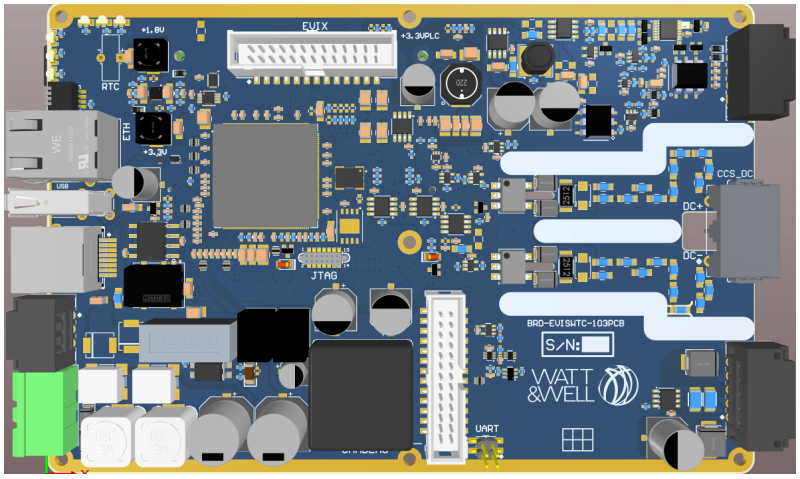
Watt&Well
CONVERTING POWER INTO CONFIDENCE

EVCC SERIES

Electrical Vehicle Interface

COMMUNICATION | E-MOBILITY | EV CHARGERS



OVERVIEW

EVCC is a CCS compliant Electrical Vehicle Communication Controller board equipped with all necessary signals for CCS communications.

The EVCC manages communication with charging stations, ensuring that the EV battery is charged in accordance with the standards.

EVCC is provided with communications stack pre-installed for Combo communication (DIN70121 and ISO15118).

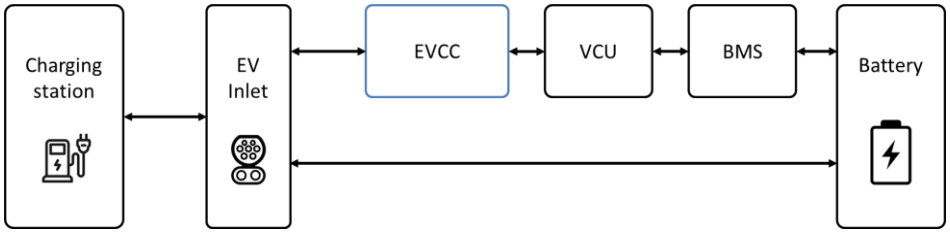
EVCC provided hardware interface for CCS inlet lock motor with 12V or 24 V and locking actuator
(4 positions, 3 positions and 4-20mA measurement)

An optional extension board (EVIX) can add additional functions such as peripheral expander board.

FEATURES

- CCS protocol compatible
  - Battery voltage measurement
  - Control Pilot resistor management.
  - Plug lock motor management.
- Cable temperature measurement
  - PT1000
  - NTC
- Integrated Insulation Measurement Device (IMD)
- Powerful computing capabilities
  - SoC with ARM® Dual Cortex-A7 & ARM® Cortex-M4
  - 1 GB of DDR3 RAM
  - 8 GB eMMC Flash
  - Chipset (microcontroller based) for security functions
- CANopen compatible digital bus with advanced control, monitoring and logging capabilities.
- Hardware Secure Element

BLOCK DIAGRAM



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 final system remains responsible for ensuring compliance to applicable standards. Watt & Well assumes no liability for any inaccuracies or discrepancies in the provided examples.

TABLE OF CONTENTS

1 Absolute maximum ratings

Parameter	Condition	Min	Max	Units
LV Input Voltage (all versions)		0	30	V
DC side voltage		0	1000	V
Operating Temperature		-40	70	°C
Long term storage Temperature		-40	70	°C
Temperature change rate			5	°C/min

Table 1: Absolute maximum ratings

2 Electrical Characteristics

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

Parameter	Condition	Value			Units
		Min	Typ	Max	
DC Side					
Voltage measurement range				1000	V
Voltage measurement initial accuracy	Full load			+/- 10	V
CAN communication					
CAN baudrate			500		kbps
CAN common mode range		-7		7	V
LV Input					
Supply voltage		11	24	29	V
Input current			0.3	1.0	A
Under Voltage Shutdown			9		V
Lock Motor Supply input					
Supply voltage (V_LOCK_POWR)		11	24	29	V
Motor current trip point				1.4	A
Wake-UP & Emergency					
Emergency Shutdown				2	mA
Wake-Up IN		4.9	12	24	V
Wake-Up OUT			12		V
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

Table 2: Electrical characteristics

3 Introduction

EVCC is a single standard Electric Vehicle Communication Controller (EVCC). It includes all required signals for CCS/Combo (DIN70121 and ISO15118) protocol to be interfaced with SECC complementary board.

It embeds a powerful processor which runs communications stack and other demanding applications.

EVCC provides all the interfaces to proceed to the CCS charge hand-shaking.

