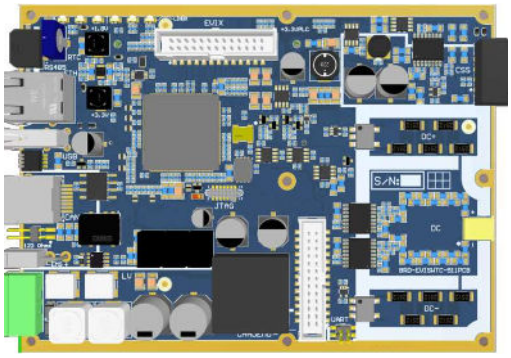
Watt&Well
CONVERTING POWER INTO CONFIDENCE
E-MOBILITY

SECC SERIES

Electrical Vehicle Interface

COMMUNICATION | E-MOBILITY | EV CHARGERS



OVERVIEW

EVI is a Supply Equipment Communication Controller (SECC) that includes an Insulation Monitoring Device (IMD).

It is compliant with IEC 61851-23 and IEC 61851-1 requirements subset for SECC, and with IEC 61557-8 and UL 2231-1/-2 standards for IMD.

EVI can act as a main controller of an EVSE and is readily compatible with:

- Power Units for DC charging (MPU)
- Bidirectional Power Units (BMPU)

Optional extension boards (EVIX) can add functions such as:

- A second or third CCS charge point
- An MCS charge point (currently in development)
- CHAdeMO interface
- Input/Output expander

FEATURES

- Communications ports
  - Ethernet 100Mbit
  - USB 2.0 (up to 480Mbps)
  - CAN, RS485 ports
  - Slot for a 3G/4G modem via extension board
  - Touch screen interface (MIPI/DSI)
- Managed protocols
  - CCS2 (DIN SPEC70121, ISO15118-2, ISO15118-20 including BPT)
  - CHAdeMO including BPT
  - OCPP 1.6J, OCPP 2.0.1 interface
  - Plug & Charge with embedded secure element
  - Web-App Monitoring
  - OTA firmware update
- Integrated 920V Insulation Measurement Device (IMD)
- Smart Charging with dynamic Power allocation between charge points.
- Powerful & safe computing capabilities
  - SoC with ARM® Dual Cortex-A7 & ARM® Cortex-M4
  - 1 GB of RAM, 8 GB eMMC Flash
  - Ability to run customer applications

The given values are susceptible to change without prior notice.

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Revision date: 2024-11

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.

Disclaimer

It should be noted that the codes and diagrams provided in this datasheet are presented for illustrative purposes only. The given values are susceptible to change without prior notice. The manufacturer of the charging station remains responsible for defining and ensuring compliance with the station's specifications. Watt & Well assumes no liability for any inaccuracies or discrepancies in the provided examples.

Contents

1 Introduction

EVI is a Supply Equipment Communication Controller (SECC) that includes an Insulation Monitoring Device (IMD).

It is compliant with IEC 61851-23 and IEC 61851-1 requirements subset for SECC, and with IEC61557-8 and UL 2231-1/-2 standards for IMD.
EVI can act as a main controller of an EVSE and is readily compatible with:
Power Units for DC charging (MPU)
Bidirectional Power Units (BMPU).

This datasheet covers details of three hardware versions of the EVI: v3.0, v3.1 and v4.0. The differences between these versions are summarized in Table 1: EVI Hardware versions and will be detailed in this document.

Designed for smart charging / smart grid applications, it features a modular conception capable of independent multi-charge point (CHAdeMO and Combo) and can control up to 14 MPU power units in a high-power system up 420 kW and 16 BMPU for bidirectional charging.

More details about these products and their corresponding datasheets can be found here: https://wattandwell.com/e-mobility/power-modules/

The EVI is also compatible with extension boards (EVIX boards) to broaden its functionalities as described in Table 2: EVI extension boards.

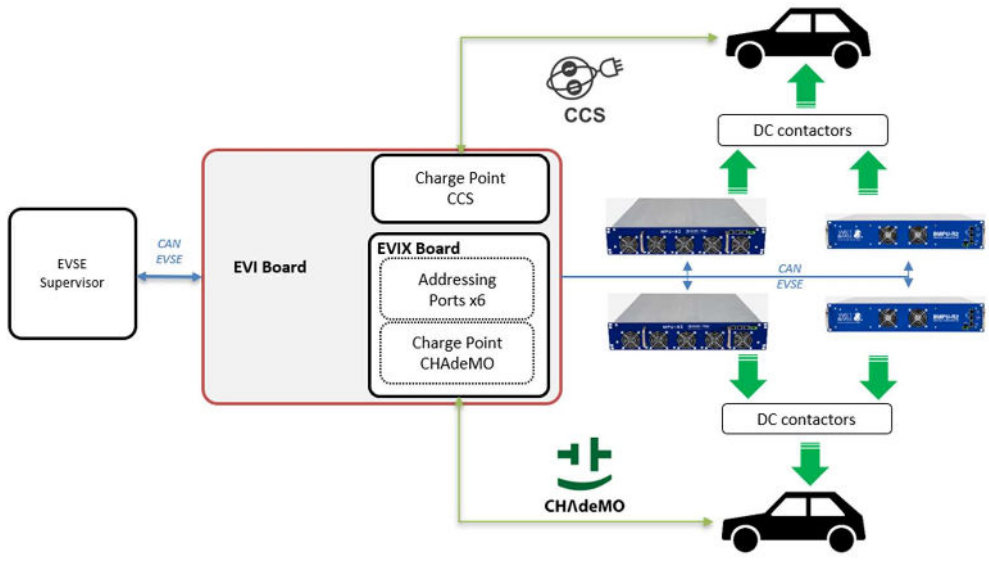


Figure 1: EVI, EVIX, MPU and BMPU in EVSE architecture

Table 1: EVI Hardware versions

EVI hardware version	EVI v3.0	EVI v3.1	EVI v4.0
UL IM/I certified	No	Yes	Yes
Operating temperature	[-5°C; +50°C]	[-40°C; +70°C]	[-40°C; +70°C]
LV connector	2 pins connector Ref: MSTB 2,5/ 2-GF-5,08	2 pins connector Ref: MSTB 2,5/ 2-GF-5,08	3 pins connector (LV+EMS) Ref: MSTB 2,5/ 3-GF-5,08
EMS connector	2 pins connector Ref: 26-01-3127	2 pins connector Ref: 26-01-3127	Merged with LV
Touch screen connector	No	No	MIPI-DSI 15 pins connector Ref: 1-84952-5
HV DC connector	2 pins connector Ref: SM02B-BHSS-1-TB	2x 1 pin connector Ref: FFKDSA1/H-6,35	2 pins connector (3 poles with only 2 pins mounted) Ref: 9EDGRB-7.62-02P
CCS	Proximity Pilot Unused (Config EE)	Proximity Pilot measured	Proximity Pilot measured
HSM Hardware Security Module	ATECC608	ATECC608	NXP SE050 E2
Compatibility with EVIX-AD6 & EVIX-AD6-CHA	Yes	Yes	No
Compatibility with EVIX-IO	Yes (Up to 2 EVIX-IO stacked)*	Yes (Up to 2 EVIX-IO stacked)*	Yes (Up to 2 EVIX-IO stacked)*
Compatibility with EVIX-CCS	No	No	Yes (Up to 2 EVIX-CCS stacked)
Compatibility with EVIX-MCS	No	No	Yes (Up to 2 EVIX-MCS stacked)

*Stacking two EVIX-IO allows to have more GPIOs than with a single one, but some functionalities of the second EVIX-IO will be disabled (USB, CAN, PWM).

Table 2: EVI extension boards

EVI extension board name	Functionalities	EVI v3.0 compatibility	EVI v3.1 compatibility	EVI v4.0 compatibility
EVIX-AD6	Hardware for addressing of 6 power	✓	✓	
EVIX-AD6-CHA	Hardware for addressing of 6 power units and CHAdeMO protocol compatibility	✓	✓	
EVIX-AD14	Hardware for addressing of 14 power units	✓	✓	✓
EVIX-IO	Peripheral expander (Digital IO and Analog inputs)	✓	✓	✓
EVIX-CCS	Up to 2 additional CCS/Combo charge points for EVI v4.0			✓
EVIX-MCS	MCS protocol compatibility			✓

2 Absolute maximum ratings

Table 3: Absolute maximum ratings

Parameter	Condition	Min	Max	Units
LV Input Voltage (all versions)		0	30	V
DC side voltage	EVI v3.0 EVI v3.1 and v4.0	0 0	930 1000	V
Operating Temperature	EVI v3.0 EVI v3.1 and v4.0	-5 -40	50 70	°C
Long term storage Temperature		-40	85	°C
Temperature change rate			5	°C/min

3 Electrical Characteristics

Table 4: Electrical characteristics

Parameter	Condition	Value			Units
		Min	Typ	Max	
DC Side					
Voltage measurement range	EVI v3.0 EVI v3.1 and v4.0			930 1000	V
Voltage measurement accuracy	Full range		5	10	V
CAN communication					
CAN baud rate			500		Kbps
CAN common mode range		-7		7	V
LV Input					
Supply voltage	Without EVIX-AD6-CHA With EVIX-AD6_CHA	9 11	24 24	29 29	V
Input current	Without EVIX-AD6-CHA With EVIX-AD6_CHA		0.25 0.5	0.5 2.5	A
Under Voltage Shutdown			9		V
Power		10	12	30	W
Insulation Measurement Device (IMD) / Isolation Monitor/Interrupter (IM/I)					
Operational voltage range	EVI v3.0 EVI v3.1 and v4.0	110 110		920 1000	V
Impedance measurement Relative uncertainty			3%	10%	%
Fault threshold			100		Ω/V
Warning threshold			500		Ω/V
Response time[1]	EVI v3.0 EVI v3.1* EVI v4.0*	 1 1	19 2 2	19 19 19	s
Maximum capacitance between DC+/- and PE				3.3	µF
Emergency Shutdown (EMS)					
Voltage			24	30	V
Current			2	4	mA

All specifications are given for the full temperature range unless otherwise noted.

[1]: IMD response time is dependent on capacitance between DC+/- and PE

4 Hardware specification

4.1 EVI theory of operation

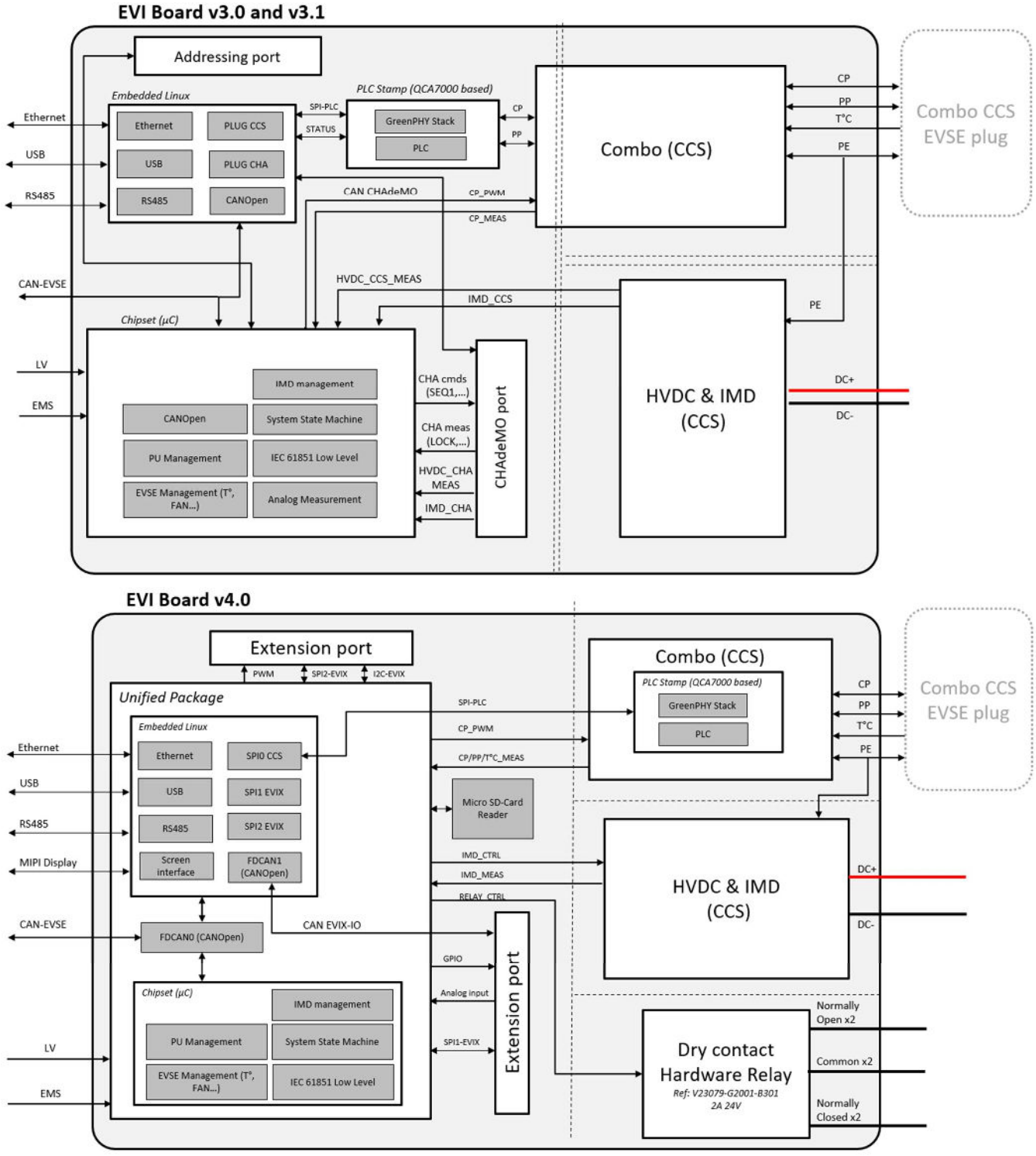


Figure 2: EVI block diagram

4.2 EVI board configuration (A, B, C or D)

To allow having several EVI on same Charging Station and on same CAN EVSE bus, it is needed to configure them with different CAN ID and then different CAN frame associated (see Error! Reference source not found. Error! Reference source not found.) using a 4 positions dipswitch.

Each switch corresponds to a EVI board configuration as explain hereafter:

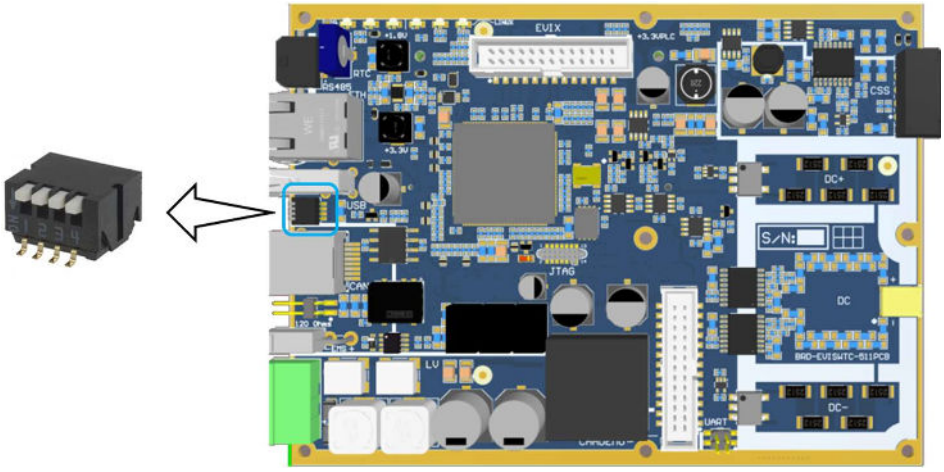


Figure 3: location of the switch for EVI board configuration

Table 5: EVI board configuration

EVIS	Switch 1	Switch 2	Switch 3	Switch 4
EVIS A	1	0	0	0
EVIS B	0	1	0	0
EVIS C	0	0	1	0
EVIS D	0	0	0	1
Not allowed	Other switches combination (LEDs blinking)			

4.3 HV DC voltage measurements

EVI features an input port for CCS HV DC voltage measurements.
These measurements allow the charge protocol software to ensure that output DC voltage is as requested by the EV and is also used in Insulation measurement feature.

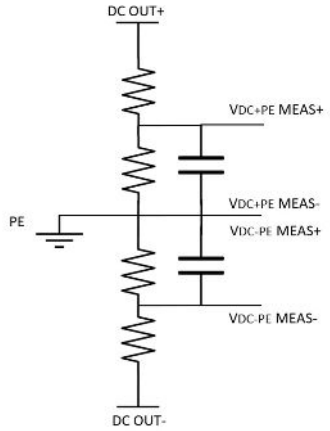


Figure 4: HV DC voltage measurement

4.4 EMS – Emergency Shutdown

EVI provide an Emergency input port that can be used to trigger an unconditional shutdown of the EVI operation. See Table 13 for the pinout of EmShut within the EMS and COM connector.

