User Manual
vSECC Controllers
Supply Equipment Communication Controllers

Version 2.9

Contents

1 Introduction

In this chapter you will find the following information:

1.1 About This User Manual

1.1.1 How to find information quickly

This user manual provides you with the following access help:

> At the beginning of each chapter, you will find a summary of its contents
> The header indicates the current chapter of the manual
> The footer shows the manual’s version
> At the end of the manual, you will find a glossary to look up used technical terms and abbreviations

1.1.2 Conventions

The two tables below show the notation and icon conventions used throughout this manual.

Style	Utilization
bold	Fields/blocks, user/surface interface elements, window- and dialog names of the software **[OK]** Buttons in square brackets **File|Save** Notation for menus and menu commands
`Source Code`	File and directory names, source code, class and object names, object attributes and values
`Hyperlink`	Hyperlinks and references
Emphasis	Terms with special emphasis

Symbol	Utilization
	This icon indicates notes and tips that facilitate your work.
	This icon warns of dangers that could lead to damage.
	This icon indicates step-by-step instructions.
	This icon indicates an introduction to a specific topic.

1.1.3 Certification

Vector Informatik GmbH is certified under ISO 9001. The ISO standard is a globally recognized standard. Details can be found at the Vector website.

1.1.4 Warranty

We reserve the right to modify the contents of the documentation or the software without notice. Vector disclaims all liabilities for the completeness or correctness of the contents and for damages which may result from the use of this documentation.

1.1.5 Service, Support and Disposal

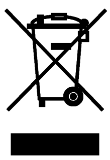
You can issue a support or hardware repair request online at vector.com/support or in our Vector Customer Portal at portal.vector.com.
You can get through to our Support hotline by calling +49 (0)711 80670-200.

Please also revise the Vector KnowledgeBase for Frequently Asked Questions.

If you want to return the device, please remove all things that were not part of the original delivery, e.g. SD cards, and send it back to:

> Vector Informatik GmbH
Dept. CPL4
Motorstr. 56
70499 Stuttgart
Germany

Observe the national regulations and laws for the disposal of the device. Ask your supplier if you are not sure how to dispose the device. Within the European Community, the Directive on Waste Electrical and Electronic Equipment (WEEE Directive) and the Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS Directive) apply.



1.1.6 Trademarks

All brand names in this documentation are either registered or non-registered trademarks of their respective owners.

1.2 Important Notes

1.2.1 Safety Instructions and Hazard Warnings

Caution: In order to avoid personal injuries and damage to property, you must read and understand the following safety instructions and hazard warnings prior to installation and use of the product. Provide this documentation (manual) to every user of the product.

1.2.2 Proper Use and Intended Purpose

The Supply Equipment Communication Controllers are used for communication between the vehicle's charge controller and the supply equipment via the charging cable and CCS or CHAdeMO (only vSECC) plug connections provided for this purpose. Based on the received and transmitted information, messages for interaction with the supply equipment operator and for controlling the power electronics are exchanged with other components of the supply equipment. The controller also sends messages to the back end of the charging station, the Charging Station Management System.

Caution: The product is designed for permanent, fixed installation in closed control cabinets and stationary charging equipment. The installation environment must be dry and protected from the weather.

Caution: Only specifically qualified, trained and authorized personnel is allowed to install, set up, configure and operate the product to prevent accidents from hazardous electrical voltage or electrical power. Access to operating products must be limited to authorized personnel at any time. The housing of the vSECC must always be assembled during operation. The device may only be used with appropriate connectors. The connectors of the vSECC Controllers may only be used and operated within the specified range, the information in the manual must be observed.

The product can be integrated into an existing IT infrastructure. The configuration of the respective parameters and IT security is the responsibility of the customer.

Caution: vSECC Controllers contain components and circuits that communicate with other components and circuits that can store and transform energy. The user has to take care of the resulting dangers and make a separate risk assessment. The devices may only be operated within the specified temperature range.

Caution: Electrical safety and data security of the Supply Equipment must be assured by separate means and is not in scope of the product. In particular, effective measures must be taken to avoid damage and injury caused by overload or short circuit in the electric power installation independent from the vSECC Controllers.

Caution: Neither the monitoring of residual current and insulation, relay monitoring (main conductor), especially sticking of the conductors; nor the cooling function (use of the temperature sensors for monitoring), monitoring of battery and wire and the performance limits in the vehicle; nor the monitoring of power electronics incl. contactors (especially emergency shutdown devices) is in the scope of the product and must therefore be assured by separate means.

1.2.3 Foreseeable Misuse

Caution: vSECC Controllers do not comply with the directive 2014/34/EU and must therefore not be used in explosion critical areas. Operation or installation in mobile equipment without adequate protection against weather and moisture is not allowed. The electrical safety of the supply equipment is not in the scope of the vSECC Controllers' functionality and must be assured independently by suitable measures such as insulation monitoring, residual current detection, overload protection and circuit breaker. It is not permitted to use the device for purposes other than controlling the charging communication. Interventions or changes to the hardware are not permitted. The vSECC Controllers may only be installed and operated by qualified and instructed personnel, who is familiar with the contents of this document and must have access to it at all times.

1.2.4 Hazards

Caution: Supply Equipment operates under high voltage which could also occur at the product in case of failure and cause heavy injury and damage. Wrong configuration and/or operation of the product may cause failures of the Supply Equipment leading to personal injury or damage to property.
Comply with safety standards and public regulations which are relevant for the operation of the system. Before you can operate the system in public areas, it should be tested on a site which is not accessible to the public and specifically prepared for performing tests in order to reduce hazards.

1.2.5 Disclaimer

Caution: Claims based on defects and liability claims against Vector are excluded to the extent damages or errors are caused by improper use of the controller or use not according to its intended purpose. The same applies to damages or errors arising from incorrect mounting, insufficient training or lack of experience of personnel using the controller.

1.2.6 Open-Source Licenses

vSECC Software includes several open source software tools. This open source software is governed by the terms and conditions of the applicable open source license. You are bound to the terms and conditions of the applicable open source license in connection with your use and distribution of the open source software in this product.

A complete list of open source software modules and their respective licenses can be found in the provided `ThirdPartyLicenses.html` file.

Upon request, we will provide the applicable GPL/LGPL source code files via the Vector Portal for a nominal cost to cover provisioning as allowed under the GPL. This offer is valid for 3 years.

1.3 vSECC Controllers at a Glance

The vSECC Family consists of various Supply Equipment Communication Controllers (SECC) and is designed to be used in smart charging applications.

