WATT &WELL

CONVERTING POWER INTO CONFIDENCE

HIGH POWER SERIES

25 kW Modular Power Unit for EVSE

HIGH POWER | E-MOBILITY | EV CHARGERS

OVERVIEW

MPU-R3 25kW is a modular power supply for EVSE systems.
It features a modular design capable of parallel operation of up to 6 units (14 as an option) for a total output power of up to 150 kW (350kW as an option).

VERSIONS

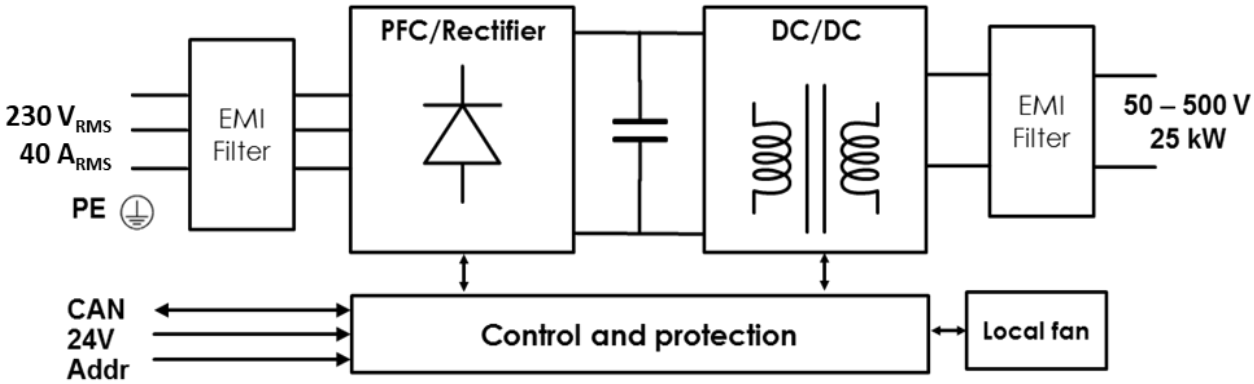
	DC out			
	P	U	I	Protections
MPU-R3-500-63-FD	25kW	500 V	63A	Fuse, diode

-HV version allows series connection of output for up to 920V operation.

FEATURES

- Three phases 400VAC phase to phase input, 3P+N+PE,50 Hz
- Reinforced galvanic isolation between input and output
- Output voltage up to 500V and 25kW (with -HV option, series connection of outputs allows up to 950V operation)
- Forced air cooling with integrated fans
- Highly compact form factor: 19” rack, 3U
- CANopen compatible digital bus with advanced control, monitoring and logging capabilities
- Integrated output fuse and reverse diode

BLOCK DIAGRAM



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Revision date: 10/2023

WARNING
This equipment operates at voltages and currents that can result in electrical shock, fire hazard and/or personal injury if not properly handled or applied. Equipment must be used with necessary caution and appropriate safeguards employed to avoid personal injury or property damage.
This board must be used only by qualified engineers and technicians' familiar with risks associated with handling high voltage electrical and mechanical components, systems and subsystems.

Table of Contents

1. Absolute maximum ratings

Table 1: Absolute maximum ratings

Parameter	Condition	Min	Max	Units
LV Input Voltage		0	30	V
Operating Temperature		-25	70	°C
Long term storage Temperature		-30	70	°C
Temperature change rate			5	°C/min
AC input (phase-phase)			460	V_{RMS}
DC output (DC+ or DC-) to PE	Standard -HV version		±500 ±950	V V

Recommended maximum ambient temperature is 50°C, beyond 50°C linear derating on power output must be applied.

2. Electrical Characteristics

All specifications are given for ambient temperature up to 50°C unless otherwise noted.

Table 2: Electrical characteristics

Parameter	Condition	Value			Units
		Min	Typ	Max	
LV Input					
Supply voltage		19	24	27	V
Input current	Stand-by Active cooling		0.6 1.2	 2.9	A
Under Voltage Shutdown (programmable)		19	20	21	V
Over Voltage Shutdown (programmable)		25	26	27	V
CAN communication					
CAN baudrate			500		kbps
CAN common mode range[1]		-7		7	V
Digital Inputs					
Positive going input current (Charge permission, Address, EMS)			2	10	mA
Negative going input current (Charge permission, Address, EMS)				0.1	mA
AC IN					
Input voltage (phase-phase)	Standard configuration	340	400	460	V_{RMS}
Input voltage (phase-neutral)		195.5	230	264.5	V_{RMS}
Input frequency	50 Hz firmware	45	50	55	Hz
Power factor	Full load		>0.99		
Current (per phase)		0		45	A_{RMS}
Voltage measurement initial accuracy	Full load			5	%
Current measurement initial accuracy	Full load			7	%
DC Out					
Output voltage	Between DC+ and DC-	50		500	V
Output power				25	kW
Output current				63	A
Voltage measurement initial accuracy	Full load			2	%
Current measurement initial accuracy	Full load			1.5	%
Insulation					

1 CAN common mode; CAN_H and CAN_L versus CAN_GND

Input (AC) to output (DC)	50/60 Hz, 1 min	3200	V_{RMS}
Input (AC) to case (PE)	50/60 Hz, 1 min	1600	V_{RMS}
Output (DC) to case (PE)[2]	50/60 Hz, 1 min	1600	V_{RMS}
Y-capacitor DC+ to PE or DC- to PE		32nF ±20%	

3. Safety instructions

3.1. Caution

The following safety instruction must be observed during all phases of operation, service and repair of this equipment. Failure to comply with the safety precautions or warnings in this documentation violates safety standards of design, manufacture and intended use of this equipment and may impair the built-in protections within. Watt & Well shall not be liable for users to comply with these requirements.

3.2. Installation

MPU-R3 25kW device must be installed following installation chapter.
This product is a safety Class 1 instrument. To minimize shock hazard, the instrument chassis must be connected to installation protective earth (safety ground) with the dedicated ground terminal.

The protective earth terminal must be connected to the safety electrical ground before another connection is made. Any interruption of the protective ground conductor, or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury.

MPU-R3 25kW device is designed to be accessible only for trained staff operator in **restricted access location.**

MPU-R3 25kW device is designed to be connected on resistive and/or capacitive load.

Warning:
This device is not intended for use in residential environments and may not provide adequate protection for radio reception in such environments.

3.3. Input rating

Do not use power supplies which exceeds the input voltage rating of this instrument. The electrical rating of this instrument is given into the chapter 2 of this document.

3.4. Live circuits

Operating personnel are not allowed to open the case of this equipment. Internal adjustment or component replacement is not allowed by non-Watt & Well qualified personnel. Never replace components with cable connected to this instrument. To avoid injuries, always disconnect power and remove external voltage sources before touching components.

3.5. Hot surface

2 Both Standard and -HV versions are tested for basic insulation of DC output (DC+ or DC-) to PE. For working voltage higher than 500V (series connection of ouptuts), -HV option of MPU-R3 25kW is required

Surface of the product could be hot during and after operation. Use protection before touching the device.

3.6. Parts substitution and modifications

Parts substitutions and modifications are allowed by authorized WATT & WELL service personnel only. For repairs or modification, the unit must be returned to WATT & WELL's After Sale Service. Contact After Sale Service (aftersaleservice@wattandwell.com) to obtain RMA number.

WATT & WELL
After Sale Service
121 Rue Louis Lumière
84120 PERTUIS
FRANCE

3.7. Environmental condition

MPU-R3 25kW device safety approval applies to the following operating conditions:

- Integrated into EVSE system in a 19" cabinet
- Maximum relative humidity : 95% at 30°C
  : 23% at 60°C non-condensing
- Altitude : up to 2000m
- Pollution degree : 2[3]
- Overvoltage category : III (4kV) (AC input only)
- IP degree of enclosure : IP2X

Protective ground conductor terminal

3.8. Regulatory compliance

MPU-R3 25kW product is compliant with European directives:

- Low Voltage Directive 2014/35/UE
- EMI Directive 2014/30/UE
- RoHS Directive 2011/65/UE
- WEEE Directive 2012/19/UE

CE

3.9. Normative compliance

MPU-R3 25kW has been tested against numerous standards requested by Low Voltage Directive 2014/35/UE and EMC Directive 2014/30/UE:

Product is tested and compatible with Combo and CHAdeMO standards.
Compliant with IEC 61851-1 dielectric tests (primary/secondary):

- 3.2 kVrms between AC in and DC out
- 1.6 kVrms between AC in and Earth
- 1.6 kVrms between DC out and Earth

[3] Attention should be paid to avoid ingress of water, metallic or conductive particles, dust or corrosive atmospheric that may cause early failures of equipment

Product is qualified according to:

Normative	**Name**	**Note**
NF EN 61000-6-4/2007 A1/2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments	
NF EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards – Immunity for industrial environments	
IEC 61000-4-8:2009	Power frequency magnetic field immunity test	100A/m
IEC 61000-4-3:2006 /AMD1:2007/AMD2:2010	Radiated, radiofrequency, electromagnetic field immunity test	Industrial Level
IEC 61000-4-2:2008	Electrostatic discharge immunity test	±4KV contact ±8KV air discharges
IEC 61000-4-4:2012	Electrical fast transient/burst immunity test	±2KV AC line, DC power out, LV power in
IEC 61000-4-5:2014	Surge immunity test AC power line	±2KV common mode ±1KV differential mode
IEC 61000-4-5:2014	Surge immunity test DC power out	±2KV common mode ±1KV differential mode
IEC 61000-4-5:2014	Surge immunity test LV power in	±0.5KV common mode ±0.5KV differential mode
IEC 61000-4-6:2013	Conducted RF Fields	10Vrms AC line, DC power out, LV power in
IEC 61000-4-34:2005 /AMD1:2009	Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase	Criterion B
IEC 61000-3-12	Electromagnetic compatibility (EMC) - Part 3-12: Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤ 75 A per phase	complying with the harmonic currents emission limits for Rsce=33 →MPU-R3 25 kW can be connected anywhere to the public supply
CISPR 16-2-1:2014/AMD1:2017	Conducted emission AC line	Class A
CISPR 16-2-1:2014/AMD1:2017	Conducted emission LV line	Class A
CISPR 16-2-3:2016	Radiated emission	Class A

Warning: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures

Where applicable, the compliance class are defined as follows:

Table 3: Susceptibility criteria during a continuous/transitory disturbance:

Class A	All functions of a device perform as designed during exposure. However, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed.
Class B	One or more functions do not perform as designed during exposure but returns automatically to normal operation after exposure is removed.
Class C	One or more functions of a device do not perform as designed during exposure and does not return to normal operation until exposure is removed and the device system is reset by simple "operator/use" action.

Please also note that MPU-R3 is designed to be compatible with the following norms:

Normative	**Name**	**Note**
IEC 61851-1:2019	Electric vehicle conductive charging system – Part 1: General requirements	ED 3.0
IEC 61851-23	Electric vehicle conductive charging system - Part 23: DC electric vehicle charging station	ED 1.0
IEC 61851-23/AC1 2016	Corrections of IEC 61861-23 ed1.0 (2014)	

However, it is the user's responsibility to ensure that MPU-R3 is installed and used in compliance with all local country laws and regulations.

4. Installation

Do not use or install MPU-R3 25kW product in case of visible physical damage.

4.1. Mechanical installation

4.1.1. Handling

MPU-R3 25kW product has a weight about 28 Kg. For correct handling, follow instruction below:

- Two operators are required to handling properly this product.
- The product must be handled flat.
- Each operator must have one hand on the front handle and the second hand under the rack on the rear.
- For operator safety use personal protective equipment.
- Do not stack.

4.1.2. Mounting

MPU-R3 25kW is design to be mounted on standard 19” cabinets. Note that the MPU-R3 25kW is a heavy instrument and requires the cabinet to be equipped with slides that supports the chassis along the depth. These slides can be width of up to 20mm.

Refer to chapter 7 Mechanical specifications for dimensions on the MPU-R3 25kW rack

Minimum air flow required for air cooling is 4 m^3/min

Recirculating of hot air should be minimized by ensuring fresh (cold) on the input (see Figure 1). In addition, minimum distances for air cooling are:

- 15 cm for front side
- 9 cm for rear side

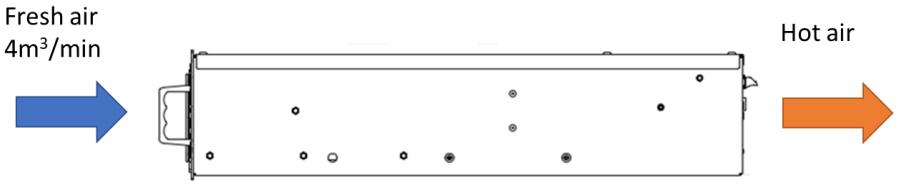


Figure 1: Air flow direction

Correct mounting of rack is flat (horizontal to ground) only. Vertical mounting, is also possible if the rack is fitted with a vertical fixation kit (see Product accessories page 35)

4.2. Electrical installation

4.2.1. Legal installation

Electrical installation shall comply with the international standards such as IEC or the requirements in national standards of each country. Only use neutral point treatment TT or TN. Earthing system IT are not allowed.

4.2.2. Safety Notice

Never invert polarity of the connector. Never force to place a connector. Use only approved manufacturer parts for electrical or mechanical connection.
It is strongly recommended to fix the cables to avoid any stress on connection. All high-power connectors must be screwed to avoid any disconnection.
Be careful if other devices are connected, risk of electrical charge transfer.

Wait two minutes before touching the device after complete suppression of input voltage. Check for lack of voltage, on all access, with the correct equipment.

4.2.3. Protective earth

The protective earth (PE) terminal must be connected to the safety electrical ground before another connection is made. Any interruption of the protective ground conductor, or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury or death. Protective earth connection is made through AC input connector.

Use the protective earth terminal with minimal characteristics:

- Wire section (minimal): 10mm²

In addition, all part of the chassis where MPU-R3 25kW is to be installed (i.e. the 19” cabinet) need to be grounded. An electrical connection to PE through mechanical parts must be done.

4.2.4. AC input

AC input is defined as three phases and neutral line. See section 1 for maximum input range
MPU-R3 25kW product must be protected against short circuit, overload protection and earth leakage current protection with external devices.
AC input wires must be connected through a residual current breaker (RCB) and a circuit breaker with short circuit protection and thermal overload protection:

- Class A (minimum)
- Earth leakage 30mA
- Current rating 50A (widely available 63A rating is also possible)
- Number of contacts: 4 (3 phases and Neutral)

See page Figure 4 in section 4.3 for details on recommended AC power cabling

AC input wires minimal section is 10mm².

AC input is internally protected with varistors between phases (460Vrms max rating) and between each phase and PE (275Vrms max rating). Apply higher voltage than absolute maximum rating could damage the product.

4.2.5. LV DC input

LV input must be connected to 24Vdc bus. This input must be protected with a rapid fuse 5A maximum. Electrical system around must be selected in accordance with fuse rating.
This bus should have minimal characteristics:

- Electrical isolation from AC input 1600Vrms
- Maximum input overvoltage 200V (line to line)
- Maximum input overvoltage 500V (line to PE)

This cable must be shorter than 3m.

4.2.6. DC Output

DC output is galvanically isolated from protective earth.
Up to six units of MPU-R3 25kW can be set in parallel to increase the total output current.
Do not power MPU-R3 25kW unit trough DC_OUT connection.

DC output wires minimal section is 10mm². This cable must be shorter than 3m.

4.2.7. EMI requirements

MPU-R3 25kW product is compliant for industrial environment.
To guarantee EMI requirement:

- Add ferrite WE 742 711 32 S with 2 turns on LV wire.
- Add ferrite FAIR-RITE 0431177081, 1 turn on AC input port.

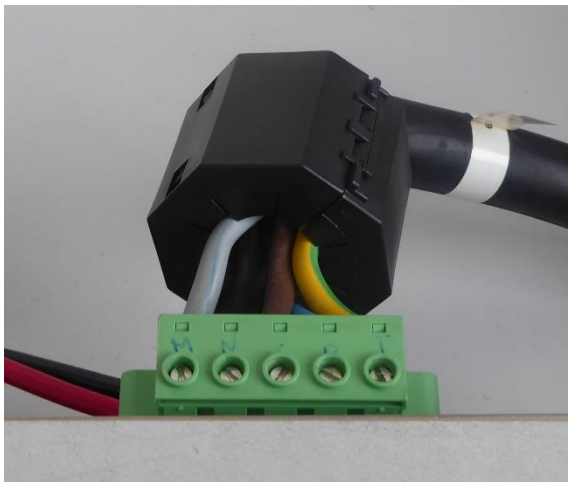


Figure 2 - AC_IN Ferrite

LV Ferrite

4.3. Multi-Unit operation

4.3.1. Parallel operation

The output power can be increased by putting up to six[4] power units in parallel.
Recommended cabling are explained below, for further details on connectors pinout, please refer to **5.4 Interfaces.**

Recommended low voltage, communication & addresses cabling

Low voltage signaling is found on front face. 3 ports need to be connected:

- COM ports which is to be connected in daisy chain. For convenience, two output ports (internally connected) are provided to wire COM port to previous and next nodes
- ADDR port (only required when multiple nodes on the same bus are used)
- LV – 24V: user must ensure isolation according to local regulations (typically the use of a SELV[5] power supply)