EmShut logic is active low:

- '0' (0mA or unconnected) Emergency Shutdown triggered.
- '1'(≥2mA): normal operation

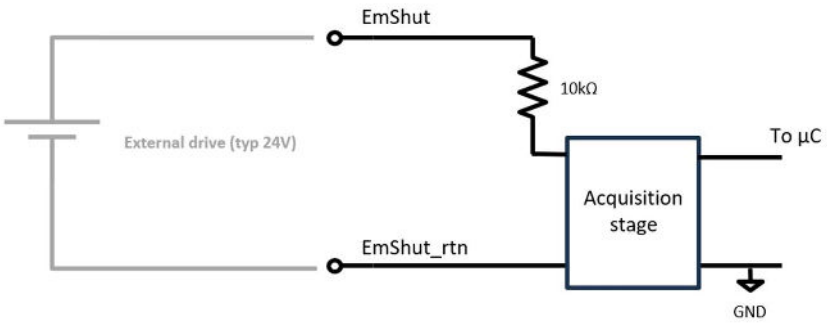


Figure 5: Typical EMS schematics

4.5 IMD - Insulation monitoring device

Mandatory for EVSE product, EVI features an Insulation Monitoring Device (IMD) that monitors continuously the insulation between DC+ and PE and between DC- and PE.
As requested by IEC61557-8 and UL 2231-1/-2 standards, this EVI feature handles detection of symmetrical and asymmetrical default between DC+/- and PE.

Through this document the term IMD is used but on some standards is referred as Ground fault detector (CHAdeMO), Earth leakage current measuring devices (IEC 61851-23 System AA) and Isolation Monitor/Interrupter (IM/I) (UL 2231-1 and UL 2231-2). They all refer to the same circuit.

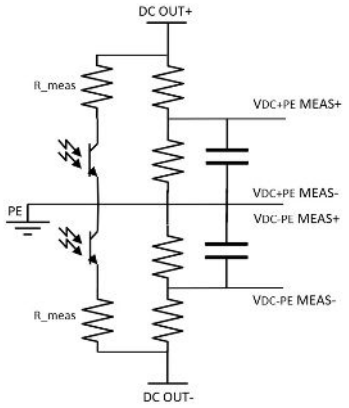


Figure 6:Insulation DC+ to PE and DC- to PE monitoring

- The IMD feature monitors the insulation resistance between the active HV PINS of the battery (BAT+ and BAT-) and the chassis ground (chassis ground).
- It complies with IEC 61557-8 standard (**see 7.5 Normative compliance**).

- EVI v3.1 complies with UL 2231-1/-2 standard, EVI v4.0 compliance to this standard is on its way (**see 7.5 Normative compliance**).

- The EVI does not provide an automatic reset function. In the event of an insulation fault delivering power to the EV stops until the supervisor resets the charging cycle.

The IMD feature includes:

- A device self-test
- Local insulation warning (Blink of Yellow LED in case of a warning, permanently ON in case of an insulation fault)
- Remote insulation warning available by CAN.
- Detection of symmetric and asymmetric insulation faults
- Continuous measurement of the insulation resistance 0…10 MΩ
- Detection of ground faults and lost ground line

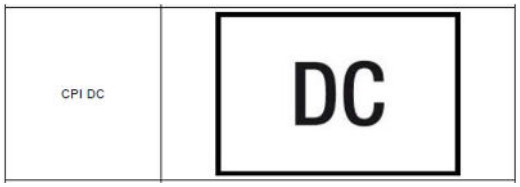


Figure 7 : DC IMD pictogram

4.6 CCS communication & interfaces

The communication between the EVI module and the Electrical Vehicle is compliant with the ISO 15118 and DIN 70121 standards for DC charge.

4.6.1 Interoperability

The EVI module is following the ISO 15118 and DIN 70121 standards and is aimed to work with all EVs supporting these standards.
Our interoperability validation strategy includes:

- Regular testing with rental vehicles and simulators
- Analysis of real life charging sessions with the thousands of EVI already used in our customer's EVSE.

It has also been validated with the ComboCS testing tool. See ComboCS datasheet: www.trialog.com/wp-content/uploads/2020/05/ComboCS_CCS-EV-Tester_Datasheet_v2.pdf.

4.6.2 Control Pilot

Implemented as specified in "IEC61851-1 A.2 Control pilot".

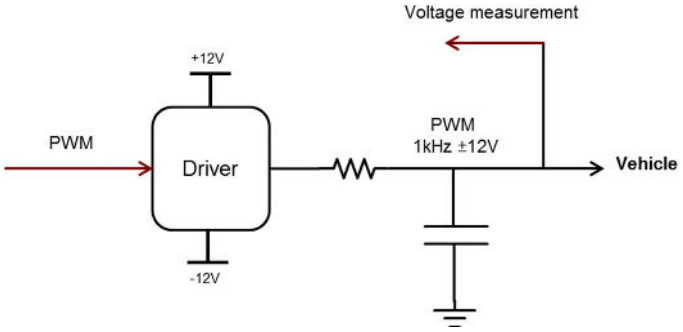


Figure 8: Control pilot

4.6.3 Proximity pilot

Proximity Pilot is used in EVCC (Electric Vehicle side controller) to detect the presence of an EVSE connector in the inlet of the vehicle.

In Combo 1 (configuration EE, mostly used in the US and Japan), it includes an optional Switch S3 for prevention of unintentional live disconnect.

In Combo 2 (configuration FF, mostly used in Europe), the resistor of the connector can be used for current coding the cable.

In both cases, proximity pilot **is not** seen by the SECC (EVSE side controller) for EVI v3.0.
But the Proximity Pilot is measured by EVI v3.1 and v4.0.

4.6.4 Temperature monitoring

Two temperature measurements channels for Pt1000 for CCS type of thermistors is available. CCS temperature measurement are done with a Wheatstone bridge as show below:

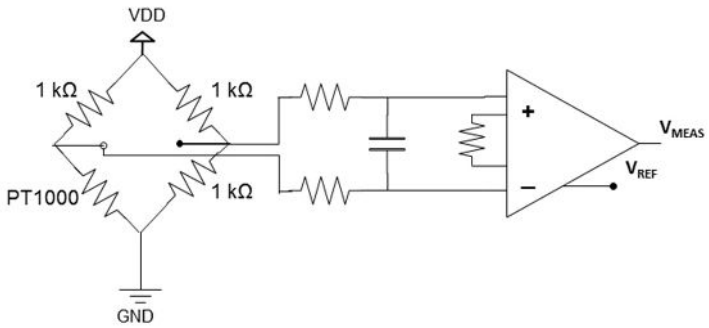


Figure 9: Wheatstone bridge for Pt1000 temperature measurement

EVI has no protection against Plug overtemperature, the temperature is measured and sent through CAN bus. It is the responsibility of EVSE to implement this overtemperature protection.

4.7 Hardware Security Module (HSM)

A HSM or secure element solution is a dedicated 3rd party secured processor and memory. It allows to store keys, to provision credentials, to secure transaction processing. It is used for device-to-device authentication, and to comply with cybersecurity normative requirements.

Table 6: ISO 15118 cybersecurity requirements for V2G and PnC charging

Normative requirement	EVI v3.0 and v3.1	EVI v4.0
ISO 15118-2		
V2G2-005: Each V2G Entity shall support Hash-operation SHA-256	✓	✓
V2G2-006: For each V2G Entity the signature operation shall be ECC-based using elliptic curves Secp256r1	✓	✓
V2G2-602: The SECC shall support: TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA256 and TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256	✓	✓
V2G2-122: Each V2G Entity shall have mechanisms to process ECDH Key exchange.	✓	✓
V2G2-835: Whenever a V2G Entity requires random numbers within this standard, a state-of-the-art Cryptographically secure random number generator shall be used.	✓	✓
ISO 15118-20		
V2G20-2318: Each V2G entity shall support SHAKE256	✓	✓
V2G20-2673: Each V2G entity shall support Hash-operation SHA-512	✓	✓
V2G20-2674: Each V2G entity shall support signature operations using ECC based elliptic curve Secp521r1		✓
V2G20-2319: Each V2G entity shall additionally support signature Operations with ECC algorithm Ed448		✓

4.7.1 For EVI v3.0 and v3.1

To answer cybersecurity requirements of ISO 15118-2: Network and application protocol requirements, the Microchip ATECC68B HSM has been chosen.
Reference: Microchip ATECC608A-MAHDA-S

4.7.2 For EVI v4.0

To answer cybersecurity requirements of ISO 15118-20: 2nd generation network and application protocol requirements, the Microchip ATECC68B HSM has been replaced by the NXP SE050 security module.
Reference: NXP SE050E2HQ1/Z01Z3Z

4.8 EVI interfaces

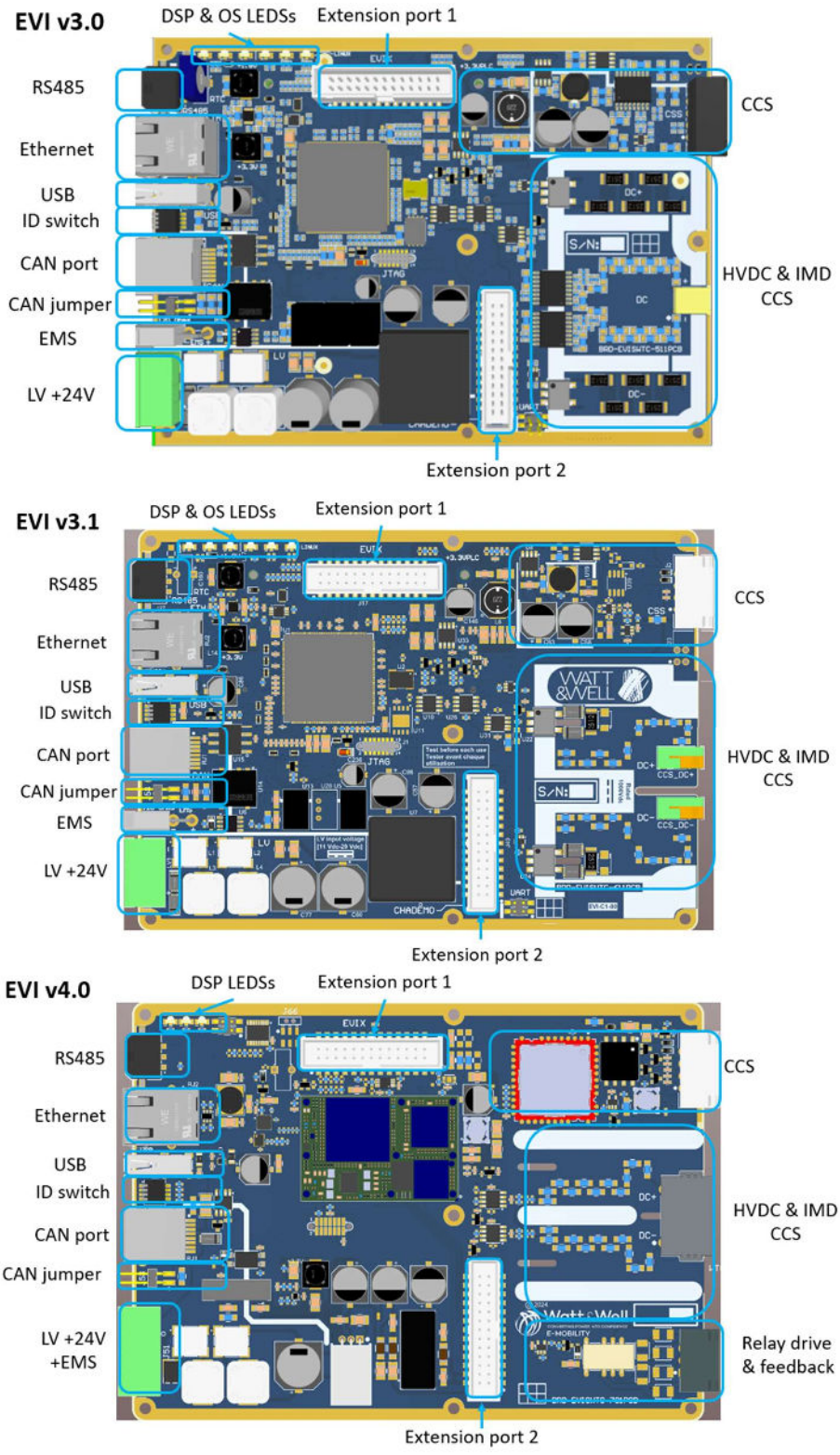


Figure 10: EVI 3.0, 3.1 and 4.0 interfaces

4.8.1 DSP & OS LEDs

Table 7: DSP LEDs for EVI v3.0, v3.1 and v4.0

LED color	LED behavior	DESCRIPTION
Blue	on	Charging
	blinking	Pre-charge states
Yellow	on	IMD fault
	blinking	IMD warning
Red	on	Error or EMS

Table 8: OS LEDs for EVI v3.0 and v3.1

LED color	LED behavior	DESCRIPTION
Blue	RFU	-
Yellow	blinking	Higher frequency means higher CPU charge
Red	RFU	-

4.8.2 LV - Low voltage connector

4.8.2.1 For EVI v3.0 and v3.1

LV connector is used to supply power to EVI board and EVIX if installed.
Connector Reference (converter side): Phoenix Contact MSTBA 2,5/ 2-G-5,08 1757242.
Recommended mating connectors (wire harness side):

- FKC 2,5/ 2-ST-5,08 1873058 (Push-in spring connection)
- MSTBP 2,5/ 2-ST-5,08 – 1769010 (Screw connection)

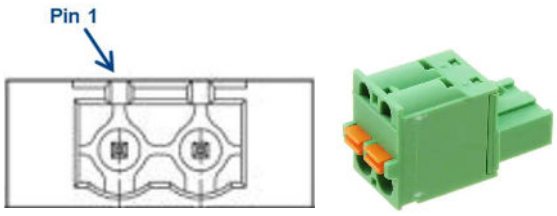


Figure 11: Low voltage mating connector for EVI v3.0 and v3.1

Table 9: LV pinout for EVI v3.0 and v3.1

PIN	FUNCTION	DESCRIPTION
1	LV_IN-	Low Voltage supply return
2	LV_IN+	Low Voltage supply

4.8.2.2 For EVI v4.0

Connector Reference: Phoenix Contact MSTBA 2,5/ 3-GF-5,08 1776511.

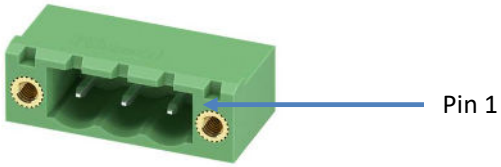


Figure 12: Low voltage connector for EVI v4.0

Recommended mating connector: Phoenix Contact MSTBA 2,5/ 3-GF-5,08 1757022

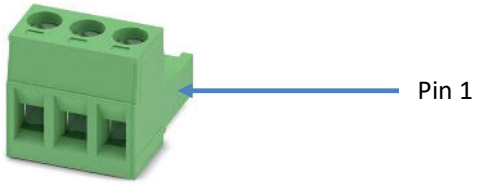


Figure 13: Low voltage connector for EVI v4.0

Table 10: LV pinout for EVI v4.0

PIN	FUNCTION	DESCRIPTION
1	EMS_SHUT +	EMS positive polarity
2	LV_IN- = PE	Low Voltage supply return internally connected to PE
3	LV_IN+	Low Voltage supply

4.8.3 Ethernet port

An Ethernet 100Mbit RJ45 port connected to embedded Linux is available on EVI.

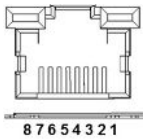


Figure 14 : Ethernet connector

Table 11: Ethernet connector pinout

PIN	FUNCTION	DESCRIPTION
1	ETH1_TX_P	Ethernet TX Differential Output (plus)
2	ETH1_TX_N	Ethernet TX Differential Output (minus)
3	ETH1_RX_P	Ethernet RX Differential Input (plus)
4	Not connected	-
5	Not connected	-
6	ETH1_RX_N	Ethernet RX Differential Input (Minus)
7	Not connected	-
8	Not connected	-

4.8.4 RS485 port

EVI provide RS485 half-duplex port for interface with external devices.
Connector Reference (board side): Molex 436500312

Figure 15: Molex – 436500312

Table 12: RS485 connector pinout

PIN	FUNCTION	DESCRIPTION
1	RS485_A	Half duplex RS485, Signal A
2	GND	Ground
3	RS485_B	Half duplex RS485, Signal A

Recommended mating connector: Molex 1718500300

Figure 16: 1718500300

4.8.5 USB port

USB port is an USB A standard type.