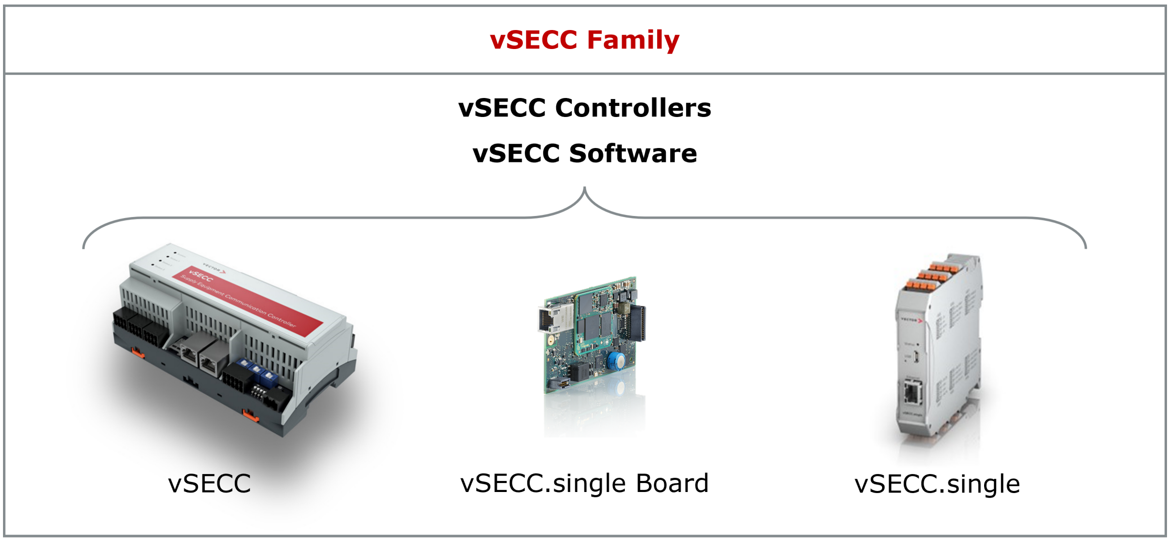


Figure 1: The vSECC Family

The vSECC Controllers designate the hardware products, which all share the same vSECC Software. Different software options are available to choose from. Today, the vSECC Software is capable of DC (bidirectional) charging; AC charging will follow at a later release. The vSECC Software is responsible for the communication between an Electric Vehicle (EV), a Charging Station Management System (CSMS), the Power Electronics (PE) and peripherals.

The **vSECC** is designed for handling up to two CCS DC (Type 1 or 2) charge points in parallel, or one CCS DC and one CHAdeMO charge point. Moreover, the vSECC can control charging stations for roof-mounted or inverted pantograph charging. In a later release it will be possible to use an AC connector as the second charge point. All the future options will be available via a pure software update.

The **vSECC.single Board** manages one CCS DC charge point and is designed for an highly integrated solution, e.g. for DC wallboxes, mobile chargers and small charge point outlets. The connectors of the vSECC.single Board's interfaces are to be placed on a so-called base board (as shown in Figure 4), which can be developed by our customers (for the integrated solution).

The **vSECC.single** handles the charging communication for one CCS DC charge point. It includes the vSECC.single Board and the so-called base board, all placed into a handy housing for mounting on a DIN rail.

The large number of practical interfaces make the vSECC Controllers widely applicable for the rapid implementation of intelligent charging stations and DC wallboxes.
The communication to the EV is established by Control Pilot (CP) basic signaling (IEC 61851 and SAE J1772), Power Line Communication (PLC) for CCS DC charging and roof-mounted pantograph charging according to DIN SPEC 70121 and ISO 15118-2, -3 and -20. Bi-directional power transfer as defined in the ISO 15118-20 is also possible with the vSECC Controllers. Moreover, the **vSECC** realizes CHAdeMO charging via CAN or inverted pantograph charging according to OppCharge via Ethernet and a Wireless Access Point (WAP).
The vSECC Controllers provide the possibilities for identification at the charging station with External Identification Means (EIM), Autocharge and Plug & Charge (PnC) as standardized in ISO 15118-2.
For the communication to the back end, e.g. for load management, the vSECC Controllers require an Open Charge Point Protocol (OCPP) 1.6J or 2.0.1 compliant CSMS, such as Vector's vCharM.
The vSECC Controllers are designed to communicate with the power electronics over Ethernet WebSocket or CAN, using the Power Electronics Protocols (PEP-WS and PEP-CAN) which are specified by Vector and will be delivered along with the controller.

For some functionalities, e.g. the usage of BPT or P&C, a license is required. Please get in touch with your sales contact for details.

1.3.1 vSECC Interfaces Overview

A top-level connection scheme of the vSECC is shown in Figure 2.

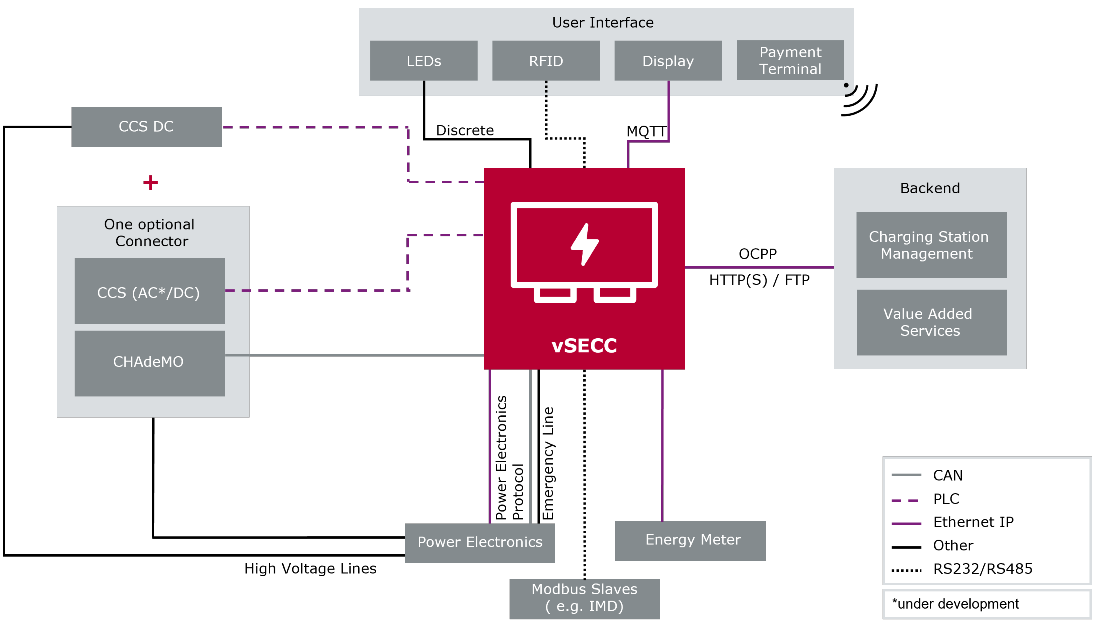


Figure 2: vSECC connection scheme

The hardware overview shown in Figure 5 in chapter 2.2 includes all connectors available with the fully populated vSECC. With the current version of the vSECC, the following connectors can be used:

- X300: CHAdeMO Charging Connector
- X301: Analog Inputs (e.g. Temperature Sensors)
- X302: CCS Charging Connector 2
- X303: CCS Charging Connector 1
- X304: Safety Outputs
- X305: Serial Communication (2x CAN, RS232, RS485)
- X306: Digital In-/Outputs, Start (CHAdeMO) and Stop Buttons, Pantograph Control
- X307: Power Supply Connector
- ETH1: RJ45 Ethernet Connector 1
- ETH2: RJ45 Ethernet Connector 2

The connectors are described more in detail in chapter 2.2.

1.3.2 vSECC.single Board Interfaces Overview

A top-level connection scheme of the vSECC.single Board is shown in Figure 3.