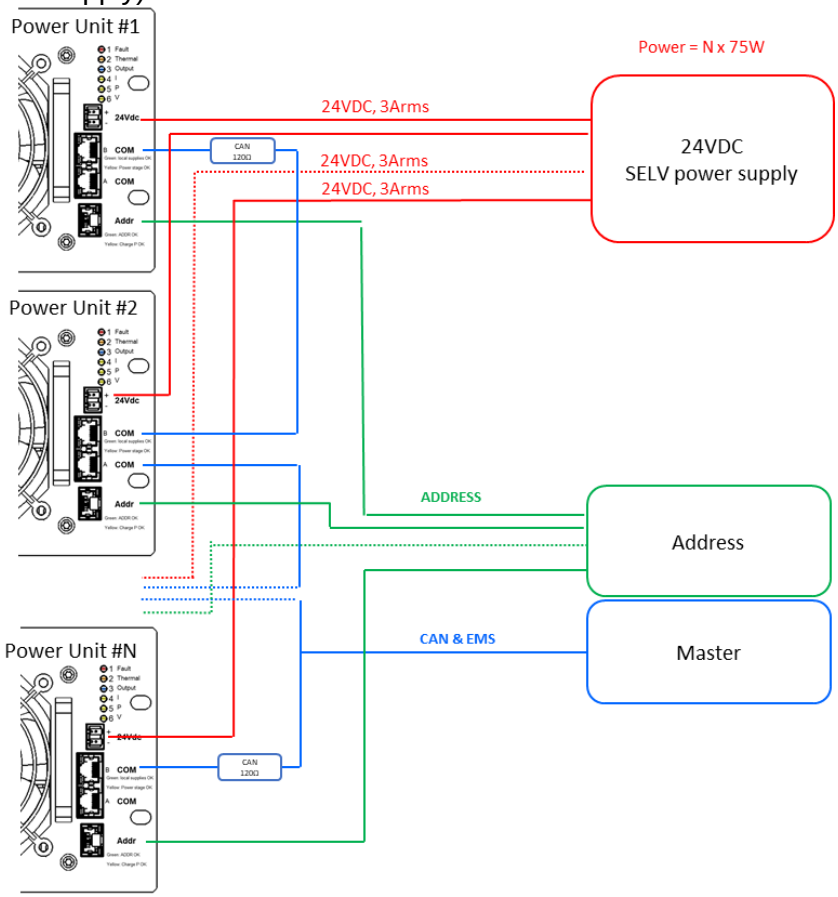


Figure 3: LV supply, Communication & Addressing with Battery 24VDC supply

[4] When using default options. More units can be added by reducing CAN bus load or segregating networks

[5] Safety Extra Low Voltage (SELV), defined by IEC 60364 as <120V_{DC}.(or <75V_{DC} according to EU's Low Voltage Directive)

Recommended AC Power cabling

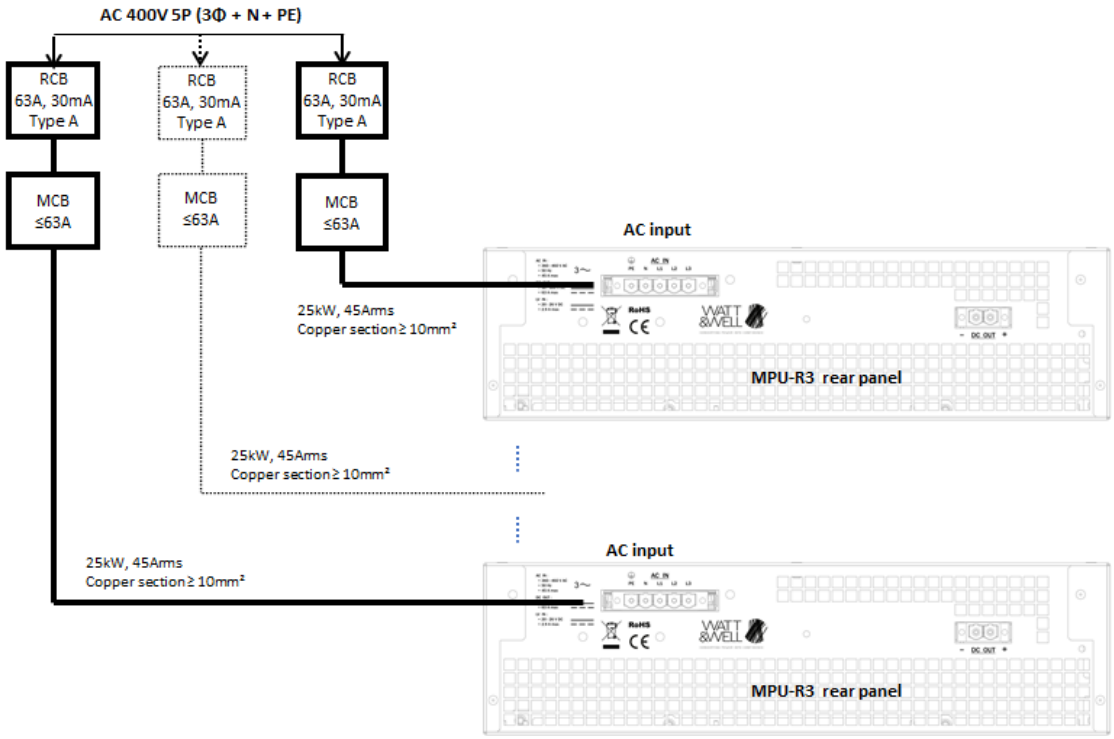


Figure 4: Recommended AC power cabling

Recommended DC Power cabling in parallel operation:

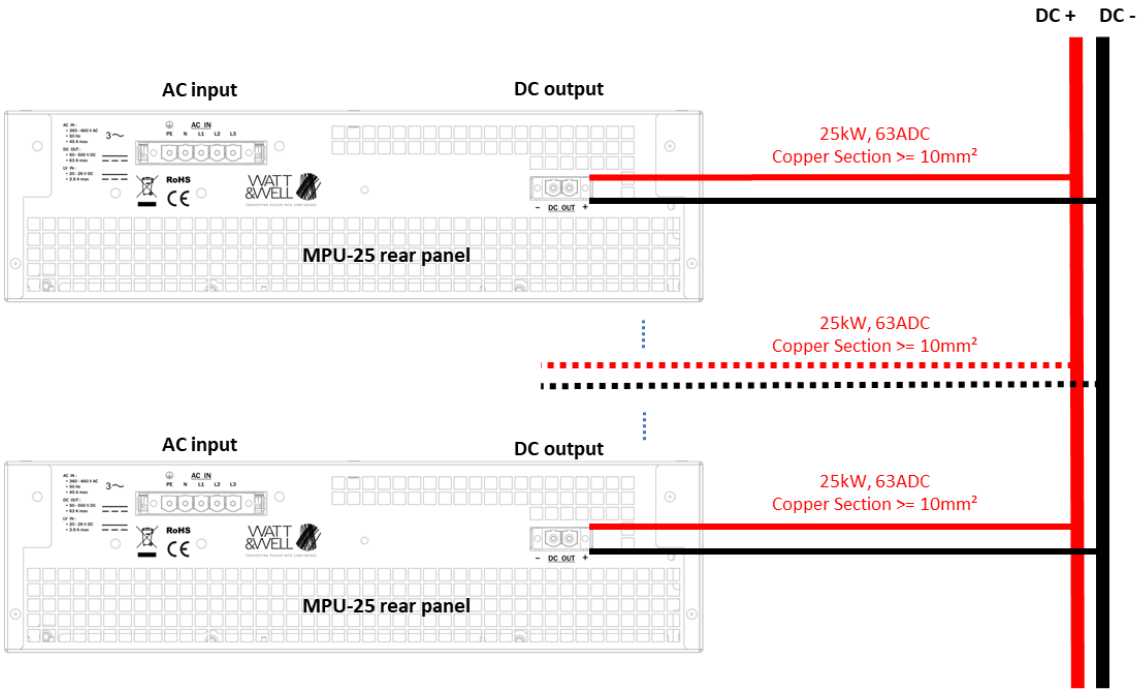


Figure 5: Figure 6: Recommended DC power cabling for parallel operation

4.3.2. Series operation

-HV version allows series connection of output for up to 920V operation. See AN002 for details.

4.4. Disposal

(Mandatory application within the European Union)
Do not dispose of electronic tools tighter with household waste material. In accordance with WEEE European Directive (2012/19/UE), Electric material that have reach the end of their life must be collected separately and return to an environmentally compatible recycling facility. Please contact WATT & WELL for any questions about WEEE

5. Hardware specification

5.1. Theory of operation

MPU-R3 25kW is composed of 4 main blocks described below that converts the power.

1) Input EMI filter

For electromagnetic compliance (EMC), a two stage EMI filter is used on the AC input.

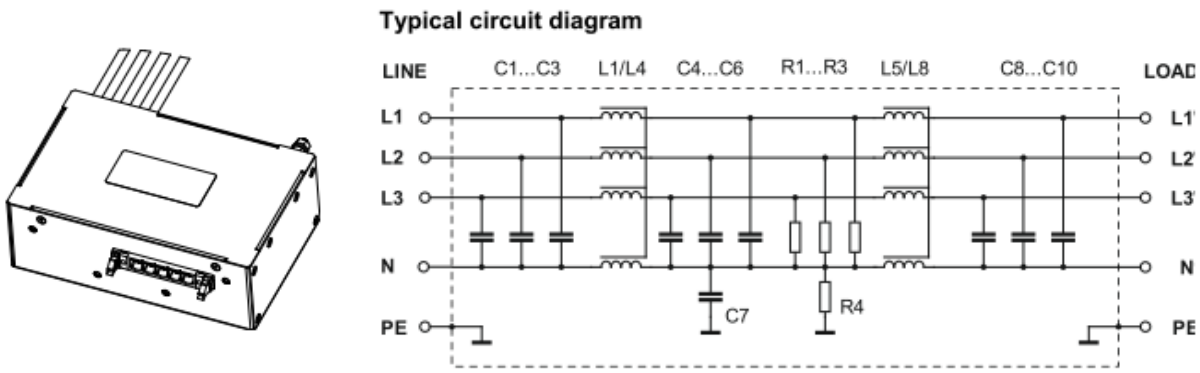


Figure 7: Input filter

2) Rectifier/PFC

An active rectifier that performs the AC to DC conversion. It features a Power Factor Corrector (PFC) algorithm that ensures a power factor close to unity. It also ensures that input current has a low harmonic distortion (THD) by making the input current as sinusoidal as the input voltage.

