)**	**9 A**
Low side voltage (Vdc)	**38 to 59 V**		**19 to 30 V**	**38 to 59 V**	**19 to 30 V**	**110 to 165 V**
Size	**Size 1**	**Size 2**	**Size 1**	**Size 1**	**Size 1**	**Size 1**
Low side current (max)	**75 A (115 A)**	**115 A (180 A)**	**92 A (140 A)**	**50 A (70 A)**	**92 A (140 A)**	**45 A**
Minimum high side load capacitance	**200 µF**	**400 µF**	**200 µF**	**200 µF**	**200 µF**	**200 µF**
Isolation (Withstand voltage)	**High to Low side: 2.5 kV; High side to earth: 4kV; Low side to earth: 1.5 kV (2.5 kV for EPC-4k8-6125) Low side to user signals: 3kV (5 kV for EPC-4k8-6125)**					
Max. efficiency	**98 %**					
Control	**Digital control self-powered from high or low voltage side (low side prioritized)**					
Stand-by	**<3 W**					
Weight	**6.05 kg**	**8.95 kg**	**6.15 kg**	**6.00 kg**	**6.05 kg**	**6.70 kg**
Dimensions (WxHxD)	**Size 1: 211x335x160 mm Size 2: 211x506x160 mm**					
Enclosure	**IP 20**					
Cooling	**Air cooled (Fans only ON when needed)**					

10.2 Wiring

Model	EPC-2k2-324i	EPC-2k2-348i	EPC-2k2-624i	EPC-3k5-648i	EPC-5k5-648i	EPC-4k8-6125i
Low side minimum wire size (mm^2)**	**25**	**25**	**25**	**25**	**50**	**16**
High side minimum wire size (mm^2)**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
Wire insulation	**PVC***					

10.3 Connectors specifications

#	Solid wire size	Stranded wire size	Torque	Wire stripe	Max. Ratings
1	0.129-1.31 mm^2 26-16 AWG	0.129-1.31 mm^2 26-16 AWG	3.0 Lb.In 0.34 Nm	6-7 mm.	Voltage: 24 Vdc / 250 VAC Current: 3 Amp**
2	0.129-1.31 mm^2 26-16 AWG	0.129-1.31 mm^2 26-16 AWG	3.0 Lb.In 0.34 Nm	6-7 mm.	Dry contacts. Do not apply voltage to terminals.
3	0.129-1.31 mm^2 26-16 AWG	0.129-1.31 mm^2 26-16 AWG	3.0 Lb.In 0.34 Nm	6-7 mm.	Dry contacts. Do not apply voltage to terminals.
4	0.205-3.31 mm^2 24-12 AWG	0.205-3.31 mm^2 24-12 AWG	5.0 Lb.In 0.56 Nm	7-8 mm.	Voltage: same as EPC low side voltage Current: 20 Amp**
5	0.5-10.0 mm^2 20-8 AWG	0.5-6.0 mm^2 20-10 AWG	10.6-13,2 Lb.In 1.2-1.5 Nm	12 mm.	Voltage and current: same as EPC high side voltage. Internally protected.
6	0.129-1.31 mm^2 26-16 AWG	0.129-1.31 mm^2 26-16 AWG	3.0 Lb.In 0.34 Nm	6-7 mm.	Voltage: 5 Vdc Current: 1 Amp.
7 / 8	M5 screw type with nut to be used with standard spade or ring tongue terminals. Max torque: 30.9 Lb.In / 3.5 Nm				
9*	1.5 – 70 mm^2 16-2/0 AWG	1.5 – 70 mm^2 16-2/0 AWG	48.6 Lb.In 5.5 Nm	20 mm.	Voltage and current: same as EPC low side voltage**

(*) Note: Only for size 2 converter.

(**) Note 2: Required external fuses (with fuseholders) for rated amperage.