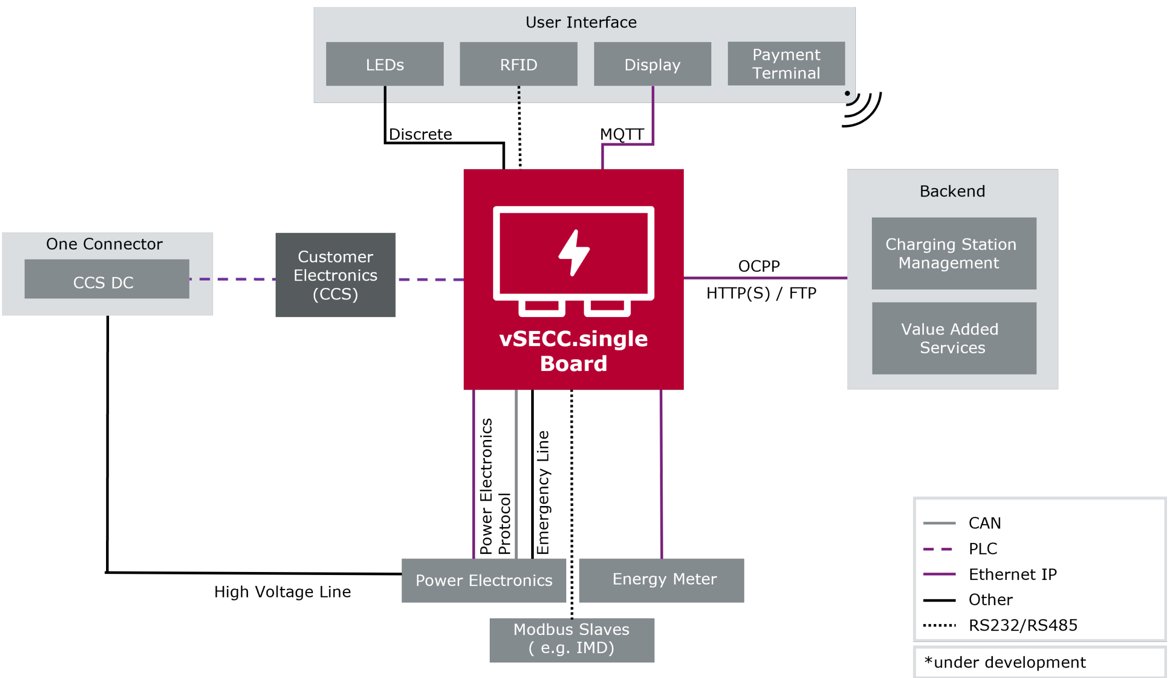


Figure 3: vSECC.single Board connection scheme

The hardware overview shown in Figure 17 in chapter 3.2 shows the connectors, including those that connect the vSECC.single Board to a so-called base board. With the current version of the vSECC.single Board, the following functionality is given for the connector and the respective pins:

> Connector X300:
  > Power Supply
  > Digital In-/Outputs
  > Analog Inputs
  > Serial Communication (1x CAN, RS232, RS485)
  > Safety Output
> Connector X301:
  > CCS Charging Communication
  > Temperature Sensors
> RJ45 Ethernet Connector

The connectors are described more in detail in chapter 3.2.

1.3.3 vSECC.single Interfaces Overview

A top-level connection scheme of the vSECC.single is shown in Figure 4.

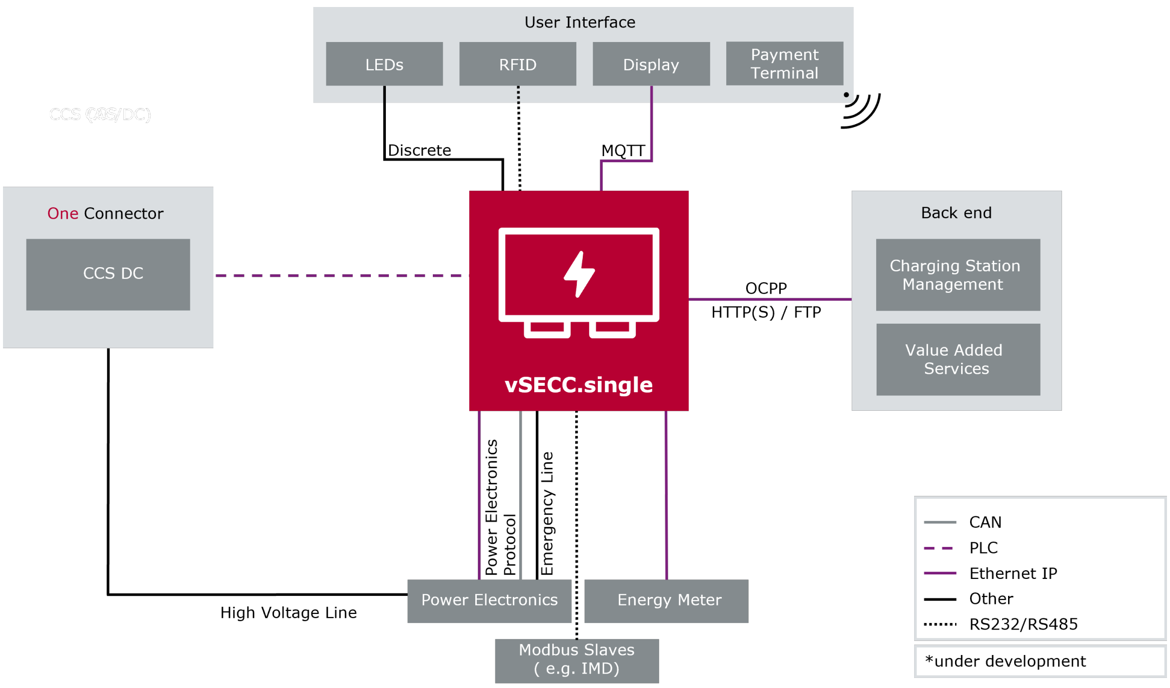


Figure 4: vSECC.single connection scheme

The hardware overview shown in Figure 21 in chapter 4.2 includes all connectors available with the fully populated vSECC.single.
With the current version of the vSECC.single, the following connectors can be used:

> X301: Digital/Analog Inputs

- > X302: CCS Charging Communication
- > X303: Safety Output
- > X304: Analog Temperature Inputs
- > X306: Power Supply, Serial Communication (RS232)
- > X307: Serial Communication (1x CAN, RS485)
- > ETH: RJ45 Ethernet Connector

The connectors are described more in detail in chapter 4.2.

1.4 vSECC Software Features

1.4.1 CCS Type 2 DC charging

- > IEC 61851 Control Pilot for basic communication
- > DIN SPEC 70121 High Level Communication
- > ISO 15118-2/-3 High Level Communication (DC only)
- > Authentication via External Identification Means (EIM)
- > Load leveling based on power electronics limits and CSMS charging schedules (received via OCPP interface)
- > Renegotiation process according to ISO 15118-2
- > Charge pause according to ISO 15118-2 and ISO 15118-3:
  - > EVSE wakeup by EV CP state BCB toggle
  - > EV wakeup by EVSE CP state by PWM signal change 100% → 5% and, if necessary BEB toggle
  - > **NEW!** EV wakeup can also be triggered via the MQTT interface **(v2.9)**
- > IEC Control Pilot signal and basic signalling (PWM) is only used for High Level Communication
- > Configurable EnergyTransferModes according to ISO 15118-2: DC_EXTENDED / DC_COMBO_CORE / DC_CORE / DC_UNIQUE

1.4.2 CCS Type 1 DC charging

- > SAE J1772 Control Pilot for basic communication
- > Same high level communication features as in CCS Type 2 DC charging
- > SAE Control Pilot signal and basic signalling (PWM) is only used for High Level Communication
- > SAE Proximity Pin (PP) handling for controlled emergency shutdown
- > Diagnostics of DIP-switch settings, if PP supervision is active

1.4.3 Prototypical Bidirectional Power Transfer with ISO 15118-20

> Charging communication according to ISO 15118-20 (DC BPT only)
> Support of dynamic control mode only
> Setting the dynamic setpoint for (dis-)charging via OCPP device model variable

1.4.4 Prototypical CHAdeMO 0.9.1 and v1.2 charging (Option, only for vSECC)

> Charging communication according CHAdeMO 0.9.1 and v1.2 protocol specification
> Handling of CHAdeMO Start and Stop Buttons