They are not designed to handle any mechanical effort, and any force exerted on them beyond their designed limits can result in damage to the device.
To avoid damaging USB connectors, please:

- Do not force the connector into the port. Make sure it is aligned correctly before plugging it in.
- Keep your USB cables organized and avoid tangling them to prevent unnecessary stress on the connector.
- Avoid exposing the connector to extreme temperatures, water, dust, or other contaminants.

4.8.6 COM connector

EVI features a galvanically isolated CAN bus for digital communications with other boards.

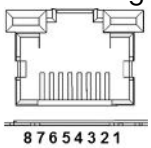


Figure 17 : COM connector (simple RJ45) front view

Table 13: COM connector pinout

PIN	FUNCTION	DESCRIPTION
1	CANA H	CAN differential +
2	CANA L	CAN differential -
3	CAN_GND	Ground reference for CAN
4	EmShut_Rtn = PE	Emergency Shutdown return line (negative) internally connected to PE
5	EmShut	Emergency Shutdown (positive)
6	Not connected	-
7	CAN_GND	Ground reference for CAN
8	ES_R/W	Read/Write pin in case of daisy chained W&W products **(Mandatory to keep floating)**

4.8.7 CAN 120Ω jumper

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 line that match this 120 Ω.
EVI includes a 120Ω resistor in series with a 2.54mm jumper allowing the user to adapt if needed the bus with termination resistor:

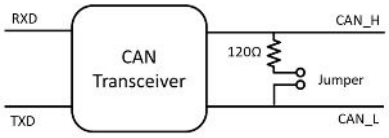


Figure 18: CAN transceiver simplified diagram

Figure 19: CAN jumper (2.54mm)

Note on CAN bus shield: Although ISO-11898-2 does not specify the wires type or the need for a shield, a shielded cable is recommended for electronically harsh environments. It is recommended to ground the shield at a single point on the dedicated Shield pin of the COM connector to avoid ground loops.
Also, remember that the CAN bus being isolated, the CAN_GND should be wired between nodes (preferred) or connected to Protective Earth (less recommended for long distances).

Recommended connection for CAN bus: EVI uses a common CAN pinout for RJ45 connectors. Some commercial CAN transceiver uses a 9 pin Sub-D socket connector (also known as female DB9 header) as interface. The recommended adaptor pinout is as follows:

Table 14: Recommended pinout for a CAN RJ45 to DB9 adaptor

Signal Name	Pin in EVI COM connector	Pin in DB9 (female)
CAN_H	1	7
CAN_L	2	2
CAN_Ref	3	3
CAN_Shield	6	5

4.8.8 EMS - Emergency Shutdown for EVI v3.0 and 3.1

The COM connector also transmits an optional **Emergency Shutdown** (EmShut) signal. This signal can be used to trigger an unconditional shutdown of the EVI operation.
For EVI v4.0, the EMS is merged with the LV within a single connector, see LV For EVI v4.0
See Table 13 for the pinout of EmShut within the COM connector.

EmShut logic is active low

- '0' (0mA or unconnected) Emergency Shutdown triggered.
- '1'(≥2mA): normal operation

Connector Reference (board side): Molex 026013127

Figure 20: Molex – 026013127

Table 15: Emergency Shutdown connector description

PIN	FUNCTION	DESCRIPTION
1	EMS_SHUT -	EMS negative polarity
2	EMS_SHUT +	EMS positive polarity

Recommended mating connector (wire harness side): 39012020 (housing[1]) and 39000207 (Crimp Terminal 18-24 AWG / 0.82-0.2mm²)

[1] Housing with UL 94 V-2 rating. If V-0 rating is required, use 39012025

4.8.9 CCS port

Two connectors are required for CCS charging: one for communication signals (CCS port) and another for battery voltage measurement and IMD (see HVDC connector)
Connector Reference (converter side): DEGSON 15EDGRHCM-THR-3.5-08P
Recommended mating connector (wire harness side): DEGSON 15EDGKNHM-3.5-08P

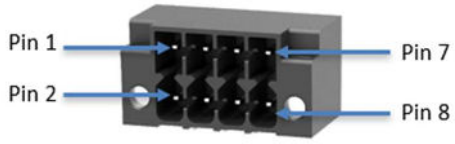


Figure 21: Combo connector (DEGSON 15EDGRHCM-THR-3.5-08P)

Table 16: COMBO main connector pin description

PIN	FUNCTION	DESCRIPTION
1	RFU	Reserved for Future Use
2	PE	Protective Earth
3	Temp 1 +	Temperature 1+ - DC connector
4	Temp 1 -	Temperature 1- - DC connector
5	Temp 2-	Temperature 2- - DC connector
6	Temp 2+	Temperature 2+ - DC connector
7	PP	Proximity pilot
8	CP	Control Pilot

4.8.10 HVDC CCS connector

4.8.10.1 For EVI v3.0

Connector reference: SM02B-BHSS-1-TB from JST
Recommended mating connector: BHSR-02VS-1(N) (Housing) + SBHS-002T-P0.5A (Contact)

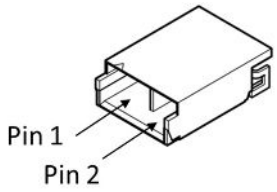


Figure 22: HVDC CCS connector (reference SM02B-BHSS-1-TB)

Table 17: HVDC CCS connector description for EVI v3.0

PIN	FUNCTION	DESCRIPTION
1	HVDC_CCS-	HV DC negative polarity
2	HVDC_CCS +	HV DC positive polarity

4.8.10.2 For EVI v3.1

Connector reference: Phoenix Contact FFKDSA1/H-6,35 1789634
Two of these single pin connectors are used for the HV DC. One per polarity as showed with the screen printing on the board.

No conducting parts should be in contact with IMD board edge and should be space at a minimum of 1.5mm.

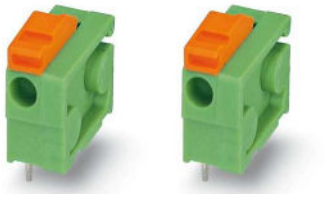


Figure 23: Two Phoenix Contact FFKDSA1/H-6,35 1789634 connectors

4.8.10.3 For EVI v4.0

Connector Reference (board side): DEGSON 9EDGRB-7.62-02P

Figure 24: DEGSON 9EDGRB-7.62-02P

Recommended mating connector: DEGSON 9EDGKD-7.62-03P

Figure 25: DEGSON 9EDGKD-7.62-03P

Table 18: HVDC CCS connector description for EVI v4.0

PIN	FUNCTION	DESCRIPTION
1	HVDC_CCS-	HV DC negative polarity
2	Not connected	-
3	HVDC_CCS +	HV DC positive polarity

4.8.11 Relay connector for EVI v4.0

Connector Reference: DEGSON 15EDGRHCM-THR-3.5-06P

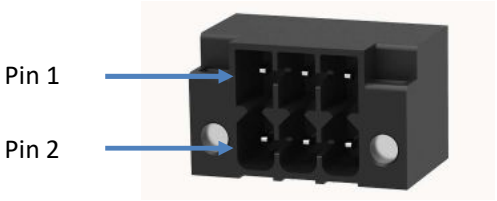


Figure 26: DEGSON 15EDGRHCM-THR-3.5-06P

Recommended mating connector: DEGSON 15EDGKNHM-3.5-06P

Table 19: Relay connector pinout and description

PIN	FUNCTION	DESCRIPTION
1	NC_1	Normally closed 1
2	NC_0	Normally closed 0
3	COM_1	Common node 1
4	COM_0	Common node 0
5	NO_1	Normally open 1
6	NO_0	Normally open 0

The 2 sets of contacts (_0 and _1) of this relay connector are driven by the same signals.

4.8.12 MIPI-DSI adapter for EVI v4.0

EVI v4.0 supports MIPI-DSI touch screens.

Support for the Riverdi RVT101HVDNWN00 is planned.

RGB888 display connector is under consideration for fully pinned header connection.

Support for specific display can be added, please contact us.

Table 20: MIPI-DSI adapter pinout

PIN	FUNCTION	DESCRIPTION
1	GND	Ground
2	GND	Ground
3	DSI DATA0 P	Display data lane 0 +
4	DSI DATA0 N	Display data lane 0 -
5	GND	Ground
6	GND	Ground
7	DSI DATA1 P	Display data lane 1 +
8	DSI DATA1 N	Display data lane 1 -
9	GND	Ground
10	GND	Ground
11	DSI CLK P	Clock +
12	DSI CLK N	Clock -
13	GND	Ground
14	GND	Ground
15	DSI DATA2 P	RFU
16	DSI DATA2 N	RFU
17	GND	Ground
18	GND	Ground
19	DSI DATA3 P	RFU
20	DSI DATA3 N	RFU
21	GND	Ground
22	GND	Ground
23	GND	Ground
24	GND	Ground
25	Vref	3.3 V
26	Vref	5 V
27	GND	Ground
28	GND	Ground
29	DSI I2C SCL	I2C Clock
30	DSI I2C SDA	I2C Serial Data
31	VIOUT	3.3 V
32	GND	Ground
33	Secure I2C.INT	I2C Interrupt
34	PWM Backlight	PWM signal for backlight
35	Reset_disp	Reset signal
36	DSI_TE	GPIO
37	Vin	24V typ, min 3V, MAX 36V, 6W
38	GND	Ground
39	Vin	24V typ, min 3V, MAX 36V, 6W
40	GND	Ground

4.9 EVIX-AD6 – Addressing extension board

EVIX-AD6 provides 6 addressing connector on RJ45 format compatible with MPU-R3 power unit. This extension board is available for EVI v3.0 and v3.1 but not for v4.0.

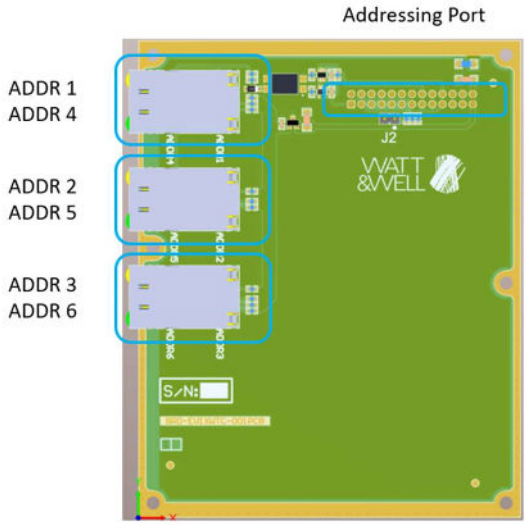


Figure 27: EVIX-AD6 board

4.9.1 Installation

Please ensure mechanical and grounding connection by connecting fixation holes to chassis.

4.9.2 Address selector and Charge Permission.

For better understanding the following part, please make sure to have read the MPU-25 datasheet available on demand.

Each MPU-25 takes its CAN **address** at boot based on the Addressing connector on the front panel.

Table 21: MPU addresses when connected to EVIX

Address	CAN ID
0 (000)	86
1 (001)	80
2 (010)	81
3 (011)	82
4 (100)	83
5 (101)	84
6 (110)	85
7 (111) or unconnected	86

Up to 7 units can be addressed with 3 DSI (digital signal inputs). Default value of each unconnected line is logic '1'.
To address automatically MPU-25 at power boot, EVIX board proposes 6 addresses RJ45 output compatible with MPU-25 standard (address 1 to 6).

The addressing connector also transmits an optional DSI (digital signal input) "**Charge Permission"** meant for CHAdeMO compatibility. This extension board is designed to work with CCS Charge points, therefore it's permanently set to 1 to disable the Charge Permission Feature.

4.9.3 Addressing interfaces

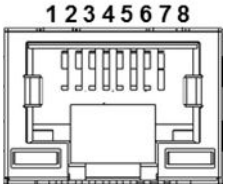


Figure 28: Addressing connector (RJ45) front view

Table 22: Addressing connector pinout

PIN	FUNCTION	DESCRIPTION
1	ADDR bit 0 signal	Address bit 0 (positive)
2	ADDR bit 0 return	Address bit 0 return (negative)
3	ADDR bit 1 signal	Address bit 1 (positive)
4	ADDR bit 1 return	Address bit 1 return (negative)
5	ADDR bit 2 signal	Address bit 2 (positive)
6	ChargePerm_RTN	Charge Permission return (negative)
7	ChargePerm	Charge Permission (positive)
8	ADDR bit 2 return	Address bit 2 return (negative)

EVIX-AD6 extension board contains 6 RJ45 ports used to address Power Unit with different addresses.
The port are numerated from ADDR1 to ADDR6 and place as below:

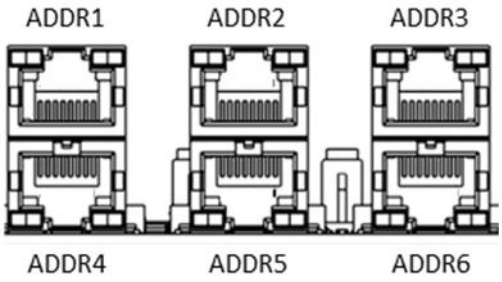


Figure 29: Addressing ports ADDR1 to ADDR6

The bit allocation is the following:

PORT \ PIN	ADDR0	ADDR0_RTN	ADDR1	ADDR1_RTN	ADDR2	ADDR2_RTN
ADDR1	**5V**	GND	GND	GND	GND	GND
ADDR2	GND	GND	**5V**	GND	GND	GND
ADDR3	**5V**	GND	**5V**	GND	GND	GND
ADDR4	GND	GND	GND	GND	**5V**	GND
ADDR5	**5V**	GND	GND	GND	**5V**	GND
ADDR6	GND	GND	**5V**	GND	**5V**	GND

4.10 EVIX-AD14 – Addressing extension board

EVIX-AD14 provides 14 addressing connectors in RJ45 format compatible with MPU-R3 & MPU-R2 power units.

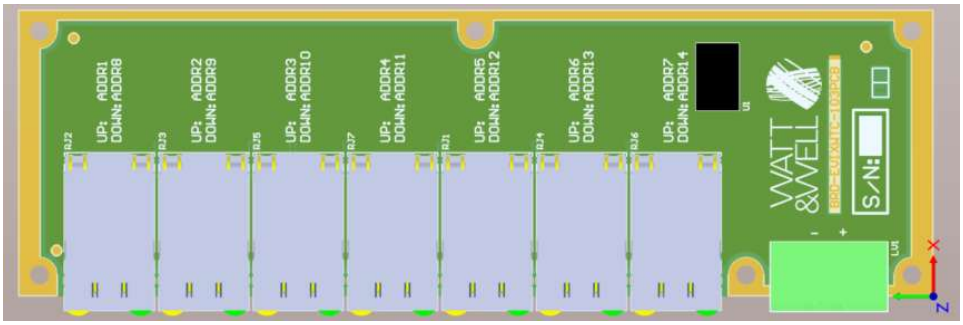


Figure 30: EVIX-AD14 board.

4.10.1 Installation

Please ensure mechanical and grounding connection by connecting fixation holes to chassis.

4.10.2 Address selector and Charge Permission.

For better understanding and more information about this section please make sure to read the MPU-R3 (available on demand) and MPU-R2 (MPU-R2-920-100-FD-datasheet.pdf) datasheets.

Each MPU-Rx takes its CAN address at boot based on the Addressing connector on the front panel.

Up to 14 units can be addressed with 3 DSI (digital signal inputs) and duty-cycles values.
To address automatically MPU-Rx at power boot, EVIX-AD14 board proposes 14 addresses RJ45 output compatible with MPU-Rx standard.

The addressing connector also transmits an optional DSI (digital signal input) "**Charge Permission"** meant for CHAdeMO compatibility. This extension board is designed to work with CCS Charge points only, therefore it's permanently set to 1 to disable the Charge Permission Feature.