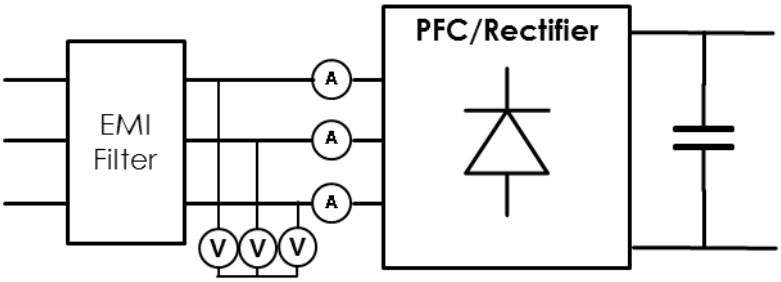


Figure 8: PFC

3) Isolated DC/DC

The DC/DC converter has a double purpose: regulate the output and ensure a reinforced galvanic isolation between the input and the output.
The DC/DC converter is composed of two converters of 12.5kW with outputs connected in parallel are used to deliver the full power of 25kW.

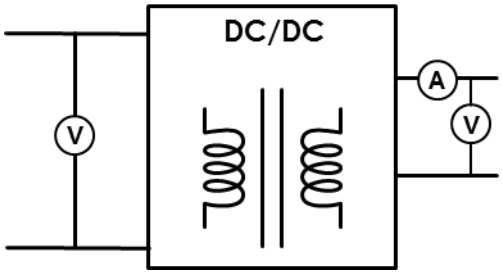


Figure 9: DC/DC Converter

The DC/DC converter can regulate the output in three ways:

- Voltage control: from 50 to 500V
- Output current: up to 63A
- Output power: up to 25kW

Internal limitation occurs when one limit is reached.

In addition, the power stage is limited to output loads of 4.7 Ω.

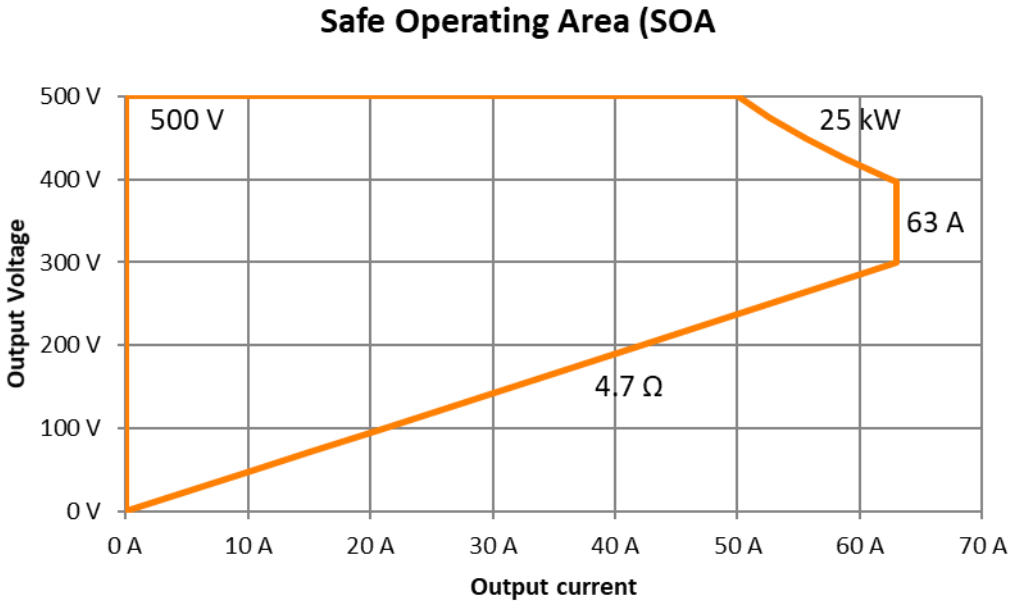


Figure 10: Converter operation[6]

[6] For standard input range only (400VAC ±10%).

4) Output filter and protections

An EMI filter is installed on DC output (common mode only). In addition, the following protections are included:

- A fast-type output fuse 100A/500V_{DC}
- A reverse blocking diode
- A fast discharge circuits consisting of a switched resistor bank of 940Ω. This resistor bank is limited to 2 shutdowns per 10 minutes. User must ensure enough cooling time before a power on to avoid overheating. **It is not sized for continuous operation**.

  The **fast discharge** circuit is designed to ensure that after a power off (due to normal operation or emergency shutdown), the capacitors are discharged to less than 60V in 1s and less than 10V in 2s.

  The fast discharge sequence is defined as follows
  - Normal stop (initiated by a CAN command)
    - SLOW discharge is triggered
    - FAST discharge is triggered after 500ms
  - Abnormal stop: initiated by an EMS, loss of CHARGE_P during run or Fault
    - SLOW and FAST discharge are triggered immediately

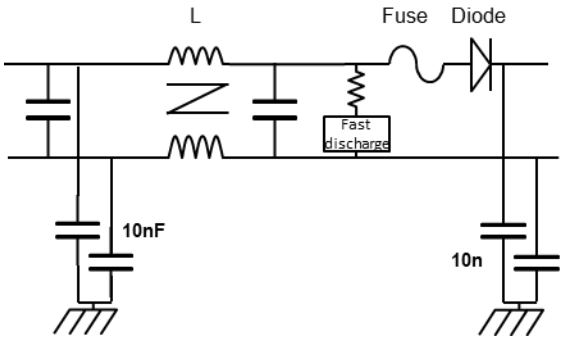


Figure 11: Output filter

5) FAN Control

There are 4 fans on the front side of MPU-R3 25kW. Operation of these fan is controlled internally as follows:

- In Standby mode:
  - Start functioning when an internal temperature measure is above 50°C at 10% of maximum air flow.
  - Max air flow is provided when an internal temperature reaches 80°C.
  - Linear ramp up between 50°C and 80°C.

- In Charging mode:
  - Max air flow is provided with linear ramp up starting from Standby mode air flow rate.

6) Available Output Current (AOC)

MPU-R3 25kW calculates the instantaneous maximum available current by considering:

- The output Safe Operating Area
  - Power < 25kW
  - Current < 63A
  - Voltage > 50V and <500V
  - Impedance > 4.7 Ω
- Input
  - Current < 45A
- Thermal limitations (based on maximum temperature among 6 measurements)

It is the responsibility of the system master to limit the requested current that does not exceed the AOC. MPU-R3 25kW includes a rate limiter of 10A/s to enable enough time to the Control Unit to inform the EV before the actual current limitation is applied and avoid a Current Deviation Fault.

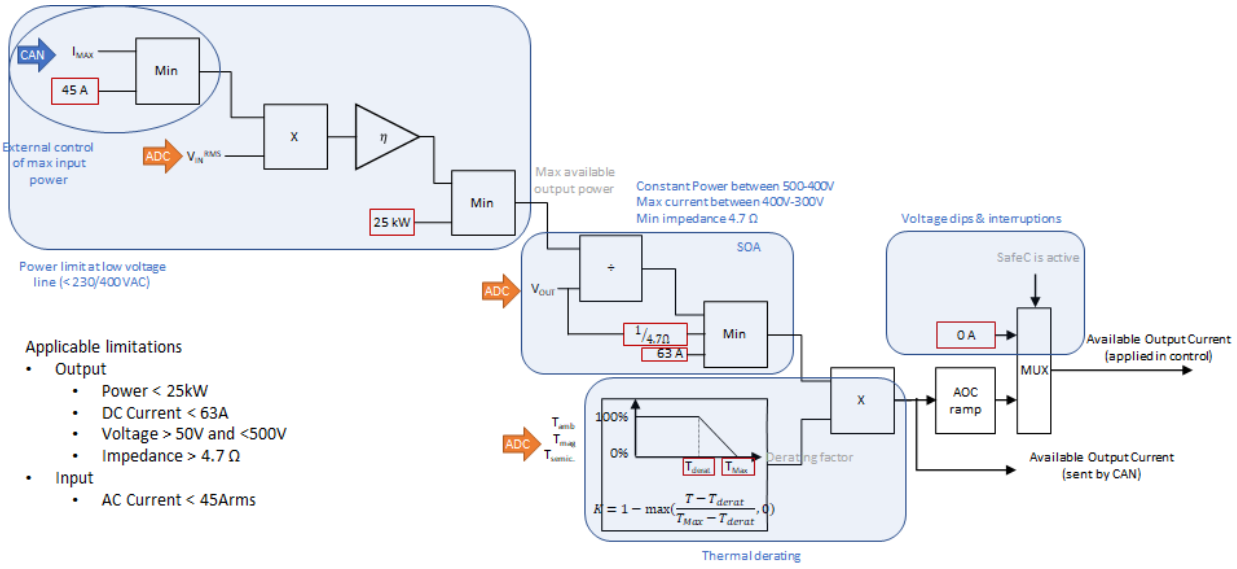


Figure 12 - Available Output Current

5.2. Typical efficiency

MPU-R3 25kW is based on a highly efficient full SiC (Silicon Carbide) technology. Peak efficiency reaches 95.5% and efficiency is consistently above 95% for a wide range of battery voltage and current as shown on Figure 13