1.4.5 Prototypical OppCharge charging (Option, only for vSECC)

> Charging communication according to OppCharge v1.3.0 protocol specification based on ISO/IEC DIS 15118-2
> Pantograph Control via digital I/Os or PEP-WS

1.4.6 Value Added Services (Internet)

> The vSECC software can be configured to offer internet access via ISO 15118 Value Added Services (VAS)
> Supports the service announcement internet access for TCP port 80 and 443
> The vSECC Controller supports the vehicle to set a global dynamic IPv6 address via Neighbor Discovery for IP version 6 (RFC 4861)
> The vSECC Controller supports VAS back ends with a fixed IPv6 address

1.4.7 Charging Schedules

> Charging Schedules are configurable as static PowerMaxLimit or provided by CSMS
> Default Charging Profiles provided by CSMS are persisted as required by OCPP

1.4.8 Secure Operating System

> Secure boot mechanisms to run only signed and verified software on the device
> Usage of hardware related security mechanisms to recognize modified software
> Linux based operating system

1.4.9 Symmetric Key and Certifcate Handling

- Creation of certificate signing requests (CSR)
- V2G EVSE leaf certificate installation (including private key creation) through CSR using OCPP
- CSMS Root certificate installation and deletion using OCPP
- Installing client certificates sent by the CSMS
- Usage of the secure storage for private keys and certificates that are used for client certificate authentication

1.4.10 Hardware IEC CP/PP supervision

- Creation of certificate signing requests (CSR)
- Proximity Pin (PP) and Control Pilot (CP) as dedicated hardware function to monitor and shutdown in emergency case
- Normally Open (relay based, potential-free) switching output

1.4.11 Stop Charging

- Graceful stop of charging by CSMS via OCPP
- Graceful stop of charging by power electronics via PEP
- Graceful stop of charging by physical stop buttons via digital inputs

1.4.12 Remote Start of Charging Sequence

- Allows starting a charging sequence remotely while the EV is plugged-in
- The remote start can be triggered by using the OCPP 1.6 message ”RemoteStart-Transaction” or OCPP 2.0.1 ”RequestStartTransactionRequest” or **(NEW! in v2.9)** via the MQTT interface
- A remote start causes a transition from CP state B to E and back, simulating unplugging and plugging in the EV

1.4.13 CSMS connectivity (OCPP)

- Supported CSMS protocols:
  - OCPP 2.0.1
  - OCPP 1.6J
- WebSocket based connection according to OCPP 2.0.1: Part 4 – JSON and OCPP-J 1.6 Specification over WebSocket is supported
- The ”Basic Implementation of OCPP 2.0” as defined in the OCPP 2.0 standard (OCPP 2.0.1: Part 0 – Introduction) is supported

1.4.14 OCPP 2.0.1 Use Cases

> It is possible to update the charging station credentials (OCPP 2.0.1 use cases A01 – A02)
> It is possible to boot the charging station (OCPP 2.0.1 use cases B01 – B04)
> It is possible to configure the charging station via a CSMS (OCPP 2.0.1 use cases B05 – B07)
> It is possible to reset the charging station (OCPP 2.0.1 use cases B11, B12)
> It is possible to authorize a driver using RFID, Plug & Charge, a start button and ISO 15118 External Identification Means (EIM). Offline authorization of an Unknown Token is possible (OCPP 2.0.1 use cases C01, C02, C07, C08, C15; *certificate-based authorization is not a feature of OCPP 1.6J specification*)
> It is possible to remotely authorize a driver through the CSMS, e.g. by using credit card information or a smartphone app (OCPP 2.0.1 use cases C03, C05, F01, F02)
> It is possible to start and stop transactions also while the charging station is offline and end the charging process (OCPP 2.0.1 use cases E01 – E09, E11 – E13, E15)
> It is possible to remotely stop transactions and the charging (OCPP 2.0.1 use cases F03, F04)
> It is possible to remotely trigger messages (OCPP 2.0.1 use case F06)
> It is possible to change and report the availability of an EVSE and its connectors (OCPP 2.0.1 use cases G01 – G04)
> **NEW!** It is possible to provide tariff and cost information to the customer (OCPP 2.0.1 use cases I02 - I04) **(v2.9)**
> It is possible to send transaction related meter values (OCPP 2.0.1 use case J02)
> It is possible to perform General Smart Charging and Renegotiation (OCPP 2.0.1 use cases K01, K02, K06, K07, K10, K16, K17)
> It is possible to perform firmware updates (OCPP 2.0.1 use case L02) via HTTP/HTTPS and FTP protocol **(NEW! in v2.9)**
> It is possible to delete certificates from a charging station and to install CA certificates (OCPP 2.0.1 use cases M04, M05)
> It is possible to upload log files (OCPP 2.0.1 use case N01) via HTTP/HTTPS and FTP **(NEW! in v2.9)** protocol
> It is possible to set and clear monitors and monitoring events (OCPP 2.0.1 use cases N04, N06 – N08; *not a feature of OCPP 1.6J specification*)
> Any non-supported messages are rejected

1.4.15 OCPP 1.6J Messages

The following messages of the OCPP 1.6J specification are supported:

- "Core" Profile
  - Authorize
  - BootNotification
  - ChangeAvailability
  - ChangeConfiguration
  - **NEW!** DataTransfer (only for charging cost) **(v2.9)**
  - GetConfiguration
  - Heartbeat
  - MeterValues
  - RemoteStartTransaction
  - RemoteStopTransaction
  - Reset
  - StartTransaction
  - StatusNotification
  - StopTransaction
- "Firmware Management" Profile
  - GetDiagnostics
  - DiagnosticsStatusNotification
  - FirmwareStatusNotification
  - UpdateFirmware
- "Smart Charging" Profile
  - ClearChargingProfile
  - SetChargingProfile
- "Remote Trigger" Profile
  - TriggerMessage
- "Security" Profile
  - CertificateSigned
  - DeleteCertificate
  - ExtendedTriggerMessage
  - GetLog
  - InstallCertificate
  - LogStatusNotification
  - SignCertificate

1.4.16 AutoCharge for identification of vehicles

> Pre-stage to Plug & Charge (ISO 15118) with simple EVCC-ID identification
> Vehicles can be identified by their EVCC-ID (MAC address of the EVCC) at the CSMS
> Vehicles can be authorized for charging by sending their EVCC-ID to the CSMS
> Authorization can be turned on/off in the vSECC Controllers' configuration file
> If a vehicle is not authorized to charge, no charging transaction is started
> If no connection to a CSMS is established, the vehicle is assumed to be unauthorized and no charging will take place

1.4.17 Authorization with RFID

- Hardware support of the following RFID readers via RS232:
  - MCRN2-RS232 RFID reader from Minova
  - TWN4 MultiTech (2) Series from Elatec
- Usage of the cardID for authorizing the vehicle/driver for a charging session
- One reader for all charging connectors is supported
- Transactions can be stopped by presenting the RFID token again
- Transactions get stopped automatically if the authorized token expires or is blocked by the CSMS during the charging process

1.4.18 NEW! External Authorization (v2.9)

- MQTT interface for external authorization with custom hardware
- Supports all types of OCPP 2.0.1 tokens
- Token can be pre-authorized or passed to the CSMS for authorization
- Enables an individual and flexible authorization sequence

1.4.19 Prototypical Authorization with Plug & Charge

- Support of Plug & Charge acc. to ISO 15118-2
- Authorization of vehicles by Contract Certificate
- Contract Certificate validation by CSMS
- EVSE Leaf Certificate installation possible via OCPP and Web Interface