The available interfaces are:

- Control Pilot
  - Configurable state with normative resistors (2740Ω, 882Ω…)
  - Duty cycle & value measurements
- Lock motor control
- Proximity Pilot
- Relay control
- Digital Signal inputs and Digital Signal outputs

The board implements a power saving strategy by allowing to stop the power supply and wake up the board when needed.

The following wake up sources are available

- Wake up by Proximity Pilot
- Wake up by external signal

4 Hardware specification

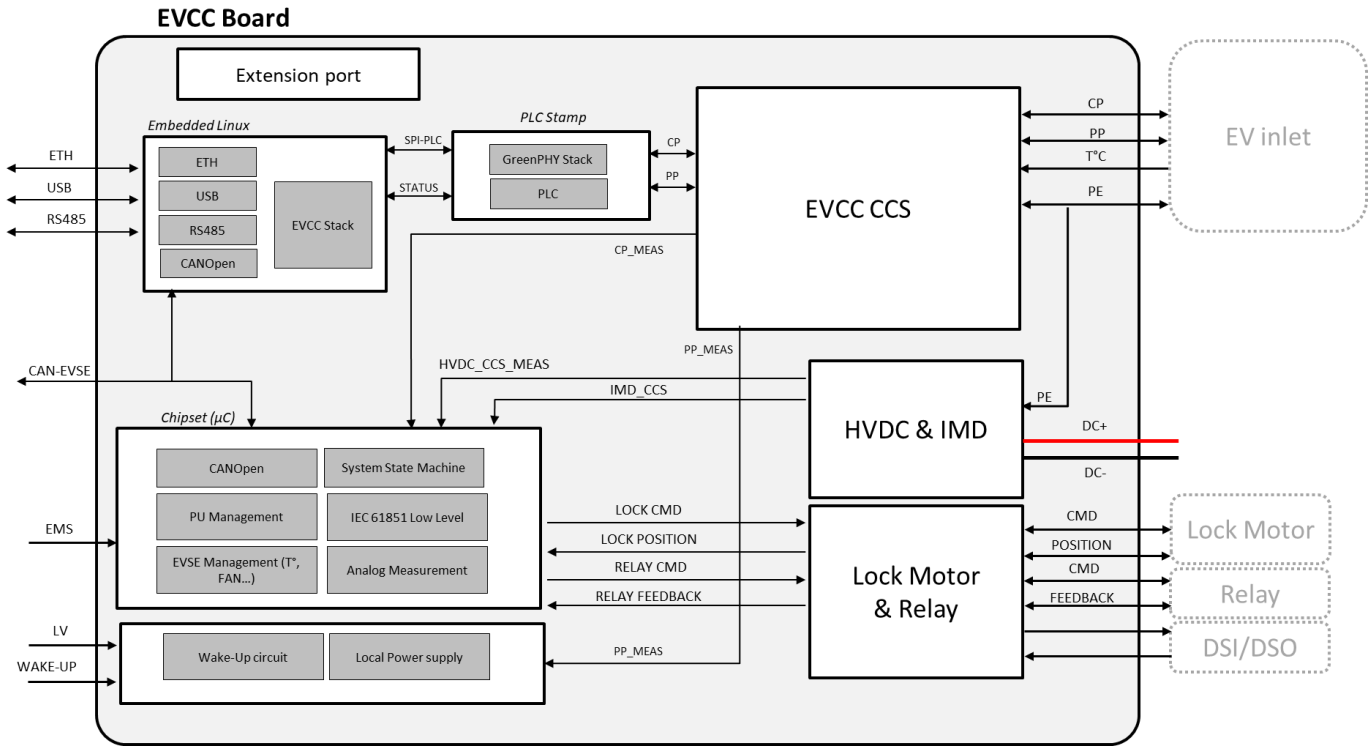


Figure 1: EVCC block diagram

4.1 Theory of operation

4.1.1 Wake-Up strategy

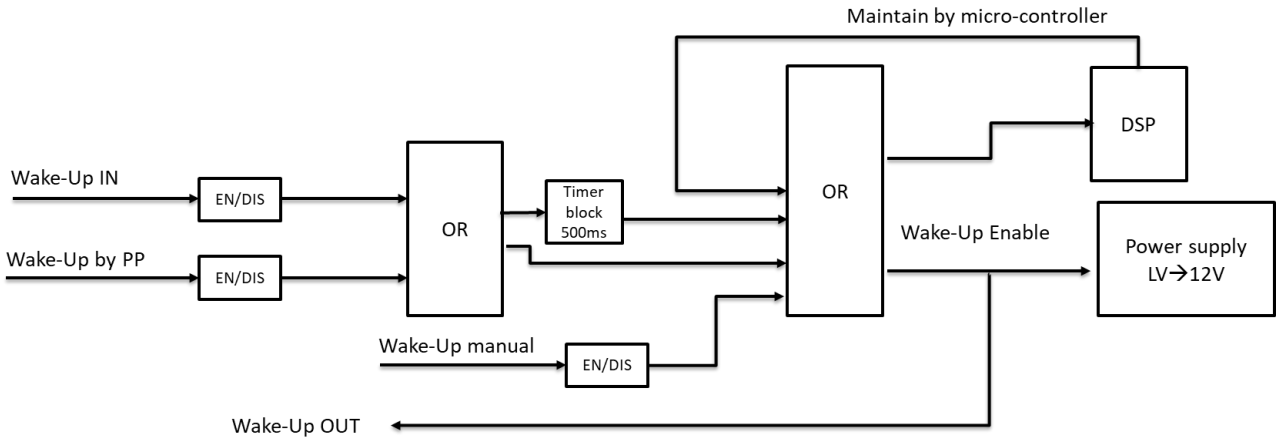


Figure 2: Wake-Up strategy block diagram

EVCC system has the ability to be in low power mode and can be woken-up by the 3 events:

1. Manual wake-up using dipswitch (See Enable/disable dipswitch chapter hereafter)
2. External signal WAKEUP_IN:
    a. High: IN > 4.9V
    b. Low: IN <4.7
3. Proximity pilot:
    a. No plug connected (external impedance higher than 4kΩ) →Sleep
    b. Plug connected to PP (external impedance lower than 3.5kΩ) →Wake up

Auto-hold :

To have an "auto-hold" feature, the wake-up enable signal (wake-up supply) will be also send to DSP which will maintain the wake-up order after having been woken-up.

A timer block configured to 500ms have been placed and will ensure that a wake-up pattern will last at minimum 500ms to let time to the DSP to boot and maintain wake-up.

Enable/Disable dipswitch:

A dipswitch is connected to wake-up signals to force them to low value if requested.

When setting the switch to ON value, it will disable the wake-up possibility by this entry.

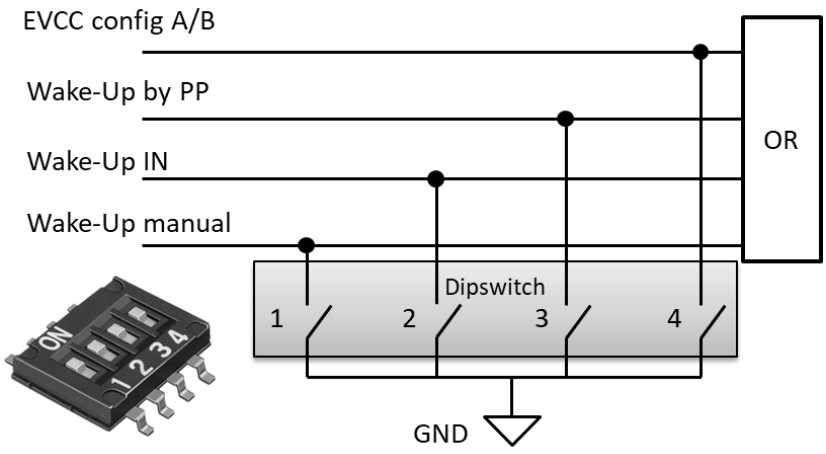


Figure 3: Dipswitch to enable/disable wake-up entries

4.2 HV DC voltage measurements

EVCC features an input port for HV DC voltage measurements.

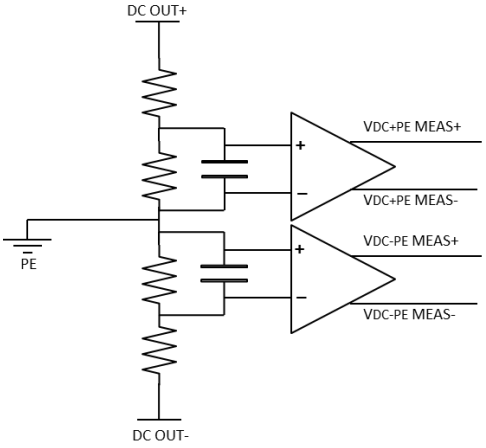


Figure 4: HV DC voltage measurement

4.3 Insulation monitoring device (IMD)

An Insulation Monitoring Device (IMD) detects ground faults in the secondary (DC side) circuit of a charger. It works by measuring earth leakage resistor between the DC power lines DC+/DC- and earth (enclosure and chassis). EVCC features an IMD that monitors on demand the insulation between DC+ and PE and between DC- and PE. Symmetrical and asymmetrical insulation faults can then be detected with this system.

4.4 Control pilot measurement

EVCC measures the control pilot value and duty-cycle value.

4.5 Control pilot resistor

Control pilot resistors can be added between CP and PE lines.
The mounted resistors values are the ones specified by the IEC 61851-1 standard for EVCC mode.

Control of CP state resistors:

- State A: No resistor
- State B: 2740Ω
- State C: 882Ω (1300//2740)
- State D: 246Ω (270//2740)

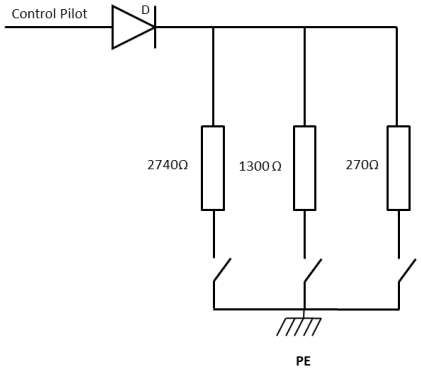


Figure 5: Control pilot resistor management

For further explanations concerning the control pilot management, see **6.3 System communication.**

4.6 Temperature monitoring

4.6.1 Temperature sensor type selection

EVCC allows users to select the temperature type between PT1000 and NTC to ensure compatibility with several EV inlet references.