Table 23: MPU addresses when connected to EVIX-AD14

Address	ADDR Bit 2	ADDR Bit 1	ADDR Bit 0	CAN ID
Not connected	0%	0%	0%	111
ADDR1	0%	0%	100%	80
ADDR2	0%	100%	0%	81
ADDR3	0%	100%	100%	82
ADDR4	100%	0%	0%	83
ADDR5	100%	0%	100%	84
ADDR6	100%	100%	0%	85
ADDR7	100%	100%	100%	86
ADDR8	0%	0%	50%	87
ADDR9	0%	50%	0%	88
ADDR10	0%	50%	50%	89
ADDR11	50%	0%	0%	90
ADDR12	50%	0%	50%	91
ADDR13	50%	50%	0%	92
ADDR14	50%	50%	50%	93

4.10.3 Addressing interfaces

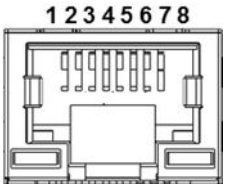


Figure 31: Addressing connector (RJ45) front view

Table 24: Addressing connector pinout

PIN	FUNCTION	DESCRIPTION
1	ADDR bit 0 signal	Address bit 0 (positive)
2	ADDR bit 0 return	Address bit 0 return (negative)
3	ADDR bit 1 signal	Address bit 1 (positive)
4	ADDR bit 1 return	Address bit 1 return (negative)
5	ADDR bit 2 signal	Address bit 2 (positive)
6	ChargePerm_RTN	Charge Permission return (negative)
7	ChargePerm	Charge Permission (positive)
8	ADDR bit 2 return	Address bit 2 return (negative)

EVIX-AD6 extension board contains 14 RJ45 ports used to address Power Unit with different addresses. The ports are numerated from ADDR1 to ADDR14 and place as below:

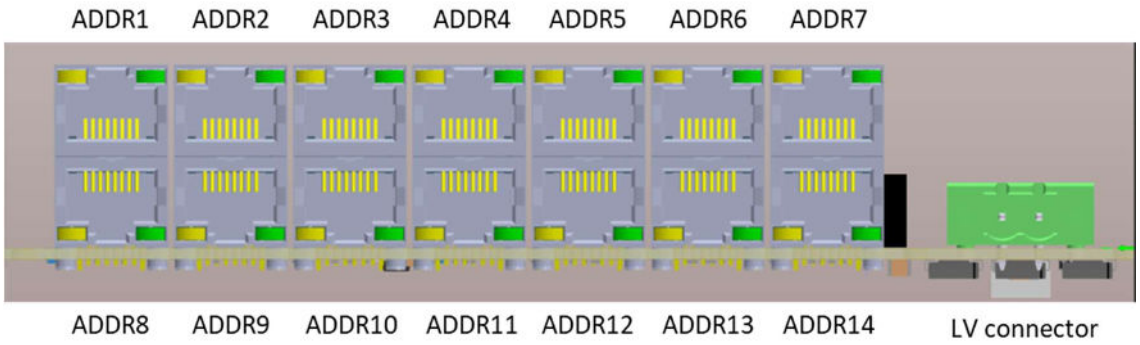


Figure 32: Addressing ports ADDR1 to ADD14 + LV connector

4.11 EVIX-AD6-CHA – Addressing and CHAdeMO extension board

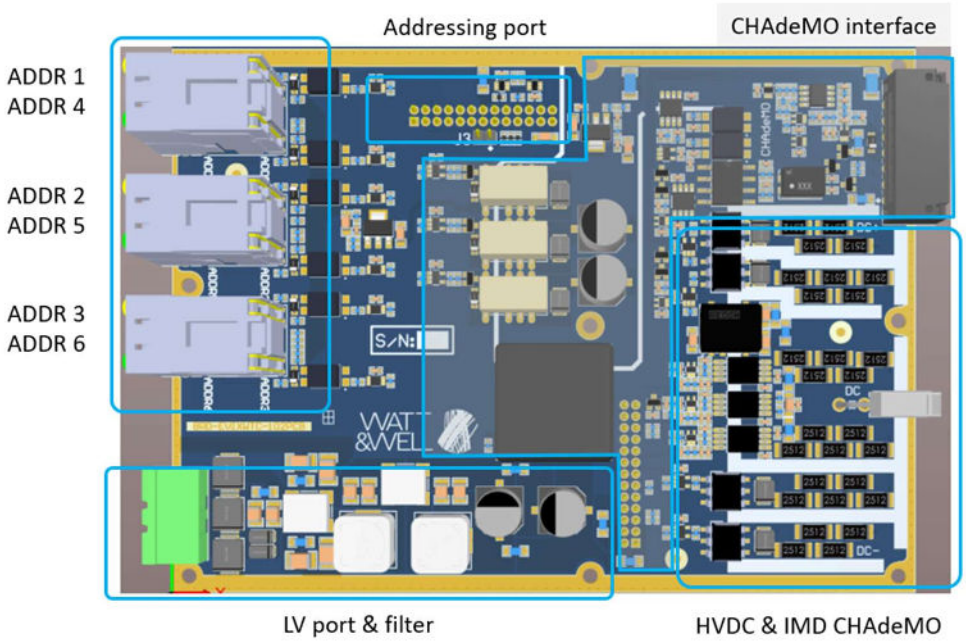


Figure 33: CHAdeMO extension board

4.11.1 Installation

Please ensure mechanical and grounding connection by connecting fixation holes to chassis. This extension board is available for EVI v3.0 and v3.1 but not for v4.0.

4.11.2 Communication

The communication between the EVI module and the EV is compatible with CHAdeMO normative specifications from versions 0.9 to 1.2.
The CAN bus is galvanically isolated for enhanced EMC and resilience. It complies with

- Standard: ISO11898-1, ISO11898-2
- Protocol: CAN 2.0B Active
- Baud-rate: 500kbps
- Bit sample point: 72.5% to 87.5%

4.11.3 Interoperability

The EVI module is compatible with the CHAdeMO standard and is working will all EVs supporting this standard.
It has been validated with the following EVs: Tesla model S 2013, Nissan Leaf, Nissan NV200.

4.11.4 Addressing interfaces

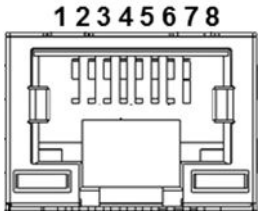


Figure 34: Addressing connector (RJ45) front view

Table 25: Addressing connector pinout

PIN	FUNCTION	DESCRIPTION
1	ADDR bit 0 signal	Address bit 0 (positive)
2	ADDR bit 0 return	Address bit 0 return (negative)
3	ADDR bit 1 signal	Address bit 1 (positive)
4	ADDR bit 1 return	Address bit 1 return (negative)
5	ADDR bit 2 signal	Address bit 2 (positive)
6	ChargePerm_RTN	Charge Permission return (negative)
7	ChargePerm	Charge Permission (positive)
8	ADDR bit 2 return	Address bit 2 return (negative)

Since this part of the extension board is dedicated to addressing, it can also address Combo systems on top of CHAdeMO systems. On Combo systems, Charge Permission output is emulated by an "always enabled" level. This allows the support of systems with dual CHAdeMO and Combo outlets. Optionally, the charge permission functionality can be used for a secure Emergency Shutdown propagation in systems with multiple outputs to avoid shutting down the whole installation.

EVIX-AD6-CHA extension board contains 6 RJ45 ports used to address Power Unit with different addresses.
The ports are numerated from ADDR1 to ADDR6 and place as below:

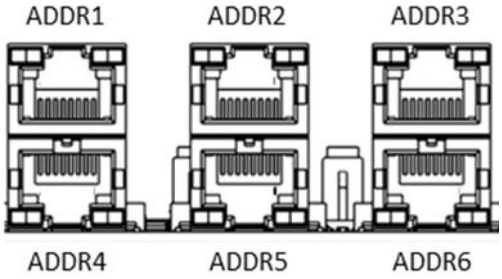


Figure 35: Addressing ports ADDR1 to ADDR6

The bit allocation is the following:

PORT \ PIN	ADDR bit 0 signal	ADDR bit 0 return	ADDR bit 1 signal	ADDR bit 1 return	ADDR bit 2 signal	ADDR bit 2 return
ADDR1	**5V**	GND	GND	GND	GND	GND
ADDR2	GND	GND	**5V**	GND	GND	GND
ADDR3	**5V**	GND	**5V**	GND	GND	GND
ADDR4	GND	GND	GND	GND	**5V**	GND
ADDR5	**5V**	GND	GND	GND	**5V**	GND
ADDR6	GND	GND	**5V**	GND	**5V**	GND

4.11.5 Charge Permission - Switch K

Charge Permission is a mandatory safety function for CHAdeMO systems (System A in IEC 61851-23) also known as Charging Enable/Disable or CP3.
It is required that the charger shall stop charging when it receives a stop instruction by either 'control signal' or 'CAN communication'. To process the stop instruction without fail, the 'vehicle charge permission' line of the control signal circuit shall directly be connected to the inverter circuit of the charger, and charging shall be securely stopped by terminating the inverter circuit compulsorily without interposing process of any circuit medium such as CPU if the 'vehicle charge permission' line is changed to OFF.

As such, EVI board transmits the Charge Permission signal sent by the vehicle to the charger rectifier

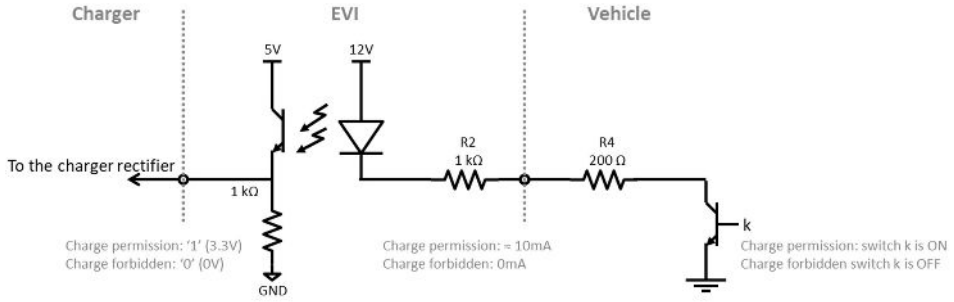


Figure 36: Charge Permission acquisition from EV and transfer to charger

In systems with multiple charging points (or 'outlets') and multiple charging rectifiers, transfer of the charger permission to correct rectifier (the one powering the active outlet) is supported with the extension board. Without CPU intervention (DSP software), EVIX propagates the Charger Permission signal based on the state of the switches.

4.11.6 Plug Lock feature.

Lock signal is used to lock/unlock Power connector of Vehicle to Charger mechanically. Lock monitoring of connector is done by measuring current going through Lock + and Lock-.

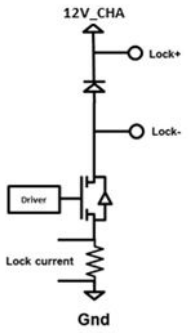


Figure 37: Lock control and monitoring

Lock current is monitored and depending on its value the lock flag wil have the following value:

To determine if EVSE CHAdeMO plug is well locked in EV , the lock current measurement shall be between 0.25A and 0.5A (EV Lock Flag = 1) , otherwise, plug is not well locked and EV Lock Flag will have 0 value.
Please note that HW compatibility tests have been done with CHAdeMO plug reference JAE KW1CGY10PDL0500E.

4.11.7 Proximity detection

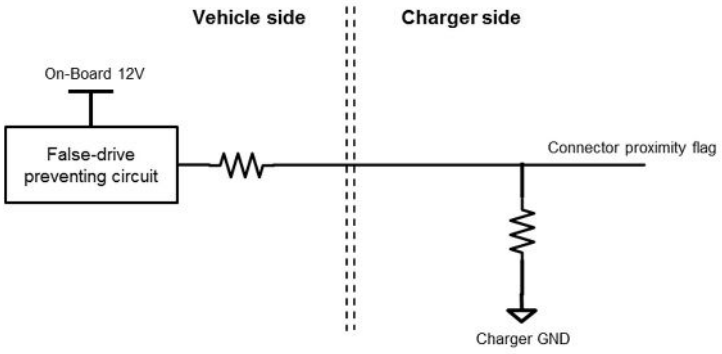


Figure 38: Proximity detection principle

4.11.8 Temperature monitoring

Two temperature measurements channels for NTC type thermistors are available.
The expected NTC thermistors shall have following characteristics:

- R25: 50000Ω
- B: 3760

NTC reference example: "B57861S0503+040" from TDK

4.11.9 CHAdeMO interfaces

Two connectors are required: one for communication signals (main connector) and another for battery voltage measurement and IMD (HV DC connector)

4.11.9.1 Main connector:

Connector Reference (converter side): DEGSON 15EDGRHCM-THR-3.5-14P
Recommended mating connector (wire harness side): DEGSON 15EDGKNHM-3.5-14P

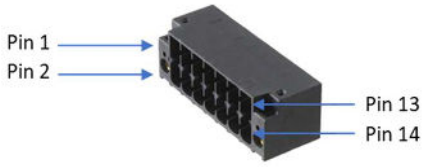


Figure 39: CHAdeMO connector (DEGSON 15EDGRHCM-THR-3.5-14P)

Table 26: CHAdeMO main connector description

PIN	FUNCTION	DESCRIPTION
1	CAN_CHA_H	CAN High signal
2	+12V_ISO	+12V Isolated
3	CHARGE PERM	Charge Permission
4	CAN_CHA_L	CAN Low signal
5	CHARGE_SEQ1	Charge Sequence 1
6	PROX_DET_CHA	Proximity Detection
7	CHARGE_SEQ2	Charge Sequence 2
8	LOCK+	Plug Lock+
9	LOCK-	Plug Lock -
10	Temp 1 -	Temperature 1- - DC connector
11	Temp 1 +	Temperature 1+ - DC connector
12	Temp 2+	Temperature 2+ - DC connector
13	Temp 2-	Temperature 2- - DC connector
14	PE	Protective Earth

4.11.9.2 HV DC voltage measurements connector:

Table 27: CHAdeMO HVDC connector description

PIN	FUNCTION	DESCRIPTION
1	HV_DC_CHA+	HV DC positive polarity
2	HV_DC_CHA-	HV DC negative polarity

Connector Reference (board side): Molex 026013127
Recommended mating connectors (wire harness side): 39012020 (housing[1]) and 39000207 (Crimp Terminal 18-24 AWG / 0.82-0.2mm²)

Figure 40: Molex – 026013127

4.12 EVIX-IO – Peripheral expander extension

EVIX-IO is an extension board that can be plugged into EVI boards (EVI v3 and after) to extend the peripheral with additional GPIOs, analog inputs, 4G access, PWM outputs, LEDs and an extra CAN bus.

Some of these peripheral needs external power supply that can be provided by dedicated pins on J6,J7 and J8 connectors having the same return named GND:

- V_DSO_PWR: external supply for digital outputs where power is requested (i.e. relay drive).
- V_PWM_PWR: external supply for output PWM type with potential power needed (i.e. FAN).
- V_DSO: external supply for digital outputs.

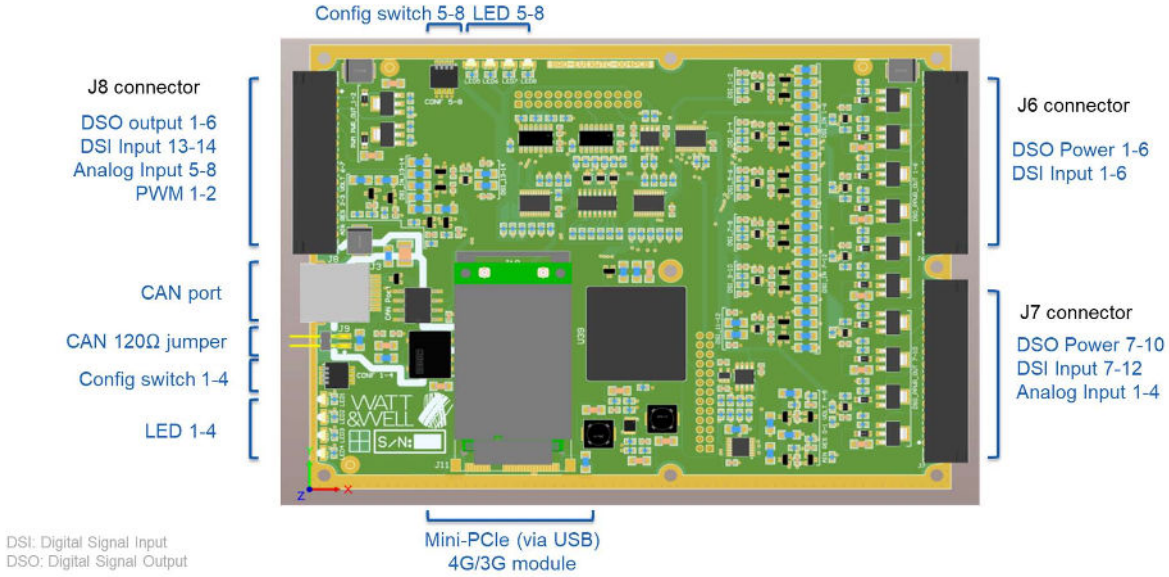


Table 28: EVIX-IO interfaces

Name	Type	Application	Quantity
DSO Power	High current digital output	Relay or contactor coil drive	10
DSI Input	Pulled-up digital input	Reading of button state or contactor auxiliary contact state	14
PWM	High current PWM output	FAN drive*	1-2*
DSO Output	Digital output	Logic signal output	6
Analog Input - Resistor	Input for resistor value measurement	Resistor meas. (thermistors for ex.)	4
Analog Input - Voltage	Input for voltage value measurement	Voltage measurement	4
LED	Output LEDS	Visual signals	3 red, 3 blue, 2 yellow
Config switch	Configuration switch (piano)	System configuration	8

*For EVI v3.0 and v3.1, one PWM output is fully functional, two PWM can be driven only with the same frequency.
For EVI v4.0, two PWM outputs are functional and can be driven independently.