1.4.20 NEW! Usage of Payment Terminals (v2.9)

> Support of cloud-based payment terminals with no direct interface to vSECC Controller
> Tariffs and the cost for charging are provided via OCPP and published on MQTT broker for display
> Compliant with German Eichrecht
> Possibility to inform the driver with an everyday language message and provide a machine-readable tariff to the energy meter at the same time

1.4.21 MQTT Broker

> MQTT broker with subscribe and publish access via ethernet interfaces
> Basic charging information is published on MQTT broker
> Digital/analog/temperature input states are published on MQTT broker

1.4.22 Power electronics control via Ethernet (PEP-WS)

> Connection to power electronic via physical Ethernet
> Communication based on WebSocket connection with JSON data exchange
> Usage of Vector’s protocol specification PEP-WS 1.8

1.4.23 Power electronics control via CAN (PEP-CAN)

> Connection to up to 2 power electronics via physical CAN (one CAN-bus)
> Communication based on Vector’s protocol specification PEP-CAN 1.4
> CAN-IDs and baudrate are configurable

1.4.24 Dynamic Switching of Power Electronics modules

> Allows switching between multiple power electronics for the vSECC’s two connectors
> Updated PEP specification to inform the power electronics about changes in charging profiles
> This is only possible using OCPP 2.0.1

1.4.25 Modbus Gateway

> Usage of Modbus RTU devices, connected to vSECC Controller’s RS485 interface, via Modbus TCP
> Fixed Modbus RTU settings on RS485
> Modbus TCP is accessible via both Ethernet interfaces (vSECC only)

1.4.26 Energy Meter Support

- Virtual energy meter: Voltage and current are taken from power electronics values to calculate power and energy
- Ethernet based energy meter (LEM): Support of LEM energy meter (see Section 5.28.1 for details)
- **NEW!** Interfacing with energy meters is possible via MQTT broker **v2.9**
- Forward of signed meter values (OCMF[1]) for LEM & MQTT energy meter to support German Eichrecht

1.4.27 Web-based Device Management

- The vSECC Controllers can be configured via a local web front end
- The vSECC Controller runs a HTTP server that allows accessing the web-based configuration via Ethernet interfaces and a normal web
- Configuration of the controller is possible via Python script
- **NEW!** The local time, date and time zone can be set and synchronized with various sources **v2.9**
- The network setting can be updated
- The password can be changed
- Firmware updates can be installed
- Licenses (to use features that require a license) can be installed
- Log files can be downloaded and cleared
- Certificates (e.g. for TLS encryption) can be installed
- The vSECC Controller allows to open a remote support interface to vector's support servers on customer request

1.4.28 Firmware Update

- Firmware updates are possible via:
  - CSMS with OCPP 1.6 and OCPP 2.0.1 use case L02
  - Web Interface
- Supported download methods: HTTP/HTTPS, **(NEW! in v2.9)** FTP
- Secure firmware images (accepts only signed updates)

[1]OCMF: Open Charge Metering Format

1.4.29 Log File Management

> Log Files can be downloaded and cleared in the Web Interface
> Log File upload to CSMS with OCPP 1.6 and according to OCPP 2.0.1 use case N01
> Supported upload methods: HTTP/HTTPS, **(NEW! in v2.9)** FTP
> vSECC Software notifies the CSMS of the current upload status

1.4.30 PLC Logging

> Logging of whole PLC communication between vSECC Controller and EV into trace files
> Trace files can be interpreted e.g. by CANoe and Wireshark
> Activation and deactivation via web interface
> **NEW!** Logfiles are rotated after running for about 2 days (20 MB size) **v2.9**

1.5 Scope of Delivery

Each delivery consists of a certain number of controllers, as specified in the order, the Safety Instructions and a link to the User Manual.

1.6 International Certification

In the following, country-specific certificates and information is listed. The official documents can be found in Appendix A.

Please note that for some countries, the vSECC.single is not yet certified. As the vSECC.single Board is no stand-alone controller, it is not certified by Vector.

1.6.1 CE

1.6.2 UKCA

1.6.3 FCC

FCC ID vSECC: 2AXYRVSECC

Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

1.6.4 cCSAus (”UL certification”)

1.6.5 ICES

Vector’s self-declaration of compliance with ISED’s ICES standard applicable:

CAN ICES-003(B) / NMB-003(B)

1.6.6 BIS (vSECC only)

IS 13252

R-41194808

Manufacturer:	Vector Informatik GmbH
Electrical Power:	Input 18-30 V
	<5 A
Model Number:	20006
Brand:	Vector
Country of Origin:	Germany

1.6.7 KC

Company Name:	Vector Informatik GmbH	
Product Name:	Supply Equipment Communication Controller (IMI61)	
Manufacturer:	Vector Informatik GmbH	
Country of Manufacture:	Germany	
Model Name:	vSECC	vSECC.single
Registration No.	R-R-VeC-vSECC	R-R-VeC-vSECCsingle
Date of Manufacture:	11-2020	03-2023

2 Installation Guide vSECC

In this chapter you will find the following information:

2.1 Physical Mounting

The vSECC is equipped with a mounting bracket which allows for an easy installation on a top-hat rail.

2.2 Electrical Connections

For wiring examples showing different use cases, please refer to Appendix D.

Figure 5 shows the vSECC from above. Each connector is described in detail below.

Figure 5: vSECC connector overview

We recommend purchasing the **vSECC Connector Kit**, please consult your Vector sales contact for details.
Alternatively, the following connector types can be directly obtained from **Phoenix Contact** for connecting to the vSECC:

vSECC Connector	Phoenix Contact Connector Name	Order Key
X301	DFMC 1,5 / 10-ST-3,5	1790182
X300, X302, X303	DFMC 1,5 / 4-ST-3,5	1790124
X304	DFMC 1,5 / 3-ST-3,5	1790111
X305	DFMC 1,5 / 5-ST-3,5	1790137
X306	DFMC 1,5 / 13-ST-3,5	1790218
X307	FKCN 2,5 / 2-ST-5,08	1754568

Caution: Please make sure that no pulling forces are applied on the wiring harness or connectors to make sure that no connector is getting pulled out.

2.2.1 X300 - CHAdeMO

1 CHD SEQ1	3 CHRG PER	5 LATCH OUT	7 GBT CC1
2 CHD SEQ2	4 PROX DET	6 LATCH IN	8 PE

Figure 6: vSECC connector: X300

This connector is used for the CHAdeMO charging interface. The pins have the following functional assignment and must be connected to the respective circuit of the charging cable.

- Pin 1, CHD SEQ1: CHAdeMO Charge Sequence Signal 1
- Pin 2, CHD SEQ2: CHAdeMO Charge Sequence Signal 2
- Pin 3, CHRG PER: Vehicle Charge Permission
- Pin 4, PROX DET: CHAdeMO Connector Proximity Detection
- Pin 5, LATCH OUT: Latch Control (output)
- Pin 6, LATCH IN: Latch Monitoring (input)
- Pin 8, PE: Protective Earth

Pin 7 is intended for GB/T or ChaoJi functionality and will be used for planned features coming with future software releases.

2.2.2 X301 - Analog In and Temperature Sensor Connectors

1 0-10V 2	3 AGND	5 AGND	7 TEMP 8	9 AGND	11 TEMP 6	13 AGND	15 TEMP 4	17 AGND	19 TEMP 2
2 0-10V 1	4 TEMP 9	6 AGND	8 TEMP 7	10 AGND	12 TEMP 5	14 AGND	16 TEMP 3	18 AGND	20 TEMP 1

Figure 7: vSECC connector: X301

This connector is used for both analog input signals and external temperature sensors. See section 5.25.7 and 5.25.8 for details and a mapping of PEP-identifiers to connector pins.