10.4 Environmental Requirements

Operating temperature	**-10 to 40 ºC**
Storage temperature	**-10 to 70 ºC**
Relative humidity	**<95%, with no condensation(*)**
Altitude	**Not to be operated above 2000 m.****
Atmosphere	**The converter must not be exposed to dust, direct sunlight, corrosive gases, flammable gases, oil mist, vapor or water drops. Pollution degree 2***.**
Mechanical	**Class 3M1 (Vibration: 1 m/s^2)**
Electrical	**Overvoltage category OVC II / Protective class I equipment**

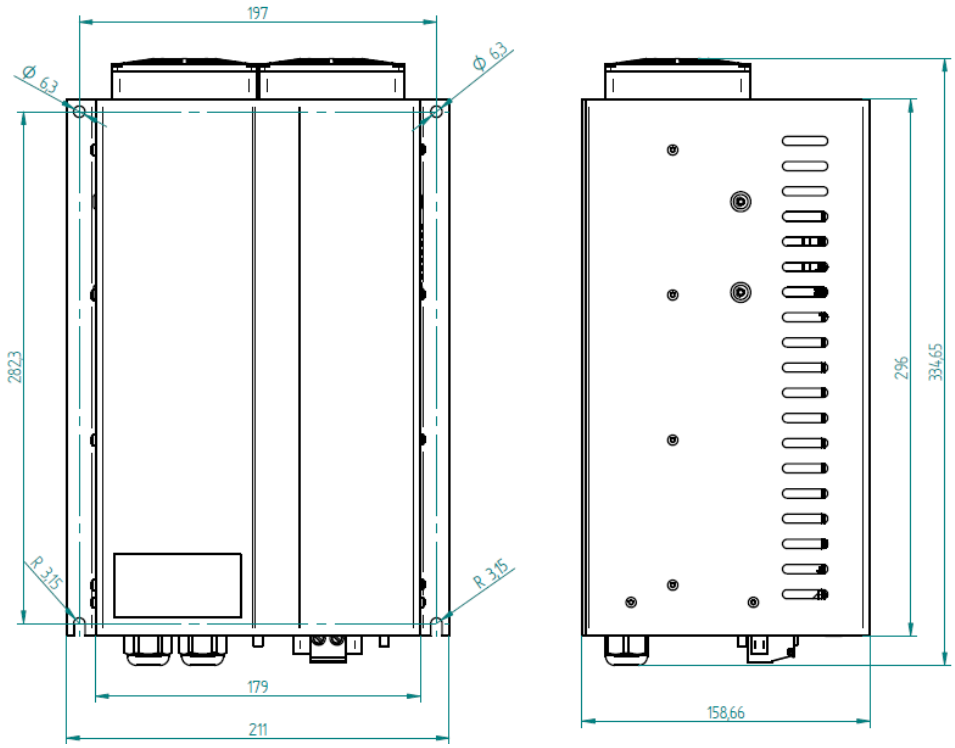
(*) Note: The system should not be summited to sudden temperature variations given that it could cause liquid condensation inside the device.

(**) Note: contact with epic power if you are intended to operate above the rated altitude.

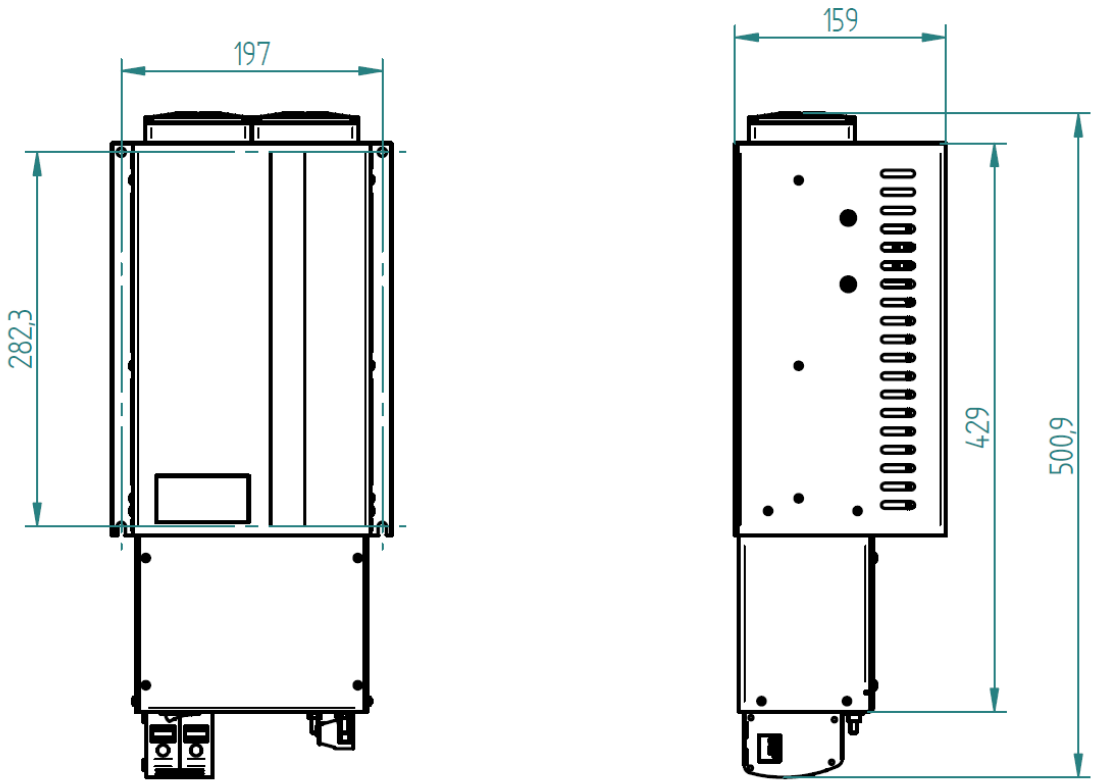
(***) Note: contact with epic power if your applications needs other requirements.