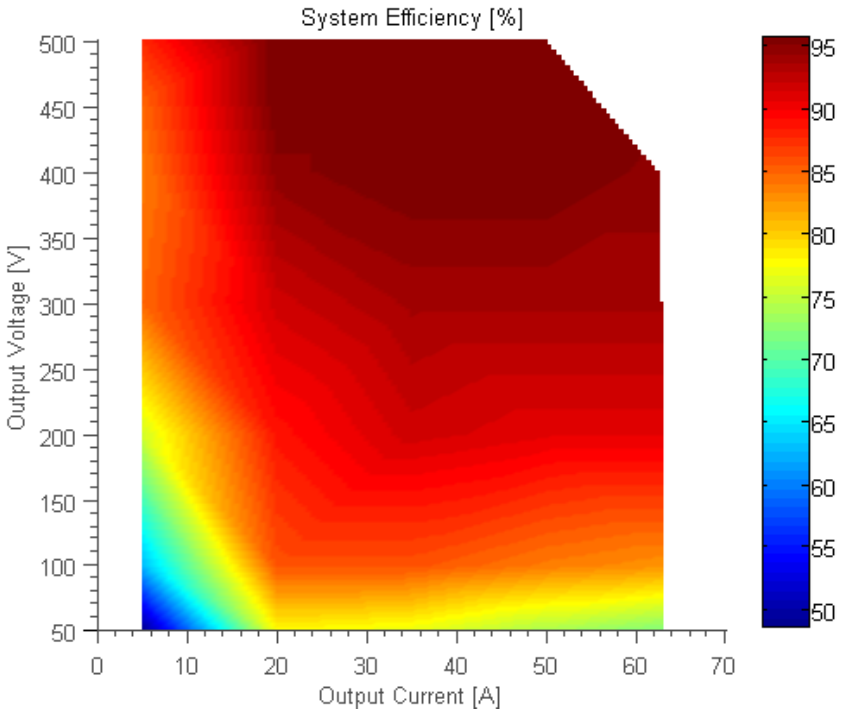


Figure 13: Typical MPU-R3 25kW efficiency[7]

[7] Measured under nominal grid conditions 230V (phase-neutral) / 400V (between phases) at room temperature

5.3. CAN communication

For more information on interfacing MPU series via CAN bus, see Application Note AN001.

5.3.1. CAN transceiver:

An isolated CAN transceiver is implemented to communicate through a high-speed CAN with other boards.

CAN bus is expected to be terminated at each bus end with a 120 Ω resistance. Wiring should be selected to have an intrinsic impedance of the twisted that match this 120 Ω. By default, MPU-R3 25kW does not include any 120 Ω resistor to avoid overloading the bus. External 120 Ω bus termination could be needed to ensure proper work.

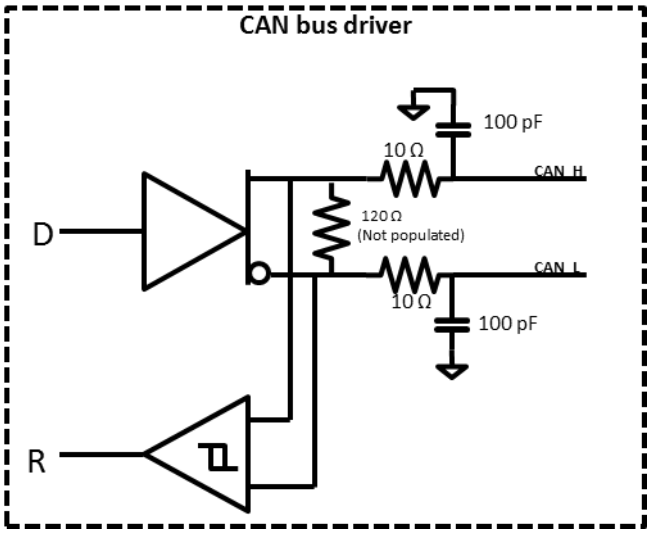


Figure 14: CAN transceiver simplified diagram

5.3.2. CAN configuration and dictionary

CAN baudrate

CAN 2.0A cadenced at 500kbit/s with little endian byte order.

Node ID

See section **Address selector** in section **5.4.** Default address is x56 (86).

Heartbeat frame

MPU-R3 25kW automatically transmits its communication state at regular intervals as evidence of its
communication ability. This frame is sent by MPU-R3 25kW every 1 sec.

MPU-R3 25kW also consumes the heartbeat of its master (expected to have the nodeID 0x1). So, the master shall emit every 1 second a heartbeat frame with an *operational* status. If this frame is

not received by the MPU-R3 25kW, the charge will be stopped and the MPU-R3 25kW will got into fault state.

Node	Frame ID	ID offset	DLC	Byte 0
MPU-R3 25kW	x756	x700	1	MPU-R3 25kW Status
Master	x701	X700	1	MasterStatus

- Frame ID = Node ID + ID offset

- Status = 0 at bootup (1 frame with 0 to be sent at boot)
- Status = 5 when node communication stack is operational (to be sent periodically)
- Status = 4 when node communication stack is stopped (to be sent periodically)
- Status = 127 when node communication stack is pre-operational (to be sent periodically)

Sync frame

In order to trigger synchronous sending of frame, MPU-R3 25kW is sensible to a SYNC message.

Frame ID	DLC
x80	0

Receive Process Data Object (RPDO)

The RPDO frame is the MPU-R3 25kW control frame. MPU-R3 25kW state and setpoints are sent from master to MPU-R3 25kW.

Frame ID	ID offset	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
x256	x200	7	StateRequest Word	OutputDcCurrent		OutputDcVoltage		InputGridMaxCurrent		

- Frame ID = Node ID + ID offset

Transmit Process Data Object (TPDO)

Frames sent from MPU-R3 25kW to master.

Frame ID	ID offset	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
x1D6	x180	6	StatusWord		FaultWord					
x2D6	x280	8	GridVoltageRMS		GridCurrentRMS		GridPower		MaxAvailableCurrent	
x3D6	x380	8	OutputVoltage		OutputCurrent		OutputPower		MaxGridCurrent	
x4D6	x480	8	MinOutVoltage		MaxOutVoltage		MaxOutCurrent		MaxOutPower	

Figure 15: Frame sent after having received SYNC on MPU-R3 25kW (x80)

- Frame ID = Node ID + ID offset

- Each TPDO is transmitted after reception of N number of Sync message. This number is defined by the transmission type parameter of the TPDO. For MPU-R3 25kW, transmission type for TPDOs are defined in the following table

Table 4 TPDOs transmission type

TPDO number	Transmission type	Note
TPDO1	7	
TPDO2	1	5 for SW prior to v2.6.5
TPDO3	1	
TPDO4	11	

For example, when using transmission type 34, the TPDO is transmitted after every 34th Sync message.

Emergency frame

Emergency frame is sent asynchronously by MPU-R3 25kW in case of default.

Frame ID	ID offset	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
xD6	x80	8	Error code		Error register	Unused	Data			

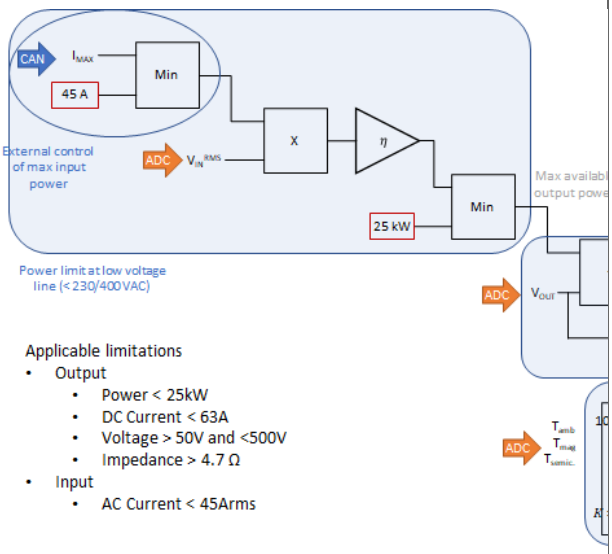
- Frame ID = Node ID + ID offset
- *Error Code*: 0xFF01 if the MPU-R3 25kW is in Fault mode. Other Error codes due to communication stack are defined by CANopen.
- *Error Register*: To be ignored, if the MPU-R3 25kW is in Fault mode
- *Data*: if the MPU-R3 25kW is in Fault mode, data = CriticalFaultWord, else, to be ignored.