2.2.3 X302 - CCS Charging Connector 2

1 M2a	**3** FB2	**5** PP2-PU	**7** CP2
2 M2b	**4** GND	**6** PP2	**8** PE

Figure 8: vSECC connector: X302

This connector is used for CCS Charging at charging port 2. Today, only DC charging is supported, which requires the following pins:

> Pin 6, PP2: Proximity Pin for SAE J1772 Proximity Detection (only used for CCS Type 1).

> Pin 7, CP2: Control Pilot line which corresponds to the respective pin of the second CCS connector.

> Pin 8, PE: Protective Earth for CCS connector 2.

The following pins may be used in the future. For now, they are ignored:

> Pin 1, M2a: Required for AC-charging.

> Pin 2, M2b: Required for AC-charging.

> Pin 3, FB2: Required for AC-charging.

> Pin 5, PP2-PU: Not used.

Please be aware of the naming: The connector X302 which has the lower number corresponds to the logical CCS connector 2.

2.2.4 X303 - CCS Charging Connector 1

1 M1a	**3** FB1	**5** PP1-PU	**7** CP1
2 M1b	**4** GND	**6** PP1	**8** PE

Figure 9: vSECC connector: X303

This connector is used for CCS Charging at charging port 1. Today, only DC charging is supported, which requires the following pins:

> Pin 6, PP1: Proximity Pin for SAE J1772 Proximity Detection (only used for CCS Type 1).

> Pin 7, CP1: Control Pilot line which corresponds to the respective pin of the first CCS connector.
> Pin 8, PE: Protective Earth for CCS connector 1.

The following pins may be used in the future. For now, they are ignored:

> Pin 1, M1a: Required for AC-charging.
> Pin 2, M1b: Required for AC-charging.
> Pin 3, FB1: Required for AC-charging.
> Pin 5, PP1-PU: Not used.

Please be aware of the naming: The connector X303 which has the higher number corresponds to the logical CCS connector 1.

2.2.5 X304 - Safety Outputs

1 REL1b	**3** REL2b	**5** REL3b
2 REL1a	**4** REL2a	**6** REL3a

Figure 10: vSECC connector: X304

This connector is used for safety purposes. It provides access to specialized outputs that add a layer of safety. They are intended to connect to the respective inputs of the power electronics circuitry. Please see the following paragraph on safety outputs, loss detection and CP/PP supervision for a general explanation of this mechanism.

The three safety outputs REL1, REL2 and REL3 serve the following safety functions:

> Pin 1 + 2, REL1: Safety output for IEC/SAE Connector 1 (CP and optionally PP) and OppCharge
> Pin 3 + 4, REL2: Safety output for IEC/SAE Connector 2 (CP and optionally PP) and GB/T
> Pin 5 + 6, REL3: Safety output for CHAdeMO

The two pins corresponding to each output are wired such that they are short-circuited if everything is fine and the respective output may be energized.
If the outlet must not be energized, the electric circuit remains open between the a and b pin.

In order to use the CCS Connector 2 with REL2 safety pins, the GB/T loss detection must be disabled by switching the corresponding DIP switches to ”ON”. See section 2.3.2 for details.

In compliance to the SAE J1772 requirements, the Proximity Detection needs to be activated for CCS Type 1 DC charging. With the activation, the PP of a connector influences the corresponding safety output. To activate the Proximity Detection for a connector, the corresponding DIP switches must be switched to "OFF". See also section 2.3.2 for details.

Safety Outputs: Loss Detection, Control Pilot / Proximity Pin Supervision

The following details apply to the IEC 61851 Control Pilot line used for DC charging. The general principle holds, too, for IEC AC charging and the GB/T equivalent (AC and DC).

The IEC 61851 standard imposes strict safety requirements on the charging process and power supply monitoring. The charging process is controlled by the electric vehicle which sets a specific CP state. Four state categories exist: Ax, Bx, Cx and Dx. Energy transfer is allowed only in state categories Cx and Dx. In some cases (e.g. for CCS Type 1 connectors), a PP supervision is also required to prevent energy transfer when the PP signal is not valid.
In order to enforce this, the vSECC Controllers provide a logical output called *CP/PP supervision*.
This output controls the power electronics' ability to energize its outlet. Conceptually, a logical AND conjunction exists in the power electronics between the Power Electronics Communication Controller's (PECC) control input and the CP/PP supervision: The power electronics is able to close its contactors if and only if the CP/PP supervision allows it, i.e. the CP state category is Cx or Dx and the PP signal is valid (if applicable).
See Figure 11 for an illustration of this principle.

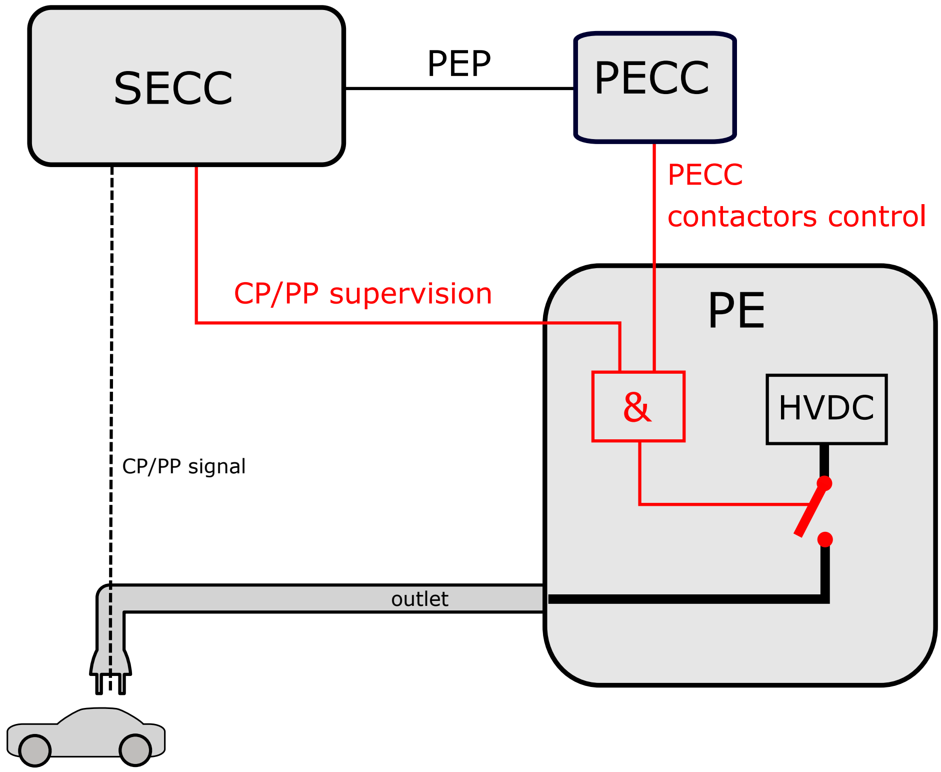


Figure 11: vSECC safety output

Control Pilot / Proximity Pin supervision: The EV communicates the charging state via the CP signal to the vSECC Controller. Depending on this state and the validity of the PP signal, the power electronics may or may not energize its outlet. The CP and PP signals are processed and provided as safety output directly to the power electronics. There, a logical AND conjunction of the input from the PECC and the vSECC safety output controls the high-voltage DC module (HVDC) output.

Caution: Please be aware that the power electronics is responsible for derating the provided current in accordance to IEC 61851 and SAE J1772, e.g. in case of an emergency shutdown.

2.2.6 X305 - CAN / Serial Interfaces

1 CAN1 H	3 CAN1 L	5 GND	7 RS485 B	9 RS485 A
2 CAN2 H	4 CAN2 L	6 GND	8 RS232 TXD	10 RS232 RXD

Figure 12: vSECC connector: X305

> CAN 1 is used when a charging connector is configured for CHAdeMO.