4.6.2 PT1000 sensor type

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

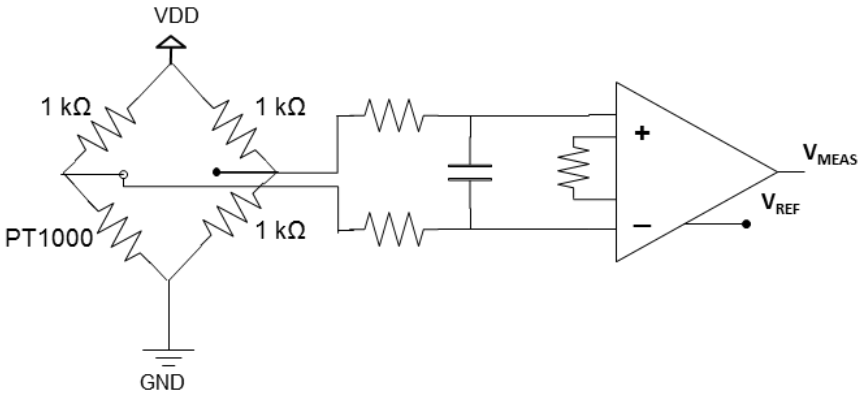
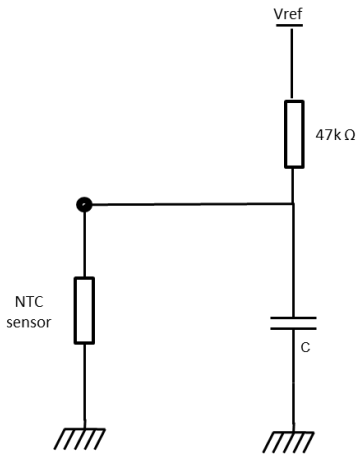


Figure 6: Wheatstone bridge for Pt1000 temperature measurement

4.6.3 NTC sensor type

Two temperature measurements channels for NTC type thermistors are available. Each measurement is done with polarization resistors



4.7 Lock Motor

EVCC product provides a DC motor driver block which can be used to control actuator for charge inlets.
The acquisition chain has been designed to be compatible with several types of lock motors:

- 4-30mA position feedback
- Open/Close circuit position feedback
- 1kΩ/11kΩ position feedback$
- 3poles lock motor

EVCC driver motor is supplied by LV and capable of drive DC motor in both forward and reverse direction as shown below:

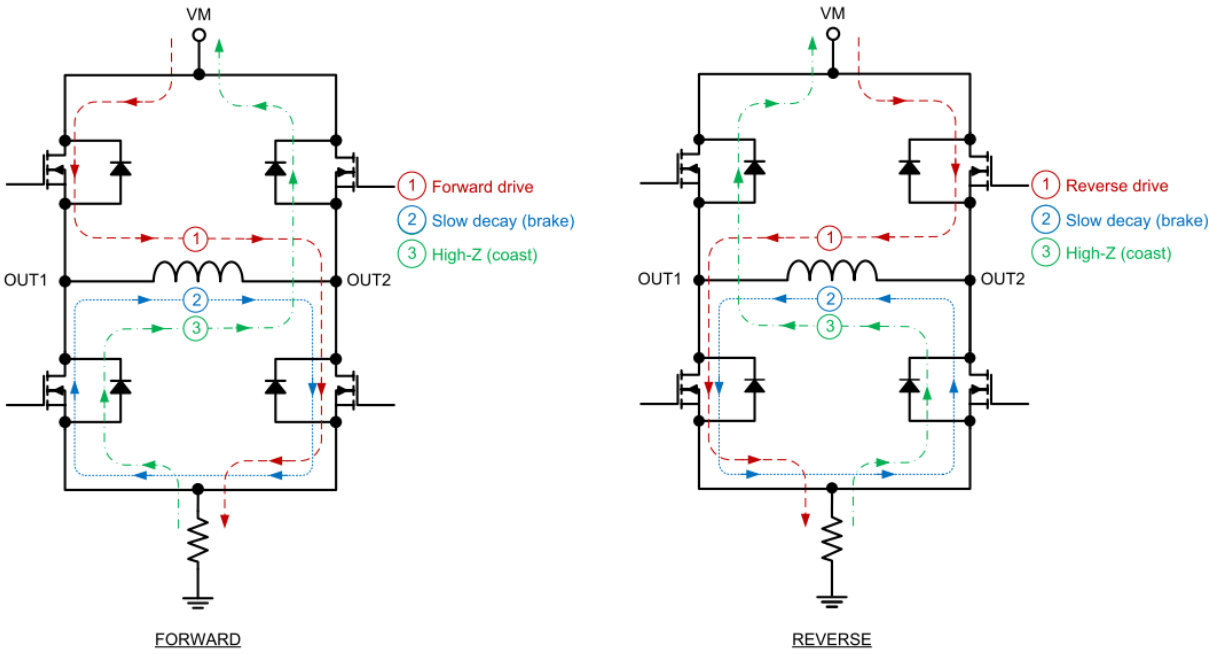


Figure 4. H-Bridge Current Paths

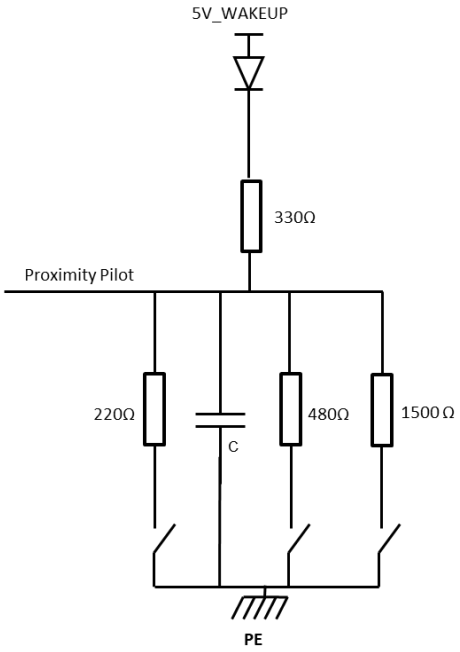
Figure 7: Motor driver mode

4.8 Proximity pilot

Proximity Pilot is used to detect the presence of a male plug in the vehicle inlet. EVSE connector
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.

Polarization of Proximity pilot resistors by 5V is not systematic and depends on EVCC board configuration:

- Wake-Up: the polarization is activated for enabling “Wake-up by PP”
- EVCC mode: the polarization is activated and done by the board.



5 EVCC interfaces

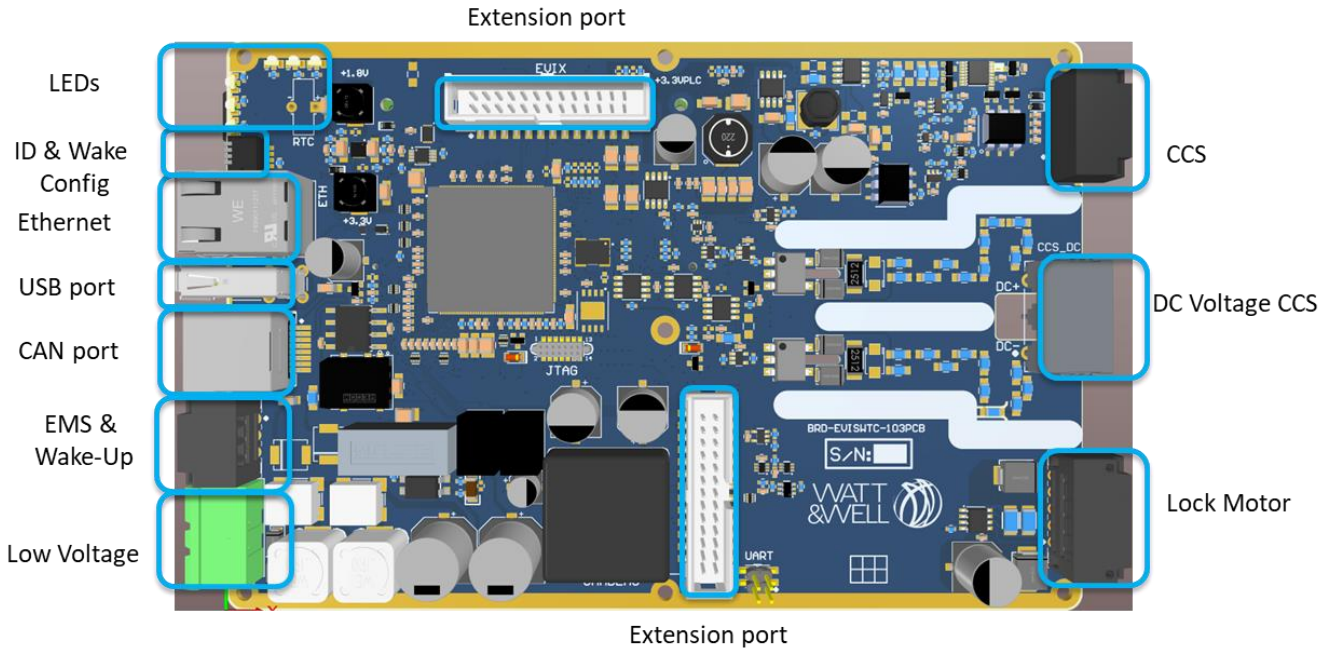


Figure 8: EVCC interfaces

5.1 Connectors

5.2 Low voltage connector

LV connector is used to supply power to fans and control independently of the DC or AC supplies. Connector Reference (converter side): Phoenix Contact MSTBA 2,5/ 2-G-5,08 1757242 and is in the front panel.