Data unit and type definition

Messages data types and units are defined in the table below

Table 5 Frame data definition

CANopen name	Data unit	Data type	r/w	Description
StatusWord		Uint16	r	See *Status Word description* table
RequestCode		Uint8	w	Same definition than SystemMode (See *Status Word description* table)
FaultWord		Uint32	r	See *Fault Word code* table
OutputDcCurrent	10mA	Uint16	w	Output DC current setpoint
OutputDcVoltage	100mV	Uint16	w	Output DC voltage setpoint
InputGridCurrentMax	10mA	Uint16	w	Limitation of grid current

GridVoltageRMS	100mV	Uint16	r	Input AC RMS voltage measurement
GridCurrentRMS	10mA	Uint16	r	Input AC RMS current measurement
GridPower	1W	Uint16	r	Input AC power measurement
OutputVoltage	100mV	Uint16	r	Output DC voltage measurement
OutputCurrent	10mA	Uint16	r	Output DC current measurement
OutputPower	1W	Uint16	r	Output DC power measurement
MaxGridCurrent	10mA	Uint16	r	Maximum AC input current capability of the MPU-R3 25kW
MinOutVoltage	100mV	Uint16	r	Minimum DC output voltage capability of the MPU-R3 25kW
MaxOutVoltage	100mV	Uint16	r	Maximum DC output voltage capability of the MPU-R3 25kW
MaxOutCurrent	10mA	Uint16	r	Maximum DC output current capability of the MPU-R3 25kW
MaxOutPower	1W	Uint16	r	Maximum DC power capability of the MPU-R3 25kW
MaxAvailableCurrent	10mA	Uint16	r	**urrent DC output current capability of the MPU-R3 25kW (depends on deratings, see**  Figure 12 - Available Output Current)

Fault Word code

In order to prevent system from failure event which could damage product, MPU-R3 25kW has several securities faults. These faults statuses are indicated in bit-wise word "FaultWord" defined as follow:

Bit	Fault	Description
0	OC PhaseA Current	Over current on Phase A
1	OC PhaseB Current	Over current on Phase B
2	OC PhaseC Current	Over current on Phase C
3	OV PhaseA Voltage	Over voltage on Phase A
4	OV PhaseB Voltage	Over voltage on Phase B
5	OV PhaseC Voltage	Over voltage on Phase C
6	UV PhaseA VoltageRMS	Under Voltage on Phase A
7	UV PhaseB VoltageRMS	Under Voltage on Phase B
8	UV PhaseC VoltageRMS	Under Voltage on Phase C
9	OV PFC p400V Voltage	Over voltage on intermediate PFC bus
10	OV PFC m400V Voltage	Over voltage on intermediate PFC bus
11	OV DCDC p400V Voltage	Over voltage on intermediate DC bus
12	OV DCDC m400V Voltage	Over voltage on intermediate DC bus
13	OV Vout Voltage	Over voltage on DC OUT
14	OV Regul Vout Voltage	Output voltage too high compare to requested current value
15	OC Iout Current	Over current on DC OUT
16	ShutT Temp PFC L UV PFC Precharge Failure	SW prior to v2.6.5 → Shutdown temperature on PFC L sensor SW v2.6.5 and newer → DC bus precharge failure
17	ShutT Temp PFC IMS UV PFC Passive Conduction	SW prior to v2.6.5 → Shutdown temperature on PFC IMS sensor SW v2.6.5 and newer → Under voltage on DC bus voltage regarding passive conduction voltage limit
18	ShutT Temp DCDC1 IMS	Shutdown temperature on DCDC1 IMS sensor
19	ShutT Temp DCDC2 IMS	Shutdown temperature on DCDC2 IMS sensor
20	ShutT Temp DCDC1 XFO	Shutdown temperature on DCDC1 XFO sensor
21	ShutT Temp DCDC2 XFO	Shutdown temperature on DCDC2 XFO sensor
22	ShutT Temp DCDC2 L	Shutdown temperature on DCDC2 L sensor
23	ShutT Temp Ambient	Shutdown on ambient temperature
24	OV LV Voltage	Over voltage on LV bus
25	UV LV Voltage	Under voltage on LV bus
26	OC LV Current	Over current on LV bus
27	Emergency Shutdown	Emergency shutdown
28	Device CAN TimeOut	Timeout CAN
29	Discharge Failure / Diode breakdown	SW prior to v2.6.5 → unused SW v2.6.5 and newer → Discharge failure of output capacitor or output diode breakdown
30	Charge Permission	Charge Permission fault
31	Address Selection	CAN ID address is illegal (86) for nominal system

Status Word description

Bit	Request Word Status Word	Description
0:3	System Mode	0 –STARTUP System receives parameters from master 1- IDLE Power is off, system waits a request 2- PASSIVE_PRECHARGE: PFC commands only thyristor, pre-charge of capacitors 3- ACTIVE_PRECHARGE: PFC control starts, and capacitors are fully charges 4- RESERVED: For future use 5- CHARGING: Charge ongoing 6- STOP: Stopping charge 7- FAULT: Critical fault occurred; system halted in this mode until user action.
4	SafeCactive	Set to 1 if the PU is in safeC mode
5	FuseAmbTempDeratingFlag	Set to 1 if fuse ambient temperature is used in power derating
6	MagneticsTempDeratingFlag	Set to 1 if DCDC magnetics temperature is used in power derating
7	PfcMOSTempDeratingFlag	et to 1 PFC MOS temperature used in power derating
8	CurrentRegulationFlag	Set to 1 if MPU is limited by max Current
9	VoltageRegulationFlag	Set to 1 if MPU is limited by max Voltage
10	PowerRegulationFlag	Set to 1 if MPU is limited by max Power
11	PfcOnFlag	Set to 1 if PFC is ON
12	DcdcOnFlag	Set to 1 if DCDC is ON
13	InputCurrentLimitationFlag	Set to 1 if MPU is limited by input current
14	OutputLoadImpedanceLimitationFlag	Set to 1 if MPU is limited by output load impedance
15	ThermalLimitationFlag	Set to 1 if MPU is limited by thermal heating
16:31	Reserved	

5.4. Interfaces

Low voltage connector

Connector Reference (converter side): Phoenix Contact MSTBA 2,5/ 2-G-5,08 1757242
Recommended matting connectors (wire harness side): MSTBP 2,5/ 2-ST-5,08 – 1769010. Part of MPU-A002 kit

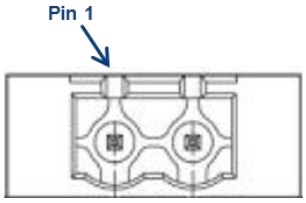


Figure 16: Low voltage connector

Table 6 – LV pinout

PIN	FUNCTION	DESCRIPTION	Preferred wiring color
1	LV_IN-	Low Voltage supply return (0V typ)	Black
2	LV_IN+	Low Voltage supply (24V typ)	Red

AC IN connectors

Connector Reference (converter side): Phoenix Contact DFK-PC 6-16/ 5-GF-SH-10,16 1701964
Recommended matting connectors (wire harness side)

- SPC 16/ 5-STF-10,16 1711404 (Push-in spring connection). Part of MPU-A002 kit
- PC 16/ 5-STF-10,16 1967485 (Screw connection)

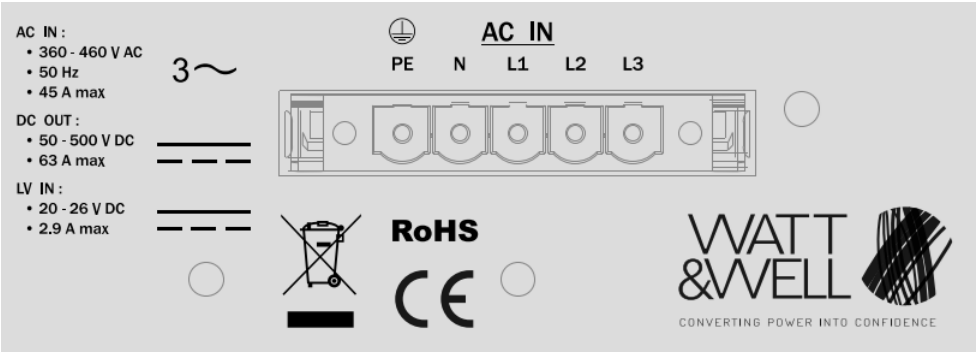


Figure 17 - AC_IN connector detail

PIN	FUNCTION	DESCRIPTION	Preferred wiring color
1	PE	Protective Earth	Green/yellow striped
2	N	Neutral	Blue
3	L1	Mains line 1	Brown
4	L2	Mains line 2	Black
5	L3	Mains line 3	Grey

DC OUT connectors

Connector Reference (converter side): Phoenix Contact: DFK-PC 6-16/ 2-GF-SH-10,16 1701935
Recommended matting connectors (wire harness side)

- SPC 16/ 2-STF-10,16 1711378 (Push-in spring connection). Part of MPU-A002 kit
- PC 16/ 2-STF-10,16 1967456 (Screw connection)

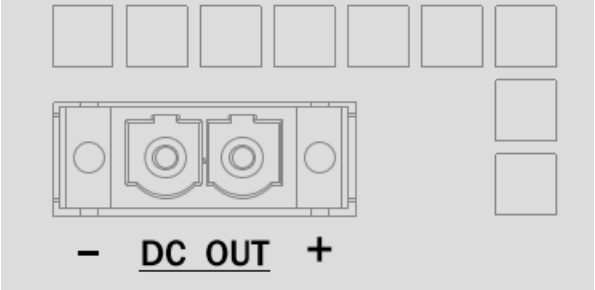


Figure 18 - DC_OUT connector detail

PIN	FUNCTION	DESCRIPTION	Preferred wiring color
1	DC_OUT-	DC output return path (0)	Black
2	DC_OUT+	DC output (positive)	Red

Protective Earth:

Protective Earth is connected through the AC in connector in the rear panel to the rack chassis

Address selector and Charge P.