For access to these peripherals of EVIX-IO through Embedded Linux, please refer to “EVI-AN005-Technical Reference Manual” document.

4.12.1 Electrical Characteristics

All specifications are given for the full temperature range unless otherwise noted.

Table 29: Electrical characteristics

Parameter	Condition	Value			Units
		Min	Typ	Max	
DSO Power					
V_DSO_PWR voltage		0	24	30	V
V_DSO_PWR current			2	4	A
DSI Inputs					
Input voltage range		0	24	30	V
Low Input threshold		1.25	1.5	2.25	V
High Input threshold		2.05	2.8	3.4	V
DSO Outputs					
V_DSO voltage		0	24	30	V
V_DSO current	Single output used. Several outputs used.			0.5 0.1	A
PWM outputs					
V_PWM_PWR voltage		0	24	30	V
V_PWM_PWR current				4	A
PWM frequency		0	10	30	kHz
Analog inputs					
AIN_RES input voltage range	Polarized by 4.096V Vref and 11kΩ resistor			4.096	V
AIN_RES Cutoff frequency			10		Hz
AIN_VOLT input voltage range		0		30	V
AIN_VOLT Cutoff frequency			10		Hz
CAN port					
CAN baud rate		0	500	1000	Kbps
CAN common mode range		-7		7	V

4.12.2 Installation

Please ensure mechanical and grounding connection by connecting fixation holes to chassis.

4.12.3 DSO Power

DSO Power outputs are designed for driving components that require driving voltage between [0-30V] and driving current capability up to 4A, such as relays or contactors.

DSO_PWR_CMD_# are accessible on EVI embedded Linux as GPIO and can then be set High or Low. As indicated on EVIX-IO introduction, V_DSO_PWR must be provided by external means.

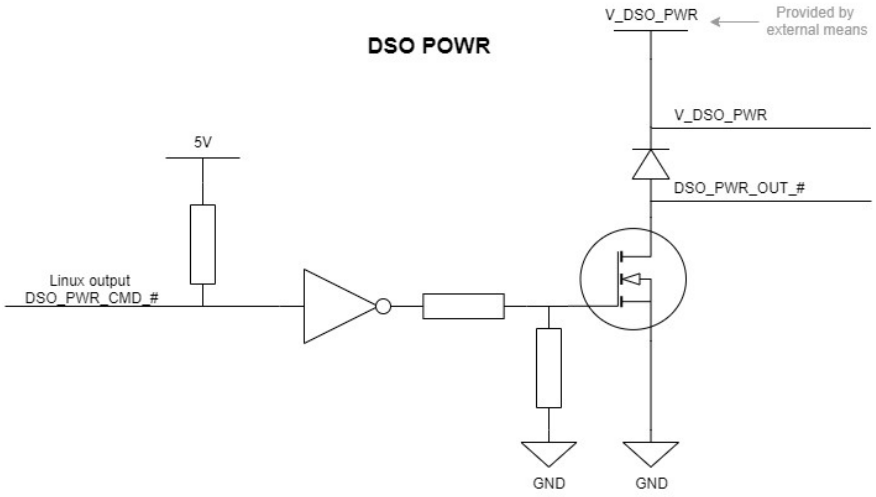


Figure 41: DSO PWR block diagram

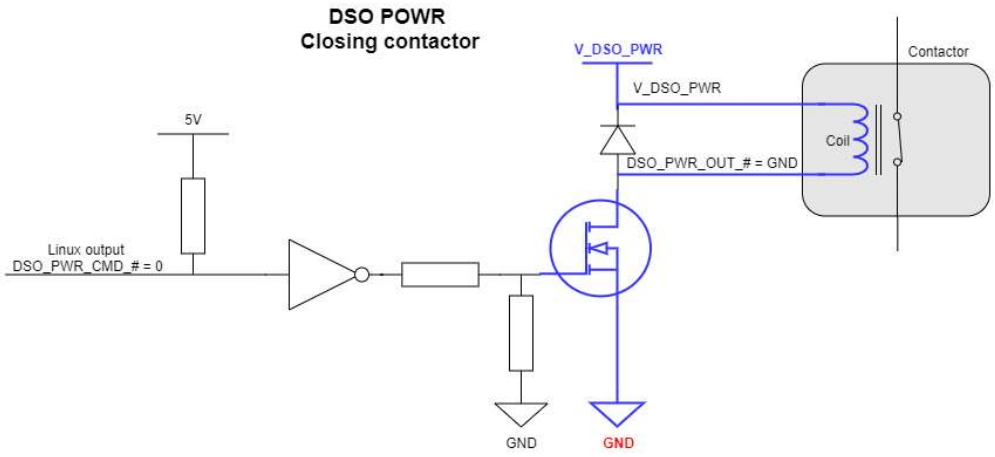


Figure 42: Driving contactor by setting GPIO to Low

4.12.4 DSI Inputs

EVIX-IO board provides 14 Digital Signal Inputs with input voltage range up to 30V.
Low Input threshold is 1.5V and High input threshold is 2.8V.
DSI input value can be read as GPIO on Embedded Linux.

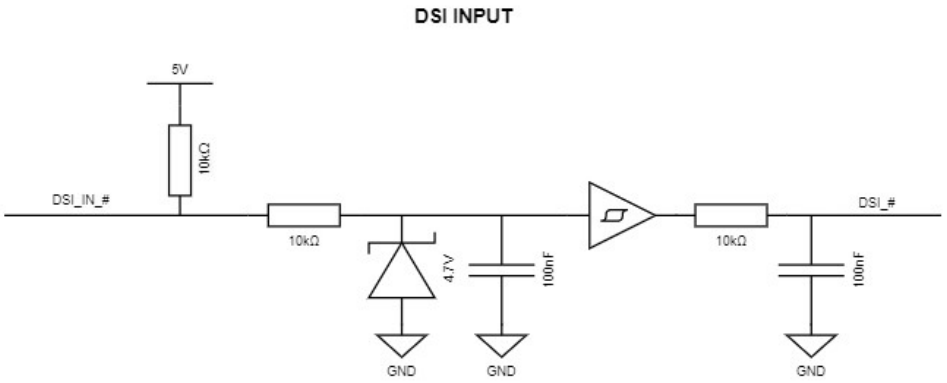
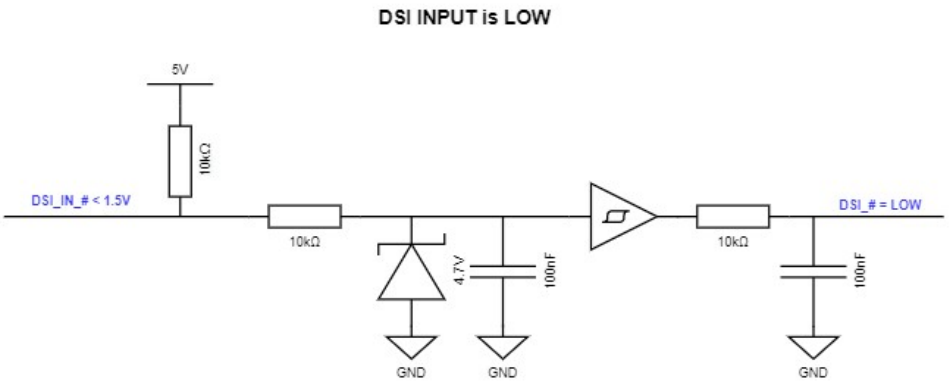
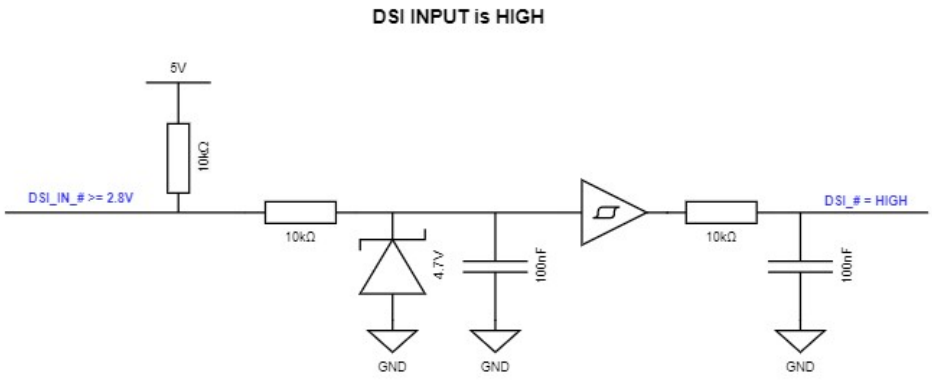


Figure 43: DSI input block diagram





4.12.5 DSO Outputs

DSO outputs are designed for driving components that require driving voltage between [0-30V] and driving current capability up to 0.1A, such as button, LEDS and other low power.

DSO_CMD_# are accessible on EVI embedded Linux as GPIO and can then be set High or Low. As indicated on EVIX-IO introduction, V_DSO must be provided by external means.

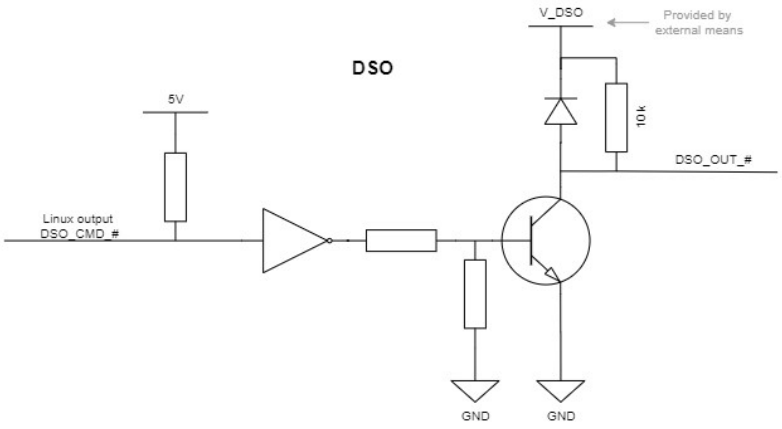
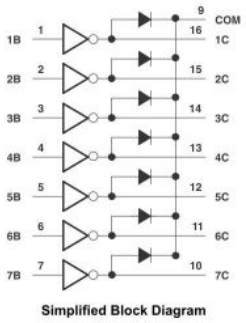


Figure 44: DSO outputs block diagram.

Please refer to ULN2003AI component datasheet for further information about maximum collector current.



Simplified Block Diagram

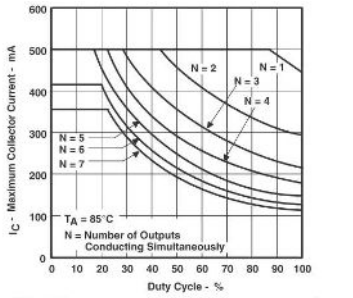
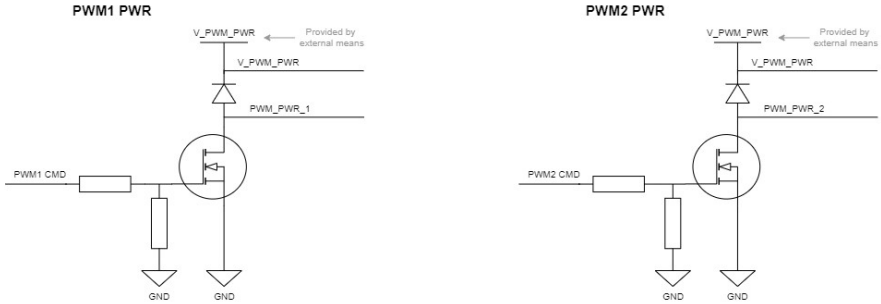


Figure 6-5. N Package Maximum Collector Current vs Duty Cycle

4.12.6 PWM Outputs

EVIX-IO offers 2 PWM outputs with maximum frequency of 30kHz.
These outputs can be used for example for driving FAN.



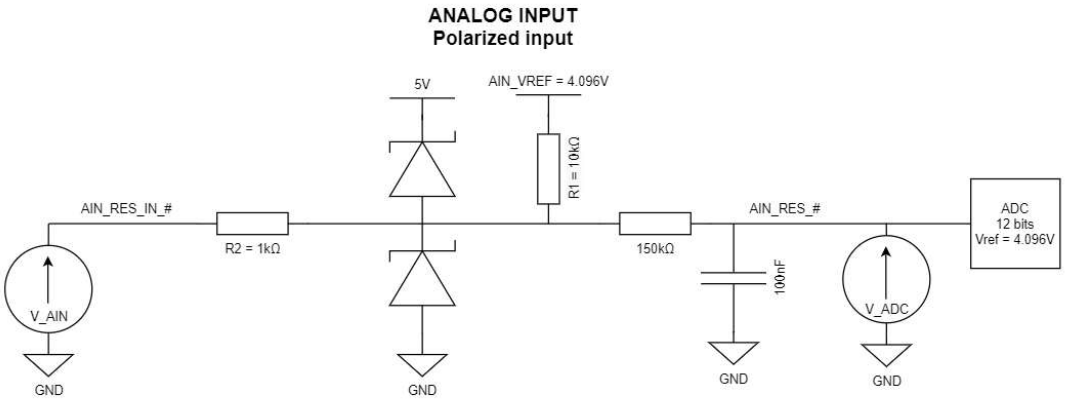
4.12.7 Analog Inputs

EVIX-IO provides 2 types of analog inputs:

- Analog Input – Resistor: analog inputs that are polarized.
- Analog Input – Voltage: analog inputs that are not polarized and have a resistor voltage divider.

These analog measurements are available on Embedded Linux. For further details, please refer to "EVI-AN005-Technical Reference Manual" document.

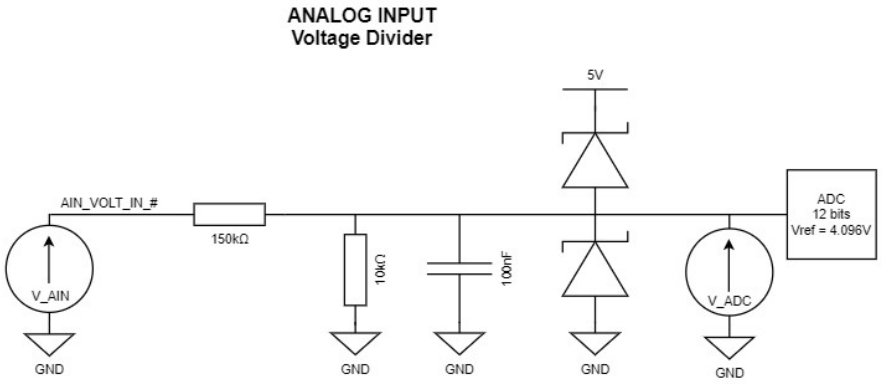
4.12.7.1 Analog Input – Resistor



By providing polarization to analog input with AIN_VREF=4.096V, this block allows measurement of passive components as resistors.
Formula to calculate analog input VAIN from ADC input VADC:

$$V_{AIN\_RES\_IN[V]} = \frac{VADC[V] * (R1 + R2) - R2 * AIN\_VREF[V]}{R1} = \frac{VADC[V] * (11) - AIN\_VREF[V]}{10}$$

4.12.7.2Analog input - Voltage



Contrary to the polarized analog inputs, these inputs must external polarization and cannot measure passive components.

$$V_{AIN\_VOLT\_IN[V]} = VADC[V] * 16$$

4.12.8 CAN port

Please refer to the section **4.8.6 COM connector.**
This port is mounted as "can1" interface on Embedded Linux.
For further details, please refer to "EVI-AN005-Technical Reference Manual" document.

4.12.9 Mini-PCIe port

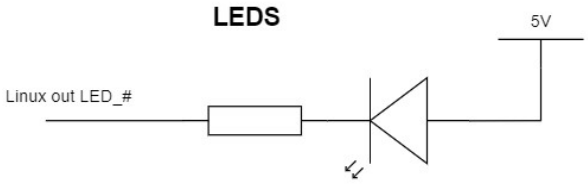
EVIX-IO provides a Mini-PCIe connector with USB connection to Embedded Linux.
This port is mounted as "wwan0" interface on Embedded Linux.
This allows the user to connect to an LTE module (as EC21 series from Quectel) and have a 3G or 4G wireless access.

Figure 45: Mini PCIe connector

Figure 46: EC21 Mini-PCIe Series

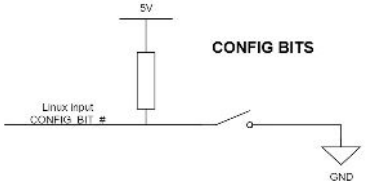
4.12.10 LEDs

EVIX-IO provides 8 LEDS placed on edge of the board (see 4.12EVIX-IO – Peripheral expander extension). For further details, please refer to "EVI-AN005-Technical Reference Manual" document.