Recommended mating connector (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)

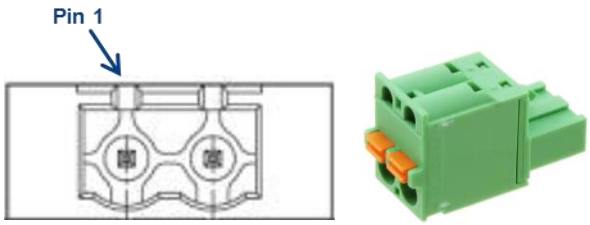


Figure 9: Low voltage connector

PIN	FUNCTION	DESCRIPTION	Preferred wiring color
1	LV_IN-	Low Voltage supply return (0V typ)	Black
2	LV_IN+	Low Voltage supply (14V typ)	Red

5.3 USB port

USB port is USB-standard type A
This port is used for communication with embedded Linux.

5.4 Ethernet port

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

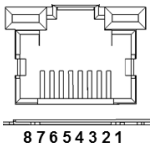


Figure 10 : Ethernet connector

Table 3: 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	ETH1_VIO_SWITCHED	Analogue power supply output to magnetics
5	ETH1_VIO_SWITCHED	
6	ETH1_RX_N	Ethernet RX Differential Input (Minus)
7	Unused	-
8	Shield = PE	Shield is connected to PE

5.5 RS485 port

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

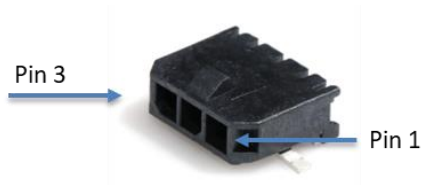


Figure 11: Molex – 436500312

Table 4: 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 12: 1718500300

5.6 COM connector

EVCC features a galvanically isolated CAN bus for digital communications with other boards.
The COM connector is a double RJ45 connector to enable easier connection of several Units in the same bus. Both side (A-side and B-side) are connected internally.

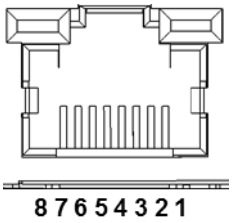


Figure 13 : COM connector (double RJ45) front view

Table 5 – COM connector pinout

PIN	FUNCTION	DESCRIPTION
1	CANA H	CAN differential +
2	CANA L	CAN differential -
3	GND	Ground reference for CAN
4	EmShut_Rtn	Emergency Shutdown return line (negative)
5	EmShut	Emergency Shutdown (positive)
6	Reserved	Reserved for future use
7	Not connected	
8	Reserved	Reserved for future use

Note on CAN bus termination: 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, EVCC does include a 120 Ω resistor

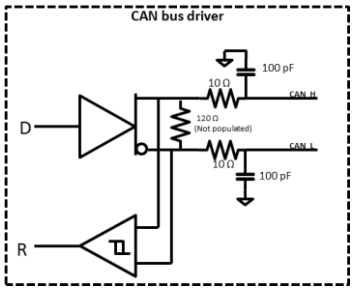


Figure 14: CAN transceiver simplified diagram

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: EVCC 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 (such as NI CAN 8473 which features a DB9 header connector). The recommended adaptor pinout is as follows:

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

Table 6: Recommended pinout for a CAN RJ45 to DB9 adaptor

5.7 Emergency Shutdown & Wake-Up

The **Emergency Shutdown (EmShut) & Wake-Up connector** is used to provide Emergency Shutdown signals to stop the charging process & Wake-UP IN and OUT signals to be able to wake-up product by external signal WAKEUP_IN and having a feedback of the wake-up status with WAKEUP_OUT signal.

EmShut logic is active low

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

See for a description of logic levels in DSI.

Connector Reference (board side): Phoenix Contact 1787027
Recommended mating connector (wire harness side): Phoenix Contact 1790302

Figure 15: Phoenix contact – 1787027

Table 7: Emergency Shutdown & Wake-Up connector description

PIN	FUNCTION	DESCRIPTION
1	WAKEUP_IN	Input to Wake-Up EVCC board
2	GND	Ground
6	WAKEUP_OUT	Wake-Up status of EVCC board
4	GND	Ground
5	EMS_SHUT +	EMS positive polarity
6	EMS_SHUT –	EMS negative polarity

5.8 Lock Motor , relay drive and feedback

The Lock motor connector is used to connect motor driver of EVCC board to lock motor.
The current lock motor block is designed to be compatible with 4 lock motor sensor type:

- 4-30mA position feedback
- Open/Close circuit position feedback
- 1kΩ/11kΩ position feedback$
- 3poles lock motor

Connector Reference (board side): Phoenix Contact 1787043
Recommended mating connector (wire harness side): Phoenix Contact 1790328

Figure 16: Phoenix contact – 1787043

Table 8: Lock Motor & Relay pinout description

PIN	FUNCTION	DESCRIPTION
1	LOCK_MOTOR_DRIVE_PIN1	Drive pin
2	LOCK_MOTOR_DRIVE_PIN3	Drive pin
3	LOCK_MOTOR_POSITION	Lock motor position feedback signal
4	V_LOCK_POWR	Power input (to provide) for driving the lock motor – Usually 12V or 24V
5	SUPPLIES_GROUND	Supplies ground pin
6	DSO_POWR_OUT1	Digital Signal Output with driving capabilities (for relay or coil)
7	DSO_POWR_OUT2	Digital Signal Output with driving capabilities (for relay or coil)
8	DSI_IN1	Digital Signal Input
9	DSI_IN2	Digital Signal Input
10	V_DSO_POWR	Power input (to provide) for the DSO POWR outputs

EVCC proposes 2 DSO outputs and 2 digital inputs to be able to drive relay and contactors and get their auxiliary feedback.