> CAN 2 is used for controlling a Power Electronics via the PEP-CAN protocol (see the provided protocol description for further reference under vector.com/vsecc/documentation).

> RS232 is used for connecting an RFID reader (see section 5.21).

> RS485 is used to connect Modbus RTU slaves to the Modbus gateway (see section 5.27).

For information regarding termination, see section 2.3.2.

2.2.7 X306 - Digital In and Digital Out Connectors, Connector Start/Stop Buttons, Pantograph Control

1 +24V	3 CN2 START	5 PANTO DOWN	7 CN1 STOP	9 DIN1	11 OUT15	13 OUT13	15 OUT11	17 OUT9	19 OUT7	21 OUT5	23 OUT3	25 OUT1
2 CN2 STOP	4 PANTO ERR	6 PANTO UP	8 CN1 START	10 PANTO CTRL	12 OUT14	14 OUT12	16 OUT10	18 OUT8	20 OUT6	22 OUT4	24 OUT2	26 GND

Figure 13: vSECC connector: X306

This connector is used for both digital input and digital output signals. See Section 5.25.5 and 5.25.6 for details and a mapping of PEP-identifiers to connector pins.

> Pin 1 outputs 24V.

> Pin 2-8 are active high digital inputs.

> Pin 10-25 are active high digital outputs.

> Pin 26 is the ground pin (GND).

In addition, four pins are used for buttons that can be used to start or stop a charging session.

Starting a charging session via button is currently only available for CHAdeMO.

See Section 5.15 for more details on the CHAdeMO charging process and for the implementation of the CHAdeMO **[EMERGENCY STOP]** button.

- Pin 8 (CN 1 START) is used for the Connector 1 **[START]** button (feature not yet available)
- Pin 7 (CN 1 STOP) is used for the Connector 1 **[STOP]** button.
- Pin 3 (CN 2 START) is used for the CHAdeMO **[START]** button.
- Pin 2 (CN 2 STOP) is used for the Connector 2/CHAdeMO **[STOP]** button.

When using OppCharge, four pins can be used for directly controlling a pantograph. Refer to Section 5.16 for more details on the OppCharge charging process and the options of controlling a pantograph.

- Pin 4 (PANTO ERR) is used as input to signal an error to the vSECC which prevents charging.
- Pin 5 (PANTO DOWN) is used as input to signal the vSECC, that the pantograph is in lower position.
- Pin 6 (PANTO UP) is used as input to signal the vSECC, that the pantograph is in upper position.
- Pin 10 (PANTO CTRL) is used as output to request moving the pantograph up (logical low) or down (logical high).

2.2.8 X307 - Power Supply Connector

1	2
Sup GND	Sup 24V

Figure 14: vSECC connector: X307

This connector is used for the supply voltage of 24 V. The current drawn is typical below 300 mA, though while booting the vSECC can draw up to 1.5 A. So the power supply should provide at least 1.5 A. Please refer to Section 7.1 for further details on power consumption.

Caution: Pressing the button above the X307 connector may cause a factory reset of the vSECC. See Section 2.3.1 for details.

2.2.9 ETH1 - Ethernet 1 (Back End / OppCharge)

This connector is used to connect network entities such as a Charging Station Management System (CSMS / Back End) or the Power Electronics Communication Controller (PECC) to the vSECC. If Value Added Services are used, this port must be used to connect the VAS-backend to the vSECC Controller. If the vSECC is configured for OppCharge, ETH1 must be used for connection to the Wi-Fi access point.

2.2.10 ETH2 - Ethernet 2

This connector is used to connect network entities to the vSECC in the same manner as it is possible with ETH1. The second port allows a higher flexibility, e.g., regarding network segmentation.

2.3 Buttons and Switches

2.3.1 Factory Reset Button

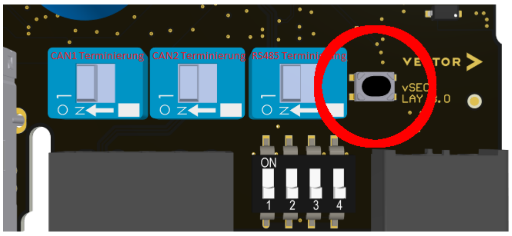


Figure 15: vSECC reset button in the lower right corner (top view)

This button is used to reset the configuration to the factory defaults. See Section 6.1 for details.

This functionality is given from vSECC version 1.3.0 upwards.

2.3.2 DIP Switches

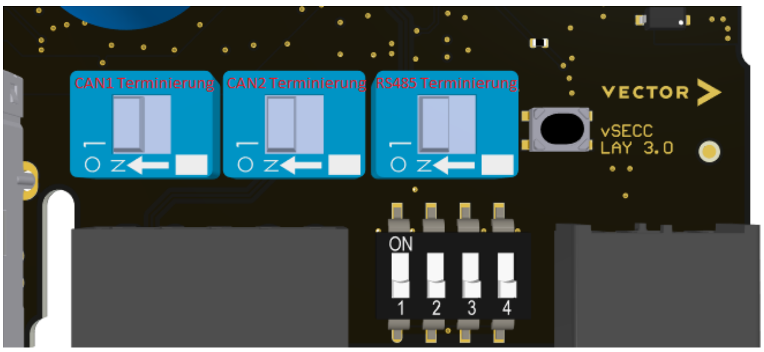


Figure 16: vSECC connector: DIP Switches

In the lower right corner, close to connectors X305 and X307, DIP switches allow the configuration of the termination for serial communication busses and the hardware supervision for the safety outputs.
The three blue switches allow the activation and deactivation of terminating resistors. All three enable the termination if switched to the left (on) and disable the termination if switched to the right.

> Left switch: CAN1 termination
> Middle switch: CAN2 termination
> Right switch: RS485 termination

In addition, four more switches reside between the X305 and X307 connectors.

Caution: These allow the deactivation of some safety-related functions. Disabling safety features may cause harm or serious injuries.

The safety supervision can be deactivated for some of the functions by flipping the respective switch to the **[ON]** position (upwards). If a function supervision has been deactivated, it is not considered for the result provided at the respective safety output.

The Proximity Pin is only relevant for CCS Type 1 and the switch for the respective connector must be set to **[OFF]** to enable CCS Type 1. For CCS Type 2, it must be set to **[ON]**.

Make sure to configure the matching CCS Type via the Web Interface. If PP loss detection is activated and CCS Type 2 is configured, the safety output will prevent energy transfer. If PP loss detection is deactivated and CCS Type 1 is configured, the connector will stay inoperative.

> Switch 1: PP1 loss detection deactivation
> Switch 2: PP2 loss detection deactivation
> Switch 3: CC1 loss AC (GB/T) detection deactivation
> Switch 4: CC1 loss DC (GB/T) detection deactivation

The supervision of CP1 and CP2 is always active and cannot be deactivated.

2.4 Use Cases: vSECC in Different Scenarios

This section details the electrical connections required for the most common use cases. Note that additional configuration may be required, e.g., setting the correct back end URI. Please use the Web Interface or an already connected CSMS to configure the vSECC (see Section 5.1). The use cases could be combined easily.

2.4.1 Use Case 1: vSECC Stand-alone Operation, CCS Charging Ready

The goal is to be able to start up the vSECC.