10.5 DC/DC converter dimensions and mounting drawing (mm)

Size 1



Size 2:



11 REGULATIONS

EPC system has been designed and manufactured according to the following regulations:

- **Low Voltage Regulations (LVD)**: **European directive 2014/35/UE**, which establishes low voltage regulations for electronic systems.
  - UNE-EN 50178:1998
  - UNE-EN 60204-1:2007
  - UNE-EN 60529:2018
  - UNE-EN 60664-1:2008
  - UNE-EN 60664-4:2006
  - UNE-EN 61293:2002
  - UNE-EN 62109-1:2011
  - UNE-EN 62477-1:2012
- **Electromagnetic Compatibility Regulations (EMC): European directive 2014/30/UE**, which regulates electromagnetic equipment compatibility and seeks the proper functioning of internal market, demanding suitable EMC levels.
  - UNE-EN 12015:2014
  - UNE-EN 12016:2014
  - UNE-EN 61000-6-1:2007
  - UNE-EN 61000-6-3:2007
  - UNE-EN 61000-6-4:2007

- **Restriction of hazardous substances: European directive 2011/65/UE**, which regulates the use of certain hazardous substances in electrical and electronic equipment.
  - UNE-EN 50581:2012

12 EU DECLARATION OF CONFORMITY

Epic Power Converters, S.L.

info@epicpower.es - www.epicpower.es

DECLARACIÓN UE DE CONFORMIDAD
EU DECLARATION OF CONFORMITY

Modelo / *Model*: EPC 3k5 648

Fabricante / *Manufacturer*: Epic Power Converters S.L.
Dirección / *Address*: C\F Oeste Nave 93 (Grupo Gregorio Quejido), 50012, Zaragoza, Spain

La presente declaración de conformidad se expide bajo la exclusiva responsabilidad del fabricante.
Objeto de la declaración: EPC 3k5 648 es un convertidor bidireccional multipropósito de 3500 W entre 48 V y 600 V de tensión nominal.
El objeto de la declaración descrita anteriormente es conforme con la legislación de armonización pertinente de la Unión:

This Declaration of Conformity is issued under the sole responsibility of the manufacturer.
Object of the declaration: EPC 3k5 648 is a 3500 W multipurpose bidirectional DCDC converter between 48 V and 600 V of nominal voltage.
The object of the declaration described above is in conformity with the following EU Directives listed below by using the relevant sections of the following EU harmonized standards.

Directiva de Baja Tensión / *Low Voltage Directive*: **2014/35/EU**
- UNE-EN 62477-1:2012

Directiva de Compatibilidad Electromagnética / *Electromagnetic Compatibility Directive*: **2014/30/EU**
- UNE-EN 12015:2014 / UNE-EN 55011:2016 / UNE-EN 55011:2016/A1:2017
- UNE-EN 12016:2014 / UNE-EN 61000-4-2:2009
- UNE-EN 61000-4-3:2006/A1:2008 / UNE-EN 61000-4-3:2006/A2:2010
- UNE-EN 61000-4-4:2012
- UNE-EN 61000-4-6:2014

Zaragoza, 01/10/2019

Rubén Gálvez, Administrador / *Administrator*

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