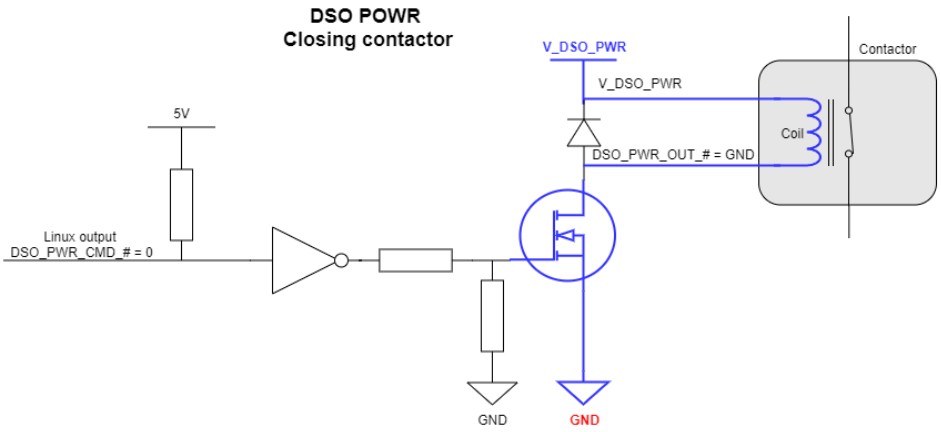


Figure 17: Relay drive

5.9 CCS signals

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

5.9.1 Main connector:

Connector Reference (converter side): Phoenix Contact DMC 1,5/ 4-G1F-3,5-LR P20THR - 1787030
Recommended mating connector (wire harness side): DFMC 1,5/ 4-STF-3,5 - 1790315

Figure 18: Combo connector (Phoenix Contact 1787030)

Table 9: 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

5.9.2 HV DC voltage measurements connector:

Table 10: COMBO HVDC connector description

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

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

Figure 19: DEGSON 9EDGRB-7.62-02P

Recommended mating connectors

Figure 20: DEGSON 9EDGKD-7.62-03P

6 Software specifications

6.1 System architecture

System architecture is designed to be composed of:

- Up to 2 EVCC boards (EVCC-A and EVCC-B)
- 1 EVIX board (extension)

6.2 Multi EVCC configuration

EVCC can operate in single configuration for 1 Combo communication port. Multiple EVCC's on the same CAN bus (to increase the number of ports) are limited to 2 for both hardware and software limitations.

6.2.1 EVCC-A or B configurations

To allow having 2 EVCC boards on same system, there are 2 boards configurations available: EVCC-A and EVCC-B. The board identify its configuration at boot-up. This configuration is set-up pin 4 of dipswitch as explained on chapter **4.1.1 Wake-Up strategy**

Dipswtich pin 4	EVCC configuration	Chipset CAN node ID	Plug module CAN node ID
1	EVCC-A	0x60	0x61
0	EVCC-B	0x70	0x71

Please consult the engineering team (engineering@wattandwell.com) for more details on how to operate 2 EVCC's together

6.3 System communication

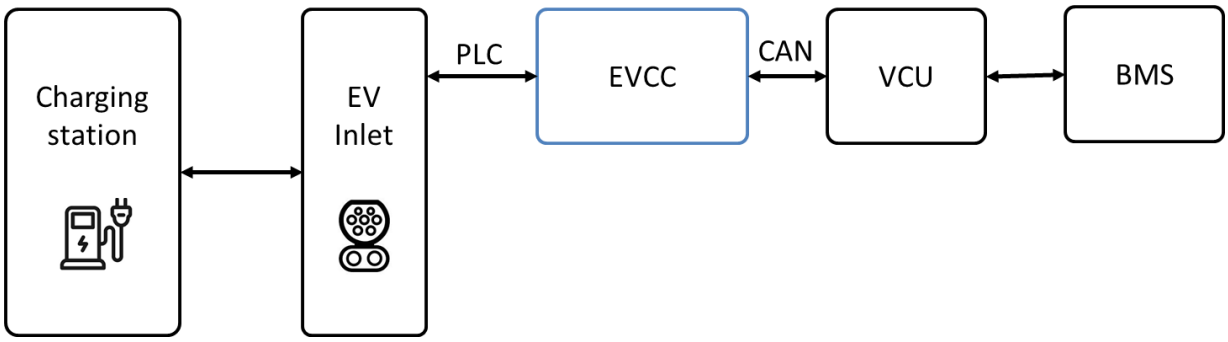


Figure 21: EVCC communications

EVCC product communicates on EV inlet side with Charging station through PLC communications and with the rest of system through CAN bus.

VCU and BMS interface documentations are available on demand.