4.12.11DSI Configuration switch

EVIX-IO provides 8 DSI Configuration bits placed on edge of the board (see 4.12EVIX-IO – Peripheral expander extension). These inputs are accessible on Embedded Linux, for further details, please refer to "EVI-AN005-Technical Reference Manual" document.



4.12.12 Interfaces & Connectors

Three connectors are dedicated to external access of inputs and outputs of the board.
Connector Reference (converter side): DEGSON 15EDGRHCM-THR-3.5-24P
Recommended mating connector (wire harness side): DEGSON 15EDGKNHM-3.5-24P

Figure 47: J6, J7 and J8 connectors

Table 30: EVIX-IO J6 connector pinout

PIN	FUNCTION	DESCRIPTION
1	GND	Ground reference for DSI
2	DSI_IN_6	DSI Input 6
3	DSI_IN_5	DSI Input 5
4	GND	Ground reference for DSI
5	DSI_IN_4	DSI Input 4
6	DSI_IN_3	DSI Input 3
7	GND	Ground reference for DSI
8	DSI_IN_2	DSI Input 2
9	DSI_IN_1	DSI Input 1
10	V_DSO_PWR	Power Input for DSO PWR
11	DSO_PWR_OUT_6	DSO PWR output 6
12	DSO_PWR_OUT_5	DSO PWR output 5
13	V_DSO_PWR	Power Input for DSO PWR
14	DSO_PWR_OUT_4	DSO PWR output 4
15	DSO_PWR_OUT_3	DSO PWR output 3
16	V_DSO_PWR	Power Input for DSO PWR
17	DSO_PWR_OUT_2	DSO PWR output 2
18	DSO_PWR_OUT_1	DSO PWR output 1
19	GND	Ground reference for DSO PWR
20	V_DSO_PWR	Power Input for DSO PWR
21	GND	Ground reference for DSO PWR
22	V_DSO_PWR	Power Input for DSO PWR
23	GND	Ground reference for DSO PWR
24	V_DSO_PWR	Power Input for DSO PWR

Table 31: EVIX-IO J7 connector pinout

PIN	FUNCTION	DESCRIPTION
1	AIN_COM	Analog input common reference (Ground)
2	AIN_VOLT_IN_5	Analog input 5 - Voltage type
3	AIN_VOLT_IN_4	Analog input 4 - Voltage type
4	AIN_RES_IN_1	Analog input 1 - Resistor type
5	AIN_RES_IN_0	Analog input 0 - Resistor type
6	GND	Ground reference for DSI
7	DSI_IN_12	DSI Input 12
8	DSI_IN_11	DSI Input 11
9	GND	Ground reference for DSI
10	DSI_IN_10	DSI Input 10
11	DSI_IN_9	DSI Input 9
12	GND	Ground reference for DSI
13	DSI_IN_8	DSI Input 8
14	DSI_IN_7	DSI Input 7
15	V_DSO_PWR	Power Input for DSO PWR
16	DSO_PWR_OUT_10	DSO PWR output 10
17	DSO_PWR_OUT_9	DSO PWR output 9
18	V_DSO_PWR	Power Input for DSO PWR
19	DSO_PWR_OUT_8	DSO PWR output 8
20	DSO_PWR_OUT_7	DSO PWR output 7
21	GND	Ground reference for DSO PWR
22	V_DSO_PWR	Power Input for DSO PWR
23	GND	Ground reference for DSO PWR
24	V_DSO_PWR	Power Input for DSO PWR

Table 32: EVIX-IO J8 connector pinout

PIN	FUNCTION	DESCRIPTION
1	V_PWM_PWR	Power Input for PWM PWR
2	GND	Ground reference for PWM PWR
3	PWM_PWR_OUT_1	PWM PWR output 1
4	PWM_PWR_OUT_2	PWM PWR output 2
5	V_PWM_PWR	Power Input for PWM PWR
6	GND	Ground reference for PWM PWR
7	V_DSO_OC	Power Input for DSO
8	DSO_OUT_1	DSO Output 1
9	DSO_OUT_2	DSO Output 2
10	V_DSO_OC	Power Input for DSO
11	DSO_OUT_3	DSO Output 3
12	DSO_OUT_4	DSO Output 4
13	V_DSO_OC	Power Input for DSO
14	DSO_OUT_5	DSO Output 5
15	DSO_OUT_6	DSO Output 6
16	V_DSO_OC	Power Input for DSO
17	DSI_IN_13	DSI Input 13
18	DSI_IN_14	DSI Input 14
19	GND	Ground reference for DSI
20	AIN_RES_IN_2	Analog input 2 - Resistor type
21	AIN_RES_IN_3	Analog input 3 - Resistor type
22	AIN_VOLT_IN_6	Analog input 6 - Voltage type
23	AIN_VOLT_IN_7	Analog input 7 - Voltage type
24	AIN_COM	Analog input common reference (Ground)

4.13 EVIX-CCS

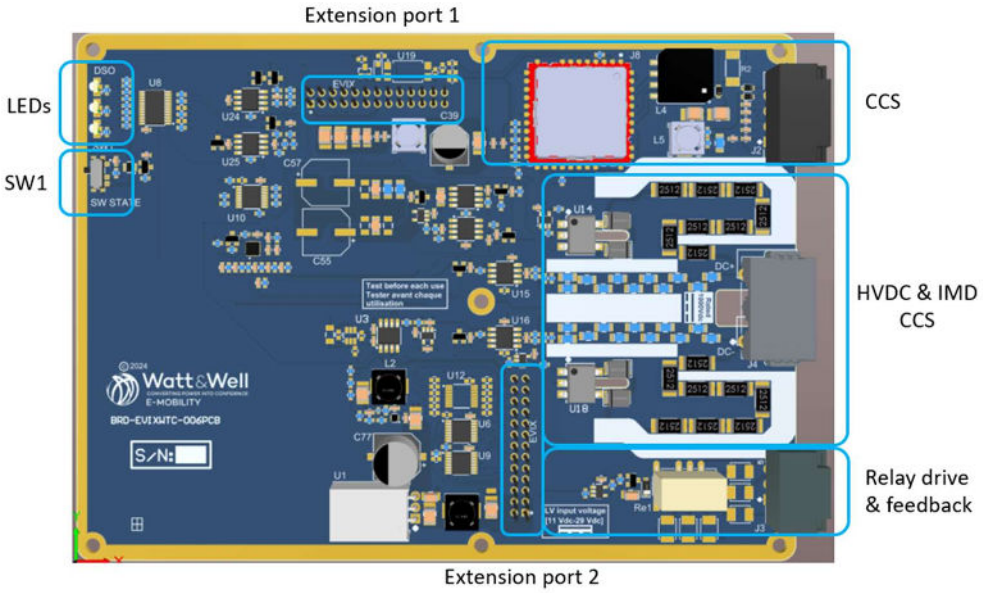


Figure 48: CCS extension board

4.13.1 Installation

Please ensure mechanical and grounding connection by connecting fixation holes to chassis. This extension board is available for v4.0 but not for EVI v3.0 and v3.1.
Up to 2 EVIX-CCS can be plugged on an EVI board to add CCS charge points.

4.13.2 LEDs

Table 33: EVIX-CCS LED table

LED color	LED behavior	DESCRIPTION
Blue	on	Charging
	blinking	Pre-charge states
Yellow	on	IMD fault
	blinking	IMD warning
Red	on	Error or EMS

4.13.3 Config switch (SW1)

This switch has two positions (default one is left). This allows the addressing and stacking of 2 EVIX-CCS extension boards without interference.
If two EVIX-CCS are stacked, the bottom one (A) should keep the default switch position and the top one (B) should be switched to the right.

4.13.4 CCS

See sections 4.6 and 4.8.9.

4.13.5 HVDC & IMD

See sections 4.3, 4.5 and 4.8.10.3.

4.13.6 Relay & Feedback

See section 4.8.11.

4.14 EVIX-MCS

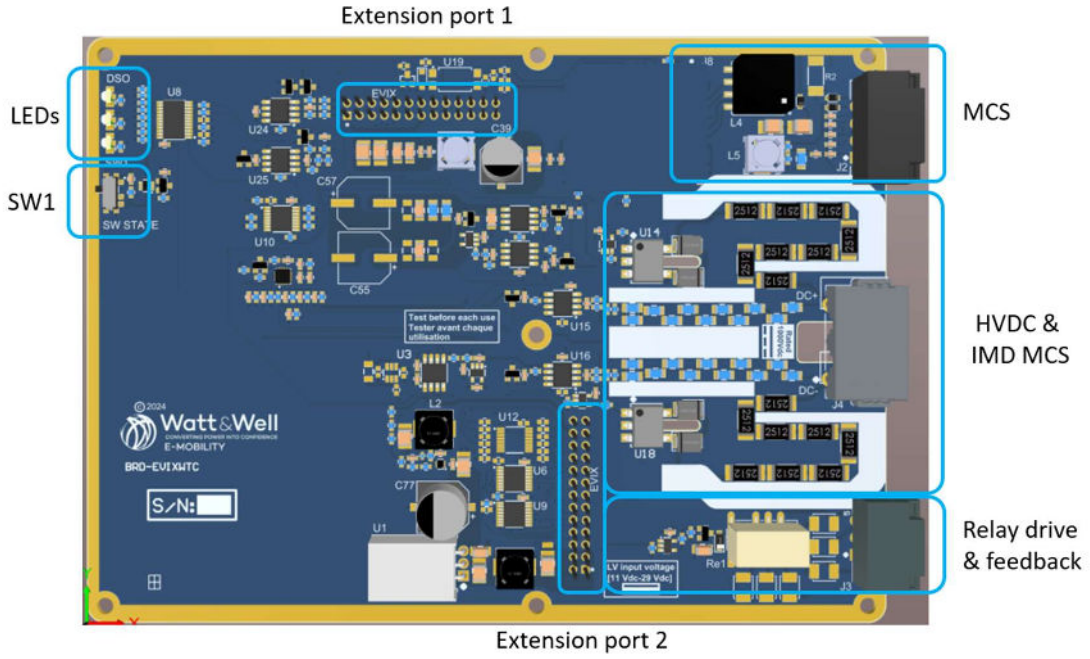


Figure 49: MCS extension board

The EVIX-MCS is an extension board for adding an MCS charge point on an EVI stack. The specifications of the extension board is compliant with IEC 61851-23-3.

4.14.1 Installation

Please ensure mechanical and grounding connection by connecting fixation holes to chassis. This extension board is available for v4.0 but not for EVI v3.0 and v3.1.
Up to 2 EVIX-MCS can be plugged on an EVI board to add CCS charge points.

4.14.2 LEDs

See section 4.13.2.

4.14.3 Config switch (SW1)

This switch has two positions (default one is left). This allows the addressing and stacking of 2 EVIX-MCS extension boards without interference.
If two EVIX-MCS are stacked, the bottom one (A) should keep the default switch position and the top one (B) should be switched to the right.

4.14.4Electrical characteristics

Table 34: EVIX-MCS electrical characteristics

Parameter	Condition	Value			Units
		Min	Typ	Max	
DC Side					
Voltage measurement range				1250	V
Voltage measurement accuracy	Full range		5	10	V
Insulation Measurement Device (IMD) / Isolation Monitor/Interrupter (IM/I)					
Operational voltage range		110		1250	V
Impedance measurement Relative uncertainty			3%	10%	%
Fault threshold			100		Ω/V
Warning threshold			500		Ω/V
Response time[1]		1	2	19	s
Maximum capacitance between DC+/- and PE				3.3	µF

All specifications are given for the full temperature range unless otherwise noted.
[1]: IMD response time is dependent on capacitance between DC+/- and PE

4.14.5MCS

Two connectors are required for MCS charging: one for communication signals (MCS port) and another for battery voltage measurement and IMD (see HVDC connector)
Digital communication of MCS is via 10BASE-T1S Ethernet instead of Homeplug Greenphy PLC.
Connector Reference (converter side): DEGSON 15EDGRHCM-THR-3.5-10P
Recommended mating connector (wire harness side): DEGSON 15EDGKNHM-3.5-10P

Figure 50: MCS connector (DEGSON 15EDGRHCM-THR-3.5-10P)

Table 35: MCS main connector pin description

PIN	FUNCTION	DESCRIPTION
1	Phy +	10BASE-T1S Ethernet +
2	Phy -	10BASE-T1S Ethernet -
3	RFU	Reserved for future use
4	PE	Protective earth
5	Temp 1 +	Temperature 1+ - DC connector
6	Temp 1 -	Temperature 1- - DC connector
7	Temp 2-	Temperature 2- - DC connector
8	Temp 2+	Temperature 2+ - DC connector
9	ID	Insert Detection
10	CE	Charge Enable

4.14.6 HVDC & IMD

For the connector and pinout, see section 4.8.10.3.
According to MCS requirement, the Impedance Measurement is continuous and real time., with active load balancing between DC+/PE and DC-/PE.

4.14.7 Relay & Feedback

See section 4.8.11.

5 Software specifications

The following paragraphs explain the overall architecture and communication of an EVI. A step-by-step example as well as all the CAN Bus interfacing information can be found inside "EVI-AN005-Technical Reference Manual" document.

5.1 System architecture

System architecture is designed to be composed of:

- Up to **14** MPU-Rx power units (25 - 30kW per unit)
- Up to **16** BMPU-R2 power units (bidirectional – 11kW per unit)
- Up to **4** EVIS boards (EVIS-A, EVIS-B, EVIS-C, EVIS-D)
- Extension boards:
    - For EVI v3.0 and v3.1: **1** EVIX board extension per EVIS
    - For EVI v4.0: Up to **4** EVIX board extension per EVIS (2 EVIX-IO + 2 EVIX-CCS, only one for the other compatible extension boards).

5.2 Multi EVI configuration

Multiple EVI's on the same CAN bus (to increase the number of ports) are limited to 4 for both hardware and software limitations.

Please consult the engineering team (engineering@wattandwell.com) for details on how to operate more than one EVI on the same CAN bus.

5.3 System communication and software API for EVIX-IO

Please refer to document "EVI-AN005-Technical Reference Manual".

5.4 Plug and play third party peripherals and systems

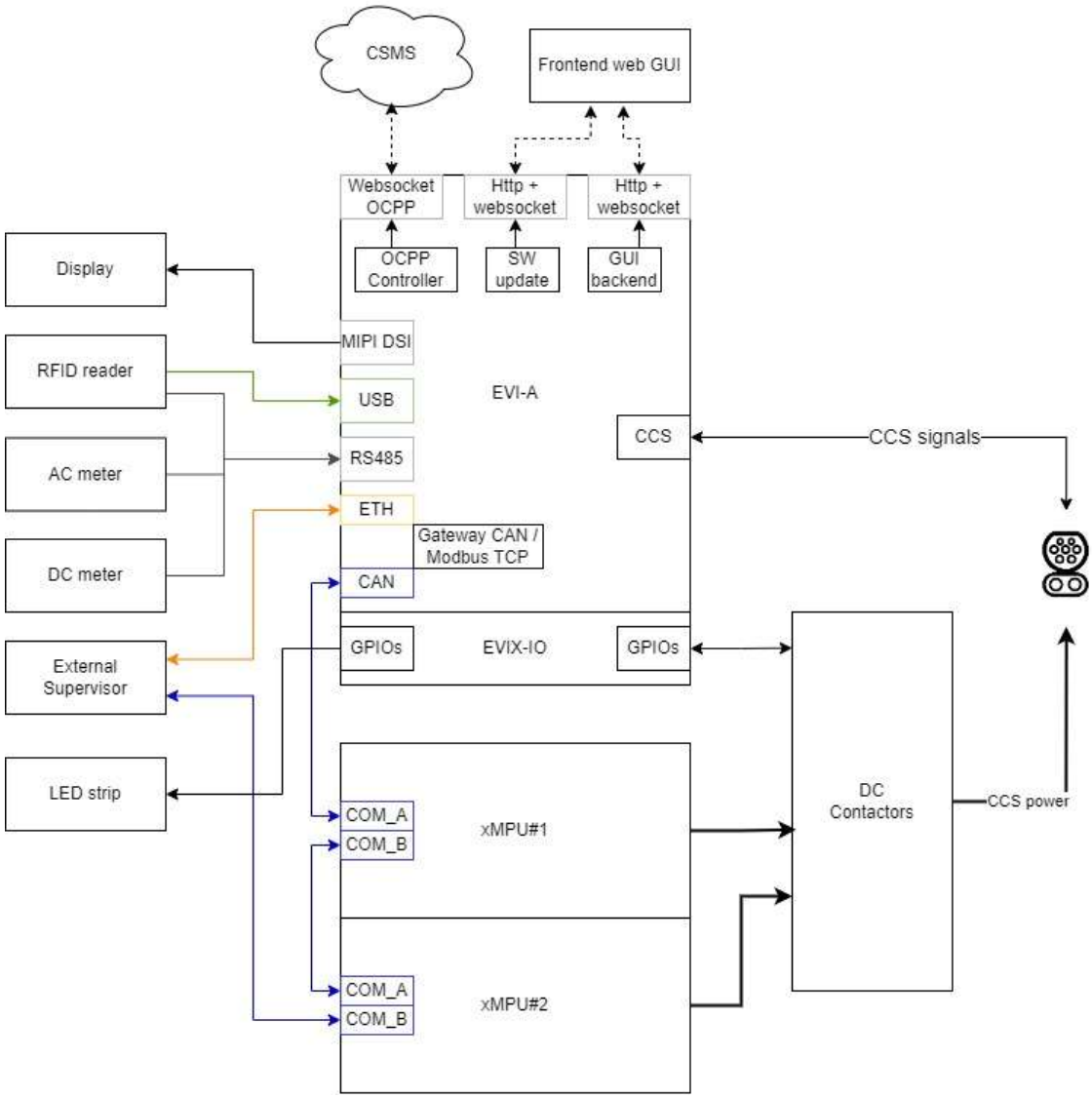


Figure 51: EVI software interfaces and compatible peripherals

5.4.1 RFID tag reader

These peripherals can be used for user authentication.
They usually connect via USB, TCP or RS485.
The functionality of this interface has been validated with the following commercially available reference:

- IDcapt RFID NFC 7102 (tested via USB, TCP and RS485)
- Advanced Card Systems ACR1252U USB NFC Reader

5.4.2 DC meter

These devices are useful to monitor the charge energy consumption (Voltage, current, power and energy). It is mandatory for compliance the EVSE compliance with the Eichrecht certification.
They usually connect via RS485 Modbus communication.
The functionality of this interface has been validated with the following commercially available reference:

- LEM DCBM-400-600
- Selec MFM384-C-CE-CL05

5.4.3 Display for EVI v4.0

A touch display solution can add ways for the user to interact with the user and monitor the state of the charging session.
Firmware and a MIPI DSI port and have been added to the v4.0 of the EVI to answer this use case.
The functionality of this interface has been validated with the following commercially available reference:

- ST MB1230-C01

5.4.4 DC contactors

The DSO PWR outputs of the EVIX-IO allow to drive contactors for the management of several power units on several charge points.
Several contactors references have been tested for this purpose:

- Sanyou SEC150Y-1000MFL3
- TE Connectivity LEV200H5ANA
- TE Connectivity ECK150AAAPA

The Sanyou reference contactors are the one used in the Starter Kit.
https://wattandwell.com/app/uploads/StarterKit-VxG-xC-datasheet.pdf

5.4.5 LEDs strip

The DSO outputs of the EVIX-IO allow to drive RGB LEDs and LED strips.
This functionality has been confirmed using this LED strip reference:

- PowerLED F8-RGB28-24-120-20-FP

5.5 Compatible communication protocols

5.5.1 CANopen / Modbus TCP gateway

The EVI communication interface is centred around CAN and devices communicate between each other via the CANopen protocol.
For more information about the CANopen implementation for EVI, please refer to "EVI-AN005-Technical Reference Manual" document.

Since Modbus TCP is used prominently in the automation industry, a Modbus TCP & CANopen gateway is available on the EVI.
For more information about this gateway, please refer to the Datasheet for the Modbus TCP & CANopen Gateway.

5.5.2 OCPP

OCPP is a communication protocol for interoperability between EVSE and Charging Station Management System (CSMS).
OCPP 1.6 is used to communicate to the CSMS information about the charge such as load balancing, charge profile settings, timing and status of the Control Pilot.
The 2.0.1 version of the OCPP adds better security of the communication and billing, comprehensive support of ISO 15118 for V2G, more functionalities for smart charging, user oriented display and messaging.

Plugfests and testivals have been opportunities to validate the OCPP stack integrated in the EVI. This stack is developed by Trialog, and is used by the Open Charge Alliance for the OCPP certification.

5.5.3 Plug & Charge and Autocharge

Plug and Charge (PnC) and Autocharge are methods to make the authorization process for the charge of an EV more secure and user friendly. These methods use the MAC address of the EV (which is communicated to the EVSE through CCS) instead of an RFID card or a smartphone app.
The main difference between the two methods is that Autocharge uses the MAC address of the EV as is for authorizing the charge, while PnC requires specific cryptographic algorithms to authenticate the ID of the vehicle and secure the exchanges and billing.

The EVI is compatible with both Autocharge and PnC. The PnC stack used in EVI has been precertified with Hubject in 2024.

5.6 GUI and software update

The EVI features a Graphical User Interface (GUI).
This GUI is implemented as a web application hosted locally on the EVI embedded Linux.

It allows users to set up, launch and monitor EV charging or V2G sessions. It also grants a user friendly control panel for the GPIOs of the EVIX-IO.

Finally, this GUI is also the preferred method to import the license key files necessary for the first activation of the EVI product and the software update files.

More information about the EVI GUI can be found on the dedicated user manual:
https://wattandwell.com/app/uploads/EVI-GUI-user-manual.pdf

6 Mechanical specifications

6.1 EVI dimensions

- Length: 170 mm
- Width: 120 mm
- Height: total height is 30mm
    - Top component height: 20mm
    - Bottom component height:8mm
- Weight: 206 gr

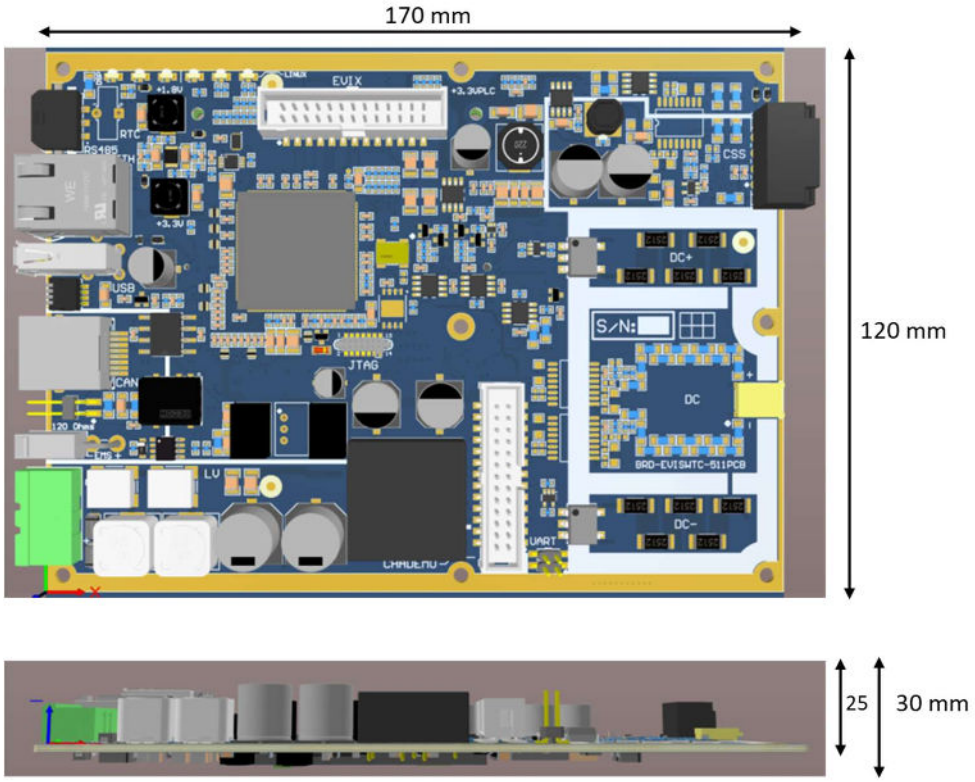


Figure 52: EVI dimensions

6.2 EVIX-AD6 dimensions

- Length: 100 mm
- Width: 120 mm
- Height:
  - Total Height: 46 mm
  - Top component height: 25mm
  - Bottom Component Height: 21mm
- Weight: 90 gr

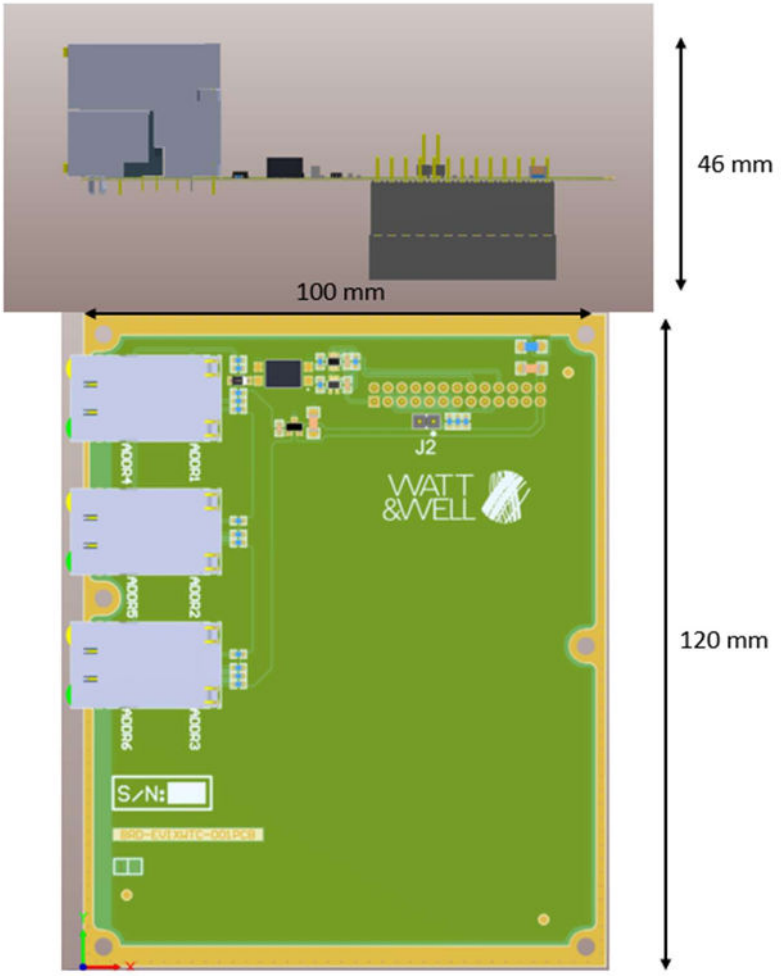


Figure 53: EVIX-AD6 dimensions

6.3 EVIX-AD6-CHA dimensions

- Length: 170 mm
- Width: 120 mm
- Height:
  - Total Height: 46 mm
  - Top component height: 25mm
  - Bottom Component Height: 21mm
- Weight: 156 gr

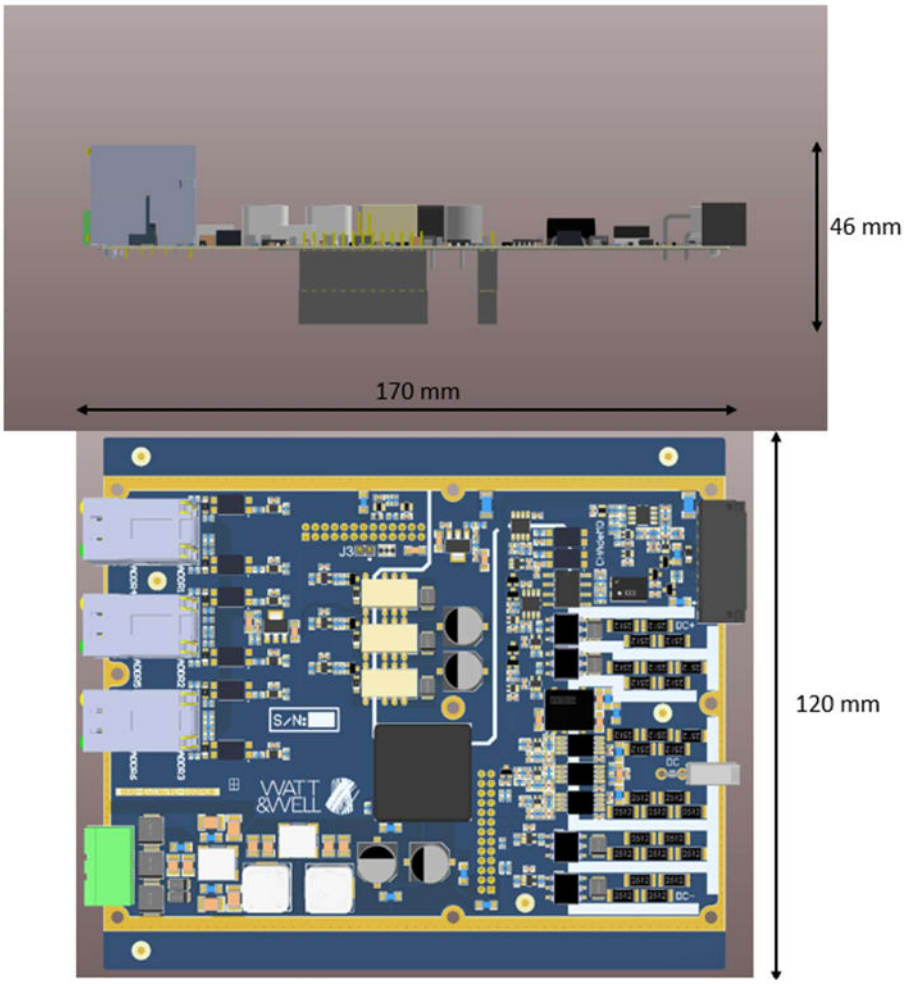


Figure 54: EVIX-AD6-CHA dimensions

6.4 EVIX-IO dimensions

- Length: 170 mm
- Width: 120 mm
- Height:
  - Total Height: 46 mm
  - Top component height: 25mm
  - Bottom Component Height: 21mm
- Weight: 156 gr

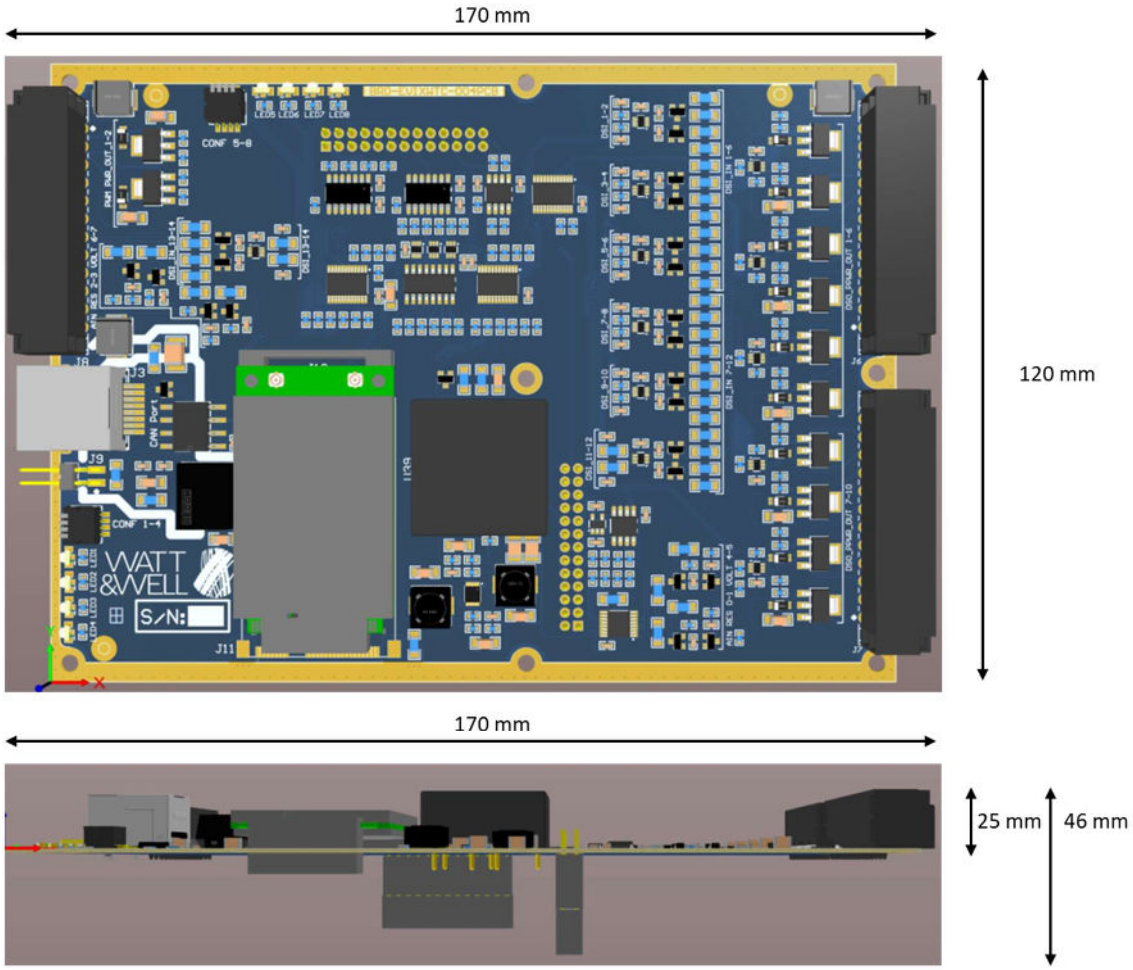


Figure 55: EVIX-IO dimensions

6.5 EVIX-CCS dimensions

- Length: 170 mm
- Width: 120 mm
- Height:
  - Total Height: 26.19 mm
  - Top component height: 11 mm
  - Bottom Component Height: 13.59 mm
- Weight: 156 gr