Each MPU-R3 25kW takes its CAN **address** at boot based on the Addressing connector on the front panel.
Recommended configuration is

a) In single unit configuration: use the default address (000) that is used when no ADDR por is connected (or if all theirs lines are 0).
b) In multiple unit configuration with single output
   - Uses addresses 1 (001) to 6 (110) for each unit
   - Avoid default address (000) to avoid confusion and declare it illegal to catch unconnected port issues
c) In multiple unit configuration with dual output (e.g. a CHAdeMO port and a COMBO port)
   - Use Addresses 1 to 3 for first output (can be done by the EV communication module[8])
   - Use Addresses 4 to 6 for second output (“channel B” in the EVI Module)
   - Avoid default address (000)

Address	CAN ID

[8] EV Interface module is a charging controller developed by Watt & Well. See

Related products

1 (001)	80
2 (010)	81
3 (011)	82
4 (100)	83
5 (101)	84
6 (110)	85
Default address[9] (000)	86
Illegal (111)	

Note: In dual output (simultaneous multioutlet) configuration, address selection should match the DC output connection of MPU-R3 25kW physically. Use recommended channel segregation and ensure correct installation (e.g. if address selection is 3 (011), DC output should be connected only with other Channel A outputs. **Failure to do so may result in catastrophic failure i**f multiple MPU-R3 25kW are connected in parallel

The addressing connector also transmits a **Charge Permission** signal. This signal can be used as a redundant stop signal since MPU-R3 25kW stops operation when it receives a stop instruction by either “Charge Permission signal” or “CAN communication message”
Logic levels are defined as

- 0V: no output (forbidden operation). If a start message is received by CAN, a fault will be generated.
- 24V: charge permission OK (system can start if a CAN message is received)

Figure 19 shows the input stage of the Charge Permission signal. Note that the stage is current driven and therefore, current should be limited to less than 10mA. It is recommended to drive the signal from a voltage source that includes an output impedance to limit current (10kΩ for 24V operation)

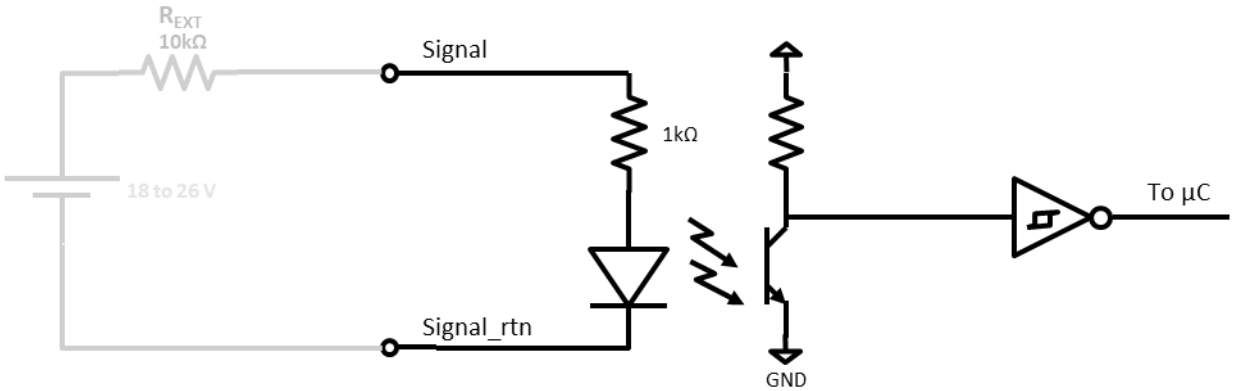


Figure 19: Input stage of digital inputs (black) and recommended driving circuit (gray)

[9] Default address when no ADDR port is connected is 000. This address can be used in single unit configuration, but it is not recommended on multi-unit configuration to help detect wiring errors

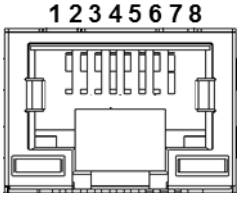


Figure 20: Addressing connector (RJ45) front view

Table 7: Addressing connector pinout

PIN	FUNCTION	DESCRIPTION
1	ADDR0	Address bit 0 (positive)
2	ADDR0_RTN	Address bit 0 return (negative)
3	ADDR1	Address bit 1 (positive)
4	ADDR1_RTN	Address bit 1 return (negative)
5	ADDR2	Address bit 2 (positive)
6	ChargePerm_RTN	Charge Permission return (negative)
7	ChargePerm	Charge Permission (positive)
8	ADDR2_RTN	Address bit 2 return (negative)

COM Connector

MPU-R3 25kW features a CAN bus for digital communications. The COM connector is a double RJ45 connector to enable connection of several Units in the same bus. A-side could then be used as COM in and B-side as COM out. Cable connected to these ports must be shorter than 3m.

The COM connector also transmits an **Emergency Shutdown** signal EMS). This signal triggers an unconditional shutdown of the MPU-R3 25kW operation. In addition, a fast discharge circuit will discharge the internal output capacitors to a safe level (<<60V) in less than 1 second
Logic levels are defined as

- 0V: Emergency Shutdown activated (active low)
- 24V: normal operation

The driving circuit of the EMS is equivalent to the one for Charge Permission (see Figure 19). It should be current limited to less than 15mA Figure 21

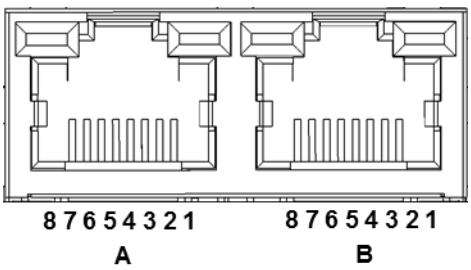


Figure 22 : COM connector (double RJ45) front view

Table 8 - CAN IN connector pinout

PIN	FUNCTION	DESCRIPTION
1	CAN H	CAN differential +
2	CAN L	CAN differential -

3	CAN_GND	Ground reference for CAN
4	EmShut_Rtn	Emergency Shutdown return line (negative)
5	EmShut	Emergency Shutdown (positive)
6	Shield	Optional shield. Internally connected to PE
7	CAN_GND	Ground reference for CAN
8	Not Used	

LEDs

6 LEDs on front panel indicate the status of the system

Table 9 – LED overview

LED	COLOR	FUNCTION	Description
1	Red	Fault	Indicates a fault on the system. Systems is stopped as a result
2	Orange	Thermal Warning	Internal temperature of MPU-R3 25kW has crossed the thermal threshold but has not yet reach a critical level. System is operational with reduced available output current
3	Blue	Output ON	Continuous: Output is connected Blinking: Safe C mode*
4	Yellow	Current regulation	System operates in output current limit
5	Yellow	Power regulation	System operates in output power limit
6	Yellow	Voltage regulation	System operates in voltage limit

*: Safe C mode occurs when input voltages are out of the working voltage range. System cuts output power and remains waiting for Safe C condition clearance. Output power is restored when input voltage is within the working voltage range [184V, 280V]. This functioning corresponds to Criterion B of Susceptibility criteria during a continuous/transitory disturbance (see Table 3).

In addition to the above-mentioned indicators, there are 6 additional LEDs on the RJ45 connectors that are used as follows

Table 10: debug LEDs of RJ45 connectors

LED	COLOR	FUNCTION	Description
COMA	Green	VCC 3.3V	Local supply 3.3V is present
	Yellow	VCC GD	Local supply for gate drivers is present
COMB	Green	LV	24V is present
	Yellow	N/A	(not used)
ADDR	Green	ADDR OK	ADDR bus is connected (at least one bit is set to ‘1’)
	Yellow	Charge P	Charge Permission signal missing. This could be due to an external system forbidding charge (‘0’ level) or that signal is not connected

6. System setting

6.1. Safety notice

The MPU-R3 25kW is configured in factory. It is strictly forbidden to change or modify internal firmware parameters.

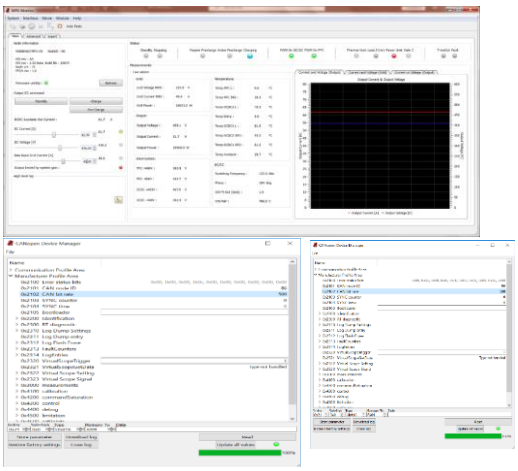
6.2. Hardware setting

See section 5.4 for

- Emergency connection.
- Addressing system
- Charge P signal

6.3. Graphical user interface

A graphical user interface for Windows-based PC can be purchased separately.
It offers direct access to measures, monitoring and configuration parameters. It can be used to control MPU-R3 25kW as a PC based master or to speed-up integration of a dedicated system master
See



Related products in page 37 or contact sales for more information

6.4. CAN communication

See CANopen dictionary for more information

Figure 23: Graphical User Interface

7. Mechanical specifications

MPU-R3 25kW is packaged in a standard 19” rack 3U tall. The total length from front to rear panel is 566.3 mm (excluding handles).