6.3.1 CAN communication

Communication between devices of the system is based on CAN communication following the CAN open protocol with the following characteristics:

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

Node ID definition & Heartbeat
Each node has a unique Node ID and Heartbeat ID. It automatically transmits its communication state at regular intervals as evidence of its communication ability.

All CAN devices in system have a specified Node ID which respects the following table:

Board	Device	CAN Node ID (decimal)	HeartBeat Frame ID	Description
Supervisor	SUP	2 (0x02)	0x702	
EVCC-A	CS (Chipset)	96 (0x60)	0x760	Charge point manager on side A
EVCC-A	PM CCS	97(0x61)	0x761	ISO15118 & DIN70121 stack manager on side A
EVCC-B	CS (Chipset)	112(0x70)	0x770	Charge point manager - Side B
EVCC-B	PM CCS	113(0x71)	0x771	ISO15118 & DIN70121 stack manager - Side B

7 Mechanical specifications

7.1 EVCC dimensions

- Length 180 mm
- Width 120 mm
- Height: total height is 28mm
    - Top component height: 17mm
    - Bottom component height: 9mm
- Weight: 230 gr

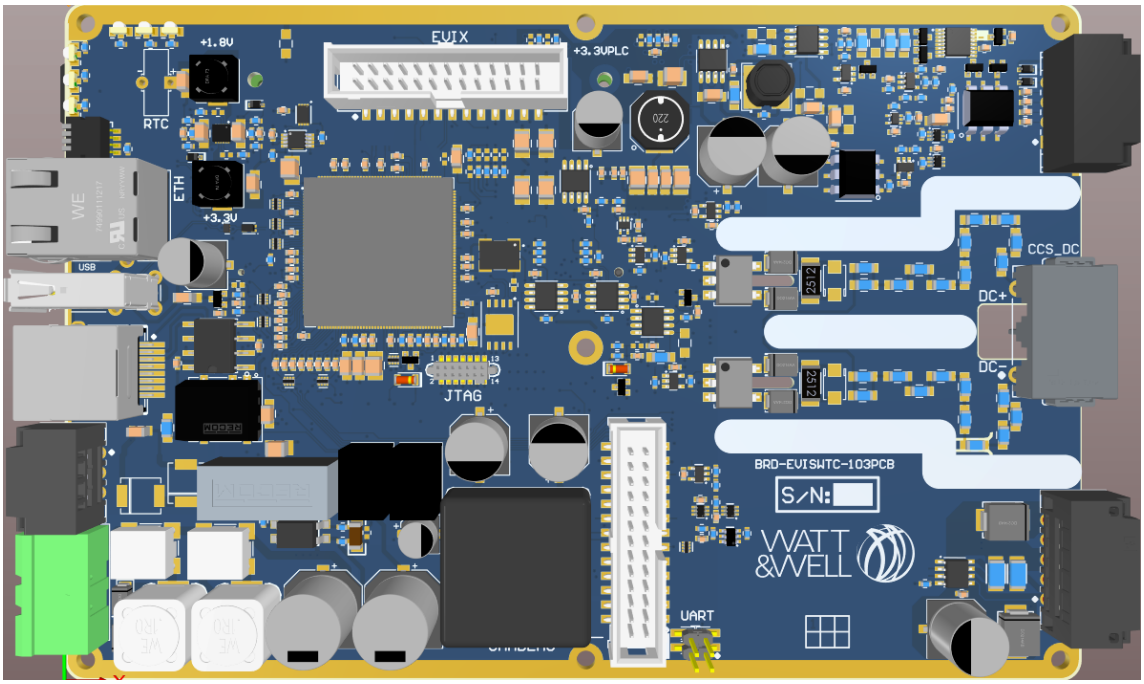


Figure 22: EVCC dimensions

8 Safety instructions

8.1 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.

8.2 Installation

EVCC is delivered as an open frame board, that is, without protective enclosure or chassis. 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. 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. 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.

8.3 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

8.4 Environmental condition

EVCC 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[1]


Protective ground conductor terminal

8.5 Normative compliance

EVCC is compliant with European directives:

- ROHS Directive 2011/65/UE
- WEEE Directive 2012/19/UE

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

8.6 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 [redacted] 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

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

9 Installation

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

9.1 Mechanical installation

Refer to section 7 for the dimensions of the product

9.2 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.

9.2.1 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 EVCC is installed is grounded to ensure correct connection.

9.2.2 LV input

An auxiliary LV input must be connected to a 12 or 24 Vdc bus depending on version. 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 200 V (line to line)
- Maximum input overvoltage 500 V (line to PE)

10 Maintenance

No maintenance is required on this product

10.1 Cleaning

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

11 Ordering information

11.1 Product Reference

Family Code	_	COMBO port	
		HW	Stack
EVCC		C: CCS port	0: No stack
			1: V1G stack
			2: V2G stack

The following table provides an overview of the available EVCC boards variants.

Order code	Hardware support	Included software stack
EVCC-C1	CCS port	Yes

11.2 Product accessories

WA006 – Pre-wired LV connector With color-coded 4mm insulated banana plug Cable length: 1m	
WA007 – CAN bus adaptor from RJ45 to DB9 including 120 Ω termination resistance	

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