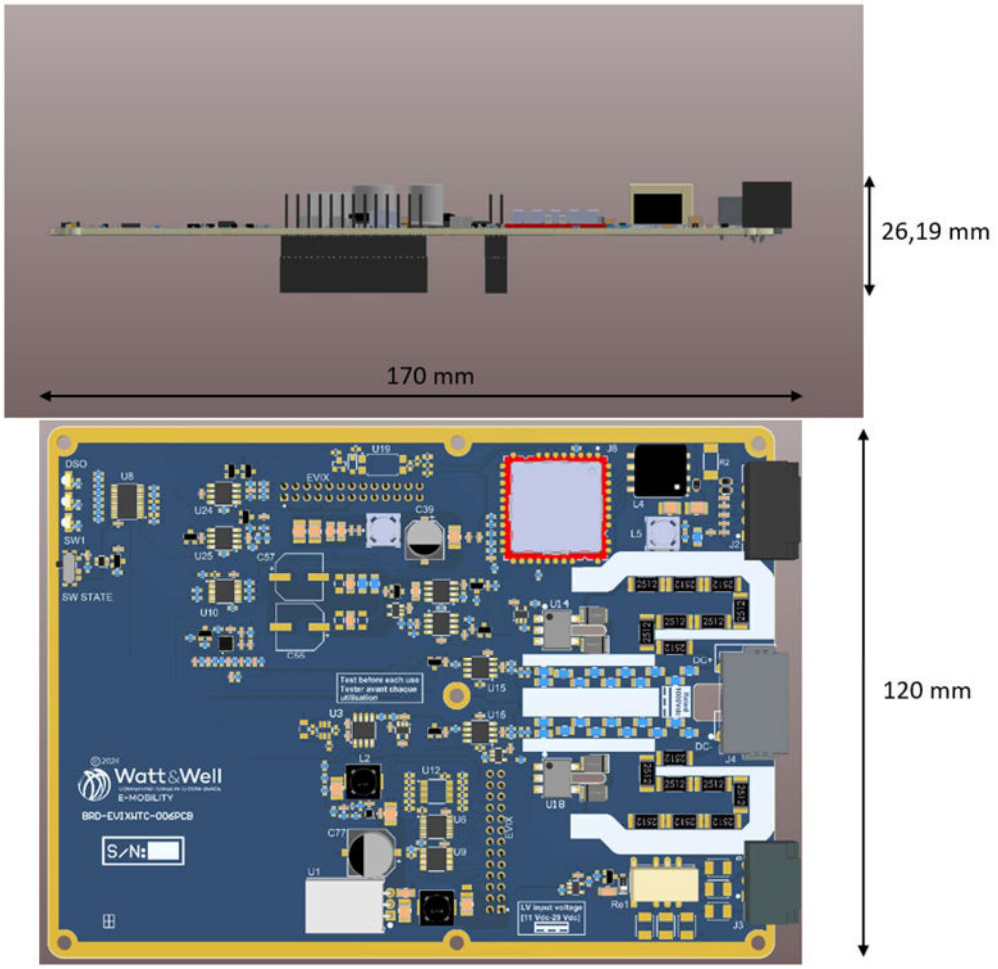


Figure 56: EVIX-CCS dimensions

6.6 EVIX-MCS dimensions

- Length: 170 mm
- Width: 120 mm
- Height:
  - Total Height: 26.19 mm
  - Top component height: 11 mm
  - Bottom Component Height: 13.59 mm
- Weight: 156 gr

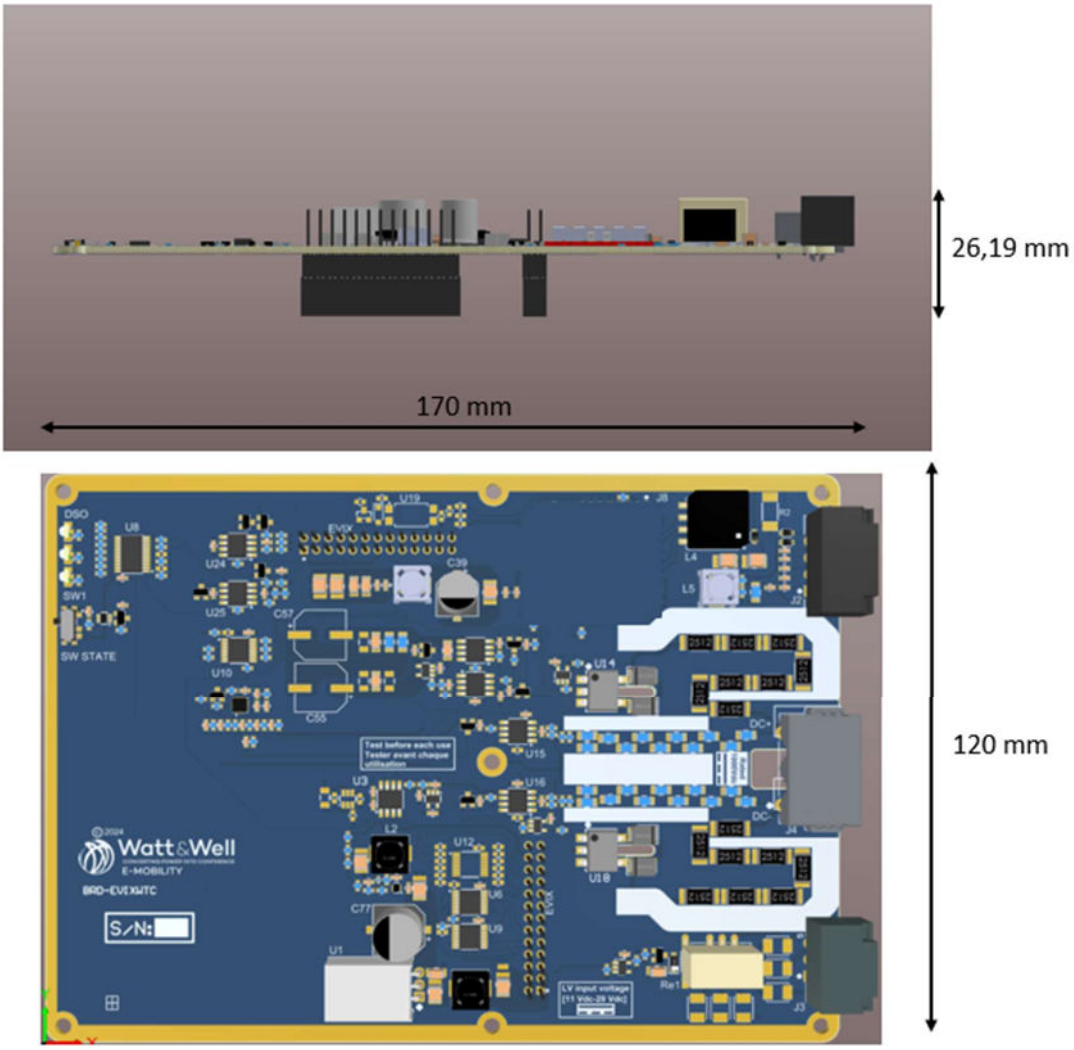


Figure 57: EVIX-MCS dimensions

7 Safety instructions

7.1 Preventing Electrostatic Discharge (ESD)

Electrostatic discharge (ESD) is a common occurrence and can cause significant damage to sensitive electronic components.

To prevent ESD, the following steps can help reduce the risk of ESD:

- **Grounding:** Ensure that all equipment and personnel are properly grounded to prevent the buildup of static electricity.
- **Control humidity:** Keep the workplace environment at a moderate level of humidity to reduce the buildup of static electricity.
- **Use ESD-safe equipment**: Use ESD-safe equipment and tools, including mats, wrist straps, and packaging materials.
- **Handling practices:** Implement proper handling practices for electronic components, such as avoiding direct contact and using protective packaging.
- **Training**: Train personnel on the risks and prevention of ESD and make sure they understand the importance of following ESD guidelines.

7.2 Installation

EVI is delivered as an open frame board, that is, without protective enclosure or chassis. It shall be integrated into an EVSE enclosure. This board contains live circuits involving high voltage that can result in electrical shock, fire hazard and/or personal injury if not properly handled or applied. If not enclosed, it must be used only by qualified engineers and technicians' familiar with risks associated with handling high voltage electrical and mechanical components, systems and subsystems.

To avoid injuries, always disconnect power and remove external voltage sources before touching components.

The protective earth terminal must be connected to the safety electrical ground before another connection is made. Product fixation holes must be connected to EVSE protective earth.

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.

7.3 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

7.4 Environmental condition

EVI device safety approval applies to the following operating conditions:

- Maximum relative humidity : 95% at 30°C
  : 23% at 60°C non-condensing
- Altitude : up to 2000m
- Pollution degree : 2[2]


Protective ground conductor terminal

The EVI has also been qualified for equipment transportation in standard packaging according to NF EN 300 019-2-2 (ETSI EN 300 019-2-2 v2:20217) Environmental test specification T2.3 public transportation:

- Vibration (Random): IEC 60068-2-64:2008
- Shock test (Half sine) : IEC 60068-2-27:2008
- Vertical impact : NF EN 300019-2-2:2018.

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

7.5 Normative compliance

EVI is compliant with European standards:

Reference	Title	Comment
ROHS Directive 2011/65/EU	Restriction of hazardous substances in electrical and electronic equipment	
WEEE Directive 2012/19/EU	Waste electrical and electronic equipment directive	
LVD Directive 2014/35/EU	Health and safety risks on electrical equipment	
EMC Directive 2014/30/EU	Ensures equipment does not generate, or is not affected by, electromagnetic disturbance	
IEC 61557-8:2014	Electrical safety in low voltage distribution systems up to 1000V a.c and 1500V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems.	Requirements for the IMD feature. Excluding shock/vibration (chapter 4.8).
IEC 61000 -6-2:2016 -4-5:2014 -4-4:2012 -4-3:2006 -4-2:2012	Immunity for industrial environments (Part 6-2) Surge immunity (Part 4-5) Electrical fast transient/burst immunity (Part 4-4) Radiated, radio-frequency, electromagnetic field immunity (Part 4-3) Electrostatic to discharge immunity test (Part 4-2)	Generic standards - EMC requirements for industrial environments.
IEC 61000-6-3:2020	Emission standard for residential, commercial and light-industrial environments (Part 6-3)	Generic standards - EMC requirements for residential environments. Conducted emission on LV port : Class B Radiated emission on enclosure[1] : Class A

1 : an optional casing can be designed as option by Watt And Well to achieve class B limits

EVI IMD complies with the following UL standard:

Reference	Title	Comment
UL 2231-1/-2	Electric Vehicle Charging System Personnel Protection Equipment – Component. See UL file FFUQ2.E540924	EVI v3.1 is UL certified EVI v4 is UL pending

EVI have been designed to be compatible with the following norms and charging protocols:

Reference	Title	Comment
IEC 61851-1:2017	Electric vehicle conductive charging system – Part 1: General requirements	SECC Subset
IEC 61851-23:2023	Electric vehicle conductive charging system – Part 23: DC electric vehicle charging station	SECC Subset
DIN SPEC 70121:2014	Electromobility - Digital communication between a d.c. EV charging station and an electric vehicle for control of d.c. charging in the Combined Charging System	SECC Subset
CHAdeMO 1.2 ed2:2017	CHAdeMO 1.2 ed2	SECC Subset
ISO 15118-2:2014	Road vehicles -- Vehicle to grid communication interface	SECC Subset
ISO 15118-20:2022	Road vehicles -- Vehicle to grid communication interface	SECC Subset
IEC 61010-1:2010	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1 : general requirements	Surge tension of 2.5 kV [2] 1.2/50us (up to 5000m of altitude).
IEC 60664-1: 2020	Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements, and tests	Surge tension of 2.5 kV [2] 1.2/50us (up to 5000m of altitude).

2 : The power unit that supplies HVDC voltage to EVI shall reduce a surge seen in its input to less than 2.5 KV in its output (Cf 11.4.101 of IEC 61851-23:2014)

It is the user's responsibility to ensure that EVI is installed and used in compliance with all local country laws and regulations.

7.6 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

7.7 Security Disclaimer

This product is designed to be connected to and to communicate information and data via a network
interface. It is Customer's sole responsibility to provide and continuously ensure a secure connection between the product and Customer network or any other network (as the case may be). Customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.
In particular, the default password should be changed on first use by the Customer.

8 Installation

Do not use or install product in case of visible physical damage.

8.1 Mechanical installation

Refer to section 5.3 for the dimensions of the product.

8.2 Electrical installation

Never invert polarity of the connectors. 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.

8.3 Protective earth installation

Electrical installation shall comply with the international standards such as IEC or the requirements in national standards of each country.
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. Protective earth connection is made through mechanical screw fixtures of the board (e.g. stand-offs). Use conductive material and/or ensure that chassis where EVI is installed is grounded to ensure correct connection.

8.4 LV input

An auxiliary LV input must be connected to a 12 or 24 Vdc bus. This input must be protected against short-circuit and over-current. Electrical system around must be selected in accordance with protection rating.
This bus should have minimal characteristics:

- Maximum input overvoltage 33 V (line to line)
- Maximum input overvoltage 33 V (line to PE)

This cable must be shorter than 3m.

9 Maintenance

No Hardware maintenance is required on this product
Early based maintenance packages are recommended to provide software updates, engineering support, SLA, and interoperability tests.
For further details, please contact contact@wattandwell.com

9.1 Cleaning

Do not use cleaning agent.
Dust can be removed with dry air cleaning.

10 Ordering information

10.1 Products References

EVI product:
Ordering Configuration: **EVI-Cx-[Ax][-O][-W][-P]**

Ordering	Configuration
Cx	CCS communication stack included C1: CCS stack with DIN SPEC70121 and 15118-2 C2: CCS stack with DIN SPEC70121, 15118-2 and 15118-20 with BPT

Options

Option	Configuration
Ax	EVIX-AD6-CHA CHAdeMO extension board included A1: CHAdeMO stack without BPT A2: CHAdeMO stack with BPT
O	OCCP stack included
P	Plug & Charge included (requires OCPP option)
W	Wireless communication – WiFi & Bluetooth

Example of possible ordering configuration:

Order code	Configuration
EVI-C1-00	*Basic* version EVI board with CCS charging (without 15118-20)
EVI-C1-A1	*Basic* version with CHAdeMO option EVI board with CCS (without 15118-20) & CHAdeMO charging (without BPT)
EVI-C2-O	*Standard* version EVI board with CCS (including 15118-20 with BPT) & OCPP feature enabled.
EVI-C2-O-P	*PnC* version EVI board with CCS (including 15118-20 with BPT) & OCPP feature enabled & Plug & Charge enabled
EVI-C2-A2-O	*Standard* version with CHAdeMO option EVI board with CCS (including 15118-20), & CHAdeMO (with BPT) charging, & OCPP feature enabled.

For other combinations, please contact us.

EVIX product
Ordering Configuration: EVIX-[…]

Ordering	Configuration
ADx	AD6: 6 addressing ports AD14: 14 addressing ports
IO	Peripheral extension board
Cx	CCS extension board C1: CCS stack with DIN SPEC70121 and 15118-2 C2: CCS stack with DIN SPEC70121, 15118-2 and 15118-20 with BPT

10.2 Product accessories

WA043 EVI Connectors kit including: - 1 meter LV port harness (outputs 4mm banana plugs) - 1 meter Emergency Shutdown port harness (outputs free wires) - 1 meter HVDC port harness to free wires (outputs free wires) - CCS port connector (DEGSON 15EDGKNHM-3.5-08P) - CAN bus adaptor from RJ45 to DB9 (WA007)	
WA007 – CAN bus adaptor from RJ45 to DB9 Including: - 120 Ω termination resistance	
WA009 – USB to CAN transceiver (Kvaser) Compatible with MPU Monitor (versions from 2019 onwards)	

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