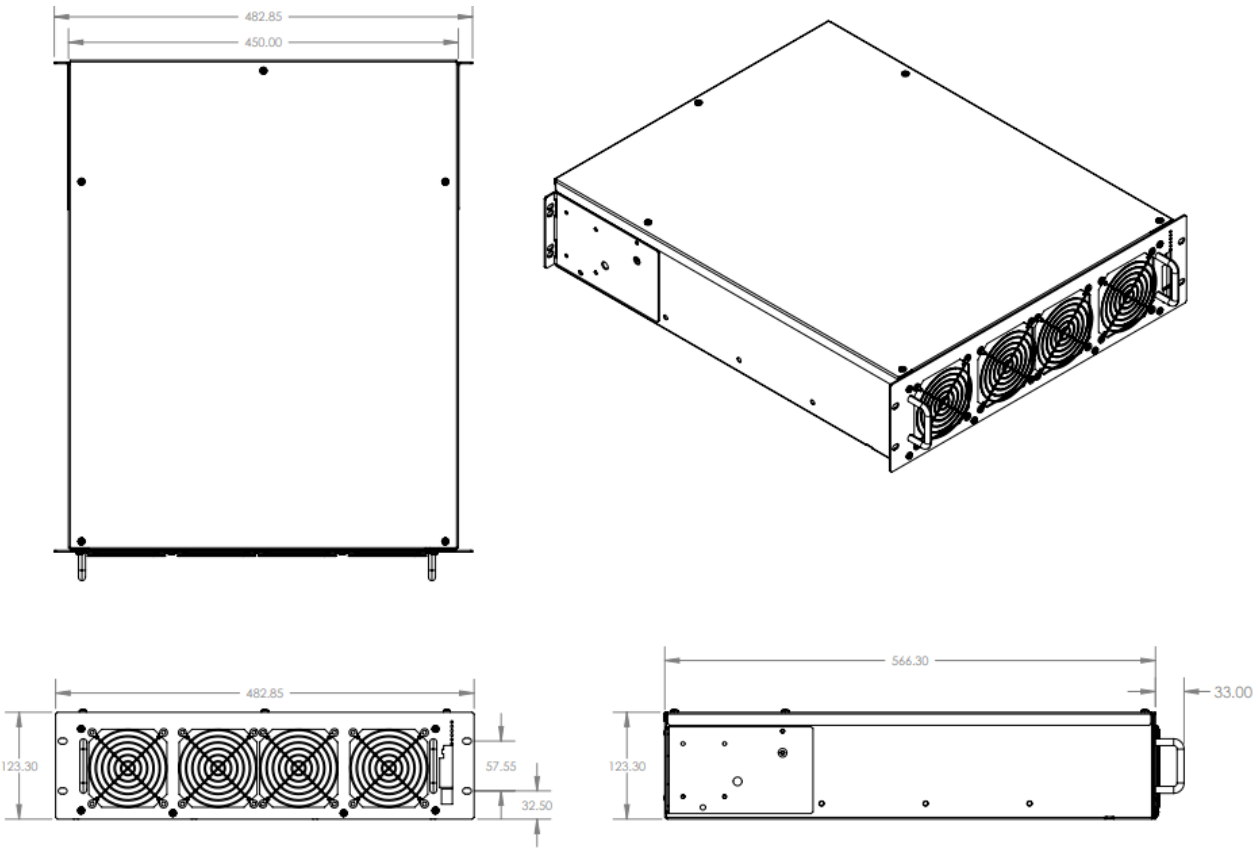


Figure 24: MPU-R3 25kW assembly drawing (v3.9.1 and later)

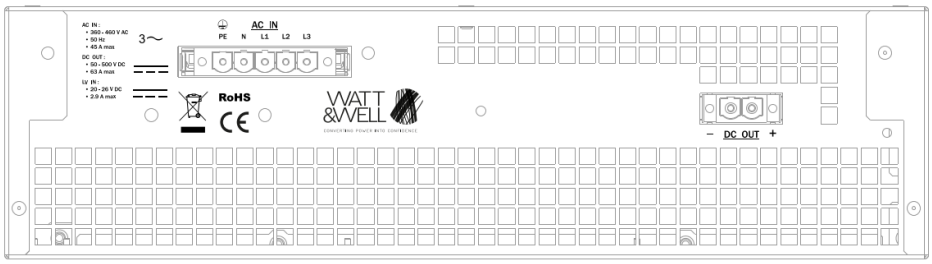


Figure 25: Detail of rear panel

8. Maintenance

It is forbidden to open the product.

8.1. Cleaning

Use a soft cloth for cleaning the device. Do not use cleaning agent.
Internal dust could be removed with hoover or dry air cleaning.

8.2. Cooling fan

Cooling fan is internally controlled. Do not obstruct apertures on the case side.

8.3. Fuse replacement

DC output is protected by a fuse. Fuse replacement is only allowed by Watt & Well qualified personnel. Return product to factory for replacement.

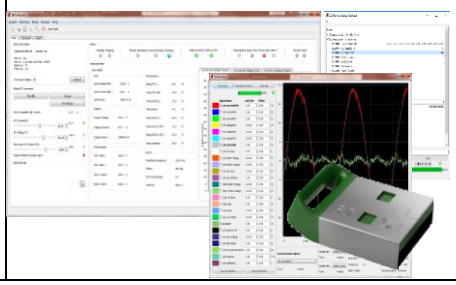
9. Ordering information

9.1. Product Reference

	DC out			
	P	**U**	**I**	**Protections**
MPU-R3-500-63-FD	25kW	500 V	63A	Output fuse and diode
MPU-R3-500-63-FD-HV	25kW	500 V	63A	Output fuse and diode -HV version allows series connection of output for up to 950V operation

9.2. Product accessories

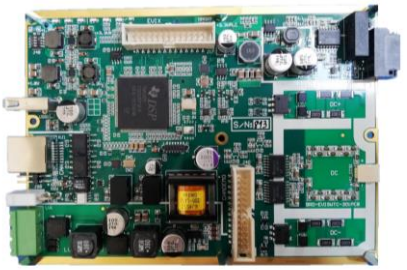
WA001 – Vertical fixation kit – Cannot be purchased separately. Needs to be factory installed –	
WA002 – Set of matting connectors AC side, DC side and LV side. Unwired	
WA003 – Pre-wired AC connector 63A with 10mm² color-coded wire and 63A connector (3P+N+PE) Cable length: 2.5m (other lengths under request)	

WA004 – Pre-wired AC connector 32A with 6mm² color-coded wire and 32A connector (3P+N+PE) Cable length: 2.5m (other lengths under request)	
WA005 – Pre-wired DC connector with 10mm² color-coded wire and M6 lug termination Cable length: 2.5m (other lengths under request)	
WA006 – Pre-wired LV connector With color-coded 4mm insulated banana plug. It includes an RJ45 connector that can optionally be fitted in one of the COM ports to disable the Emergency Shutdown function Cable length: 2.5m (other lengths under request)	
WA007 – CAN bus adaptor from RJ45 to DB9 including 120 Ω termination resistance	
WA009 – USB to CAN transceiver (Kvaser) Compatible with MPU Monitor	
WA020 – MPU Monitor license (USB license dongle) A Windows based GUI (Graphical User Interface) for easy access to measurements, monitoring and configuration parameters. See MPU-R3-500-63-FD GUI user guide for more details	

9.3. Related products

EVI – Electrical Vehicle Interface

EVI is a dual standard Supply Equipment Communication Controller (SECC) with all required signals for CCS2 /Combo and CHAdeMO communications



Main features:

- CCS protocol compatible
- CHAdeMO compatible (via Extension board)
- Version 0.9 & 1.2
- Insulation Measurement Device according to IEC61557-8
- High voltage 920V charging
- Smart Charging
- Cable temperature measurement
- Crypto ready with Secure Element embedded

EVIX – EVI Extension board:

An optional extension board (EVIX) can add additional functions such as:

- Addressing of 6 power units
- CHAdeMO HW interface

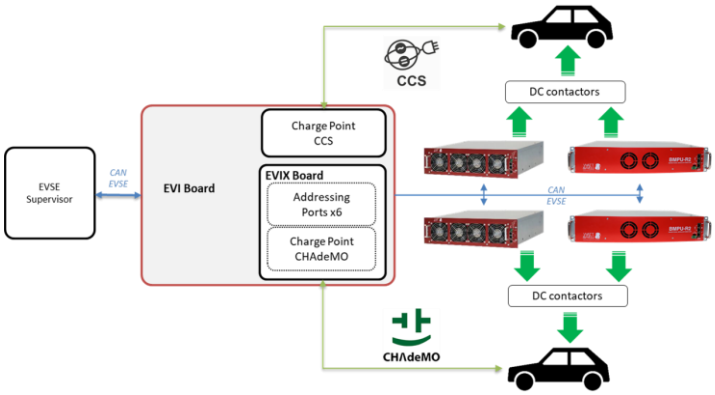


Figure 26: EVI & EVIX integration on EVSE environment

Other customization options available under request

contact@wattandwell.com
+33 1 75 5 11 50