1. Mount the vSECC such that no cable is bent and electrical short-circuits are impossible.
2. Connect the X303 charging connector according to the pin descriptions depicted in Section 2.2.4. This plug relates to the first charging port.
3. Connect the X302 charging connector according to the pin descriptions depicted in Section 2.2.3. This plug relates to the second charging port.
4. Use the DIP switches to configure CCS Type 1 or Type 2 as described in Section 2.3.2.
5. Connect the ETH1 Ethernet port to an Ethernet network providing DHCP. This allows the configuration of the vSECC via the Web Interface.
6. Connect the X307 power supply connector. Take care of the correct polarity. Ensure that 24 V and at least 1.5 A are provided.
7. Open the Web Interface and configure CCS Type 1 or Type 2 for each connector accordingly (Connector → CcsType).

It is important that the DIP switches are configured to match the CCS Type as configured in the Web Interface. If the DIP switch for PP loss detection is activated and CCS Type 2 is configured, the safety output will prevent energy transfer. If the DIP switch for PP loss detection is deactivated and CCS Type 1 is configured, the connector will stay inoperative.

The vSECC starts up as soon as the power supply is connected. The System LED (see Section 6.3) blinks green as long as the start-up is running. After the vSECC has finished initialization, the System LED turns green constantly.
The vSECC is now ready to be configured, e.g. for charging simulation purposes.

2.4.2 Use Case 2: vSECC with Power Electronics

The goal is to use a power electronics circuitry together with the vSECC.

1. Follow the Use Case 1 instructions above. Make sure that you do not connect the power supply yet.
2. Connect one of the Ethernet ports to an Ethernet network, which is providing access to the power electronics communication controller (PECC). This connection is used to control the power electronics via PEP-WS.
3. Connect the X304 safety output connector. Make sure that the pins for REL1 and REL2 are connected to the appropriate inputs of the power electronics itself. REL1 corresponds to the first charging connector and REL2 to the second.
4. Flip the DIP Switches 3 and 4 to the **[ON]** position. This disables the CC1 AC and CC1 DC loss detection.
5. (Optional) Connect the X301 (analog and temperature inputs) and X306 (digital inputs and outputs) connectors. This is necessary for the PECC to get input values or control digital outputs through PEP-WS. See Section 5.25.4 for the PEP identifiers that correspond to each pin.
6. Connect the X307 power supply connector. Take care of the correct polarity. Ensure that 24 V and at least 1.5 A are provided.

After the vSECC has started up, set the correct power electronics URI for both connectors using the Web Interface or CSMS.

2.4.3 Use Case 3: vSECC with CSMS

The goal is to use a Charging Station Management System (CSMS) to configure and manage the vSECC.

1. Follow the Use Case 1 instructions above. Make sure that you do not connect the power supply yet.
2. Connect one of the Ethernet ports to an Ethernet network, which is providing access to the CSMS.
3. Use the Web Interface (see Section 5.1.1) to set the correct back end URI and possibly login credentials.
4. Connect the X307 power supply connector. Take care of the correct polarity. Ensure that 24 V and at least 1.5 A are provided.

After the vSECC has started up, the vSECC tries to connect repeatedly to the CSMS using the configured URI and credentials.

When no Power Electronics are running and the PE Configuration in the Web Interface is not on *Simulation*, the vSECC appears in vCharM as **Inoperative**.

2.4.4 Use Case 4: vSECC and Roof-mounted Pantograph Charging

The goal is to be able to use the vSECC in a roof-mounted pantograph charging scenario.

Roof-mounted pantograph charging (”Panto-Up”) is supported by the vSECC. Regarding the vSECC, the physical connections, communication interfaces and procedures do not differ between normal CCS operation and roof-mounted pantograph charging. In particular, the Control Pilot (CP) handling, the SLAC procedure and High-Level Communication are the same. In this use-case the pantograph (including all its moving parts) is mounted on top of the vehicle. It is controlled by a separate device setup.
Please note that both the charging station and the EV must have the appropriate devices and controllers installed. We recommend to use Vector’s EV communication controller VC-EVCC-P, which supports roof-mounted pantograph charging and is tested with the vSECC.

1. Follow the Use Case 2 instructions above.
2. Connect the X307 power supply connector. Take care of the correct polarity and sufficient power as defined in the technical data section.

The vSECC starts up as soon as the power supply is connected. The System LED (see Section 6.3) blinks green as long as the startup is running. After the vSECC has finished initialization, the System LED turns green constantly.

3 Installation Guide vSECC.single Board

In this chapter you will find the following information:

3.1 Physical Mounting

The vSECC.single Board is designed to be mounted on a base board PCB. Further details can be found in the mechanical drawings in Appendix B.

3.2 Electrical Connections

Figure 17 shows the top view of the vSECC.single Board with the available connectors. Each connector is described in detail below.

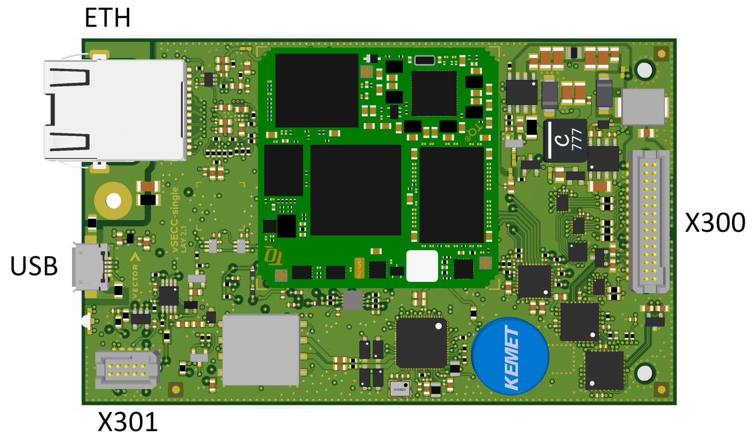


Figure 17: vSECC.single Board Top View

We recommend purchasing the following connector types from **Samtec** for connecting to the vSECC.single Board:

Connector	Manufacturer	Part Number
X300	Samtec	SFM-115-02-L-D-A
X301	Samtec	SFM-105-02-L-D-A

3.2.1 Connector X300

Connector X300 contains pins for the following functional blocks:

> Supply power to the vSECC.single Board
> Digital inputs and outputs
> Analog inputs
> Safety output from hardware supervision circuit
> Serial communication

The whole pinout is shown in the table below, the usage is described in the following sections.

PIN	Signal Name	PIN	Signal Name
1	VCC_SUP	2	VCC_SUP
3	GND	4	GND
5	VCC_LOGIC	6	DIO1
7	DIO2	8	DIO3
9	DIO4	10	DIO5
11	DIO6	12	DIO7
13	DIO8	14	DIO9
15	DIO10	16	VCC_ADC
17	GND_ADC	18	AIN1
19	AIN2	20	AIN3
21	AIN4	22	SAFETY_OUT
23	CAN1_HIGH	24	RS485_A
25	CAN1_LOW	26	RS485_B
27	RS232_RXD_TTL	28	CAN2_HIGH
29	RS232_TXD_TTL	30	CAN2_LOW

3.2.2 Connector X300 - Power Supply Connection

The vSECC.single Board must be powered with 12 V by the attached base board. Connect both pin X300.1 and pin X300.2 with the supply voltage. Connect both pin X300.3 and X300.4 with the corresponding ground.

3.2.3 Connector X300 - Digital Inputs/Outputs

The vSECC.single Board offers 10 digital inputs/outputs on pin X300.6 through X300.15. In order to enable usage of opto-couplers or a level shifter, an output of a matching supply voltage (VCC_LOGIC at pin X300.5) for these circuits is provided.

3.2.4 Connector X300 - Analog Inputs

4 analog inputs are available on pin X300.18 through X300.21. Use pin X300.17 to connect GND for the analog circuitry. If you intend to supply power to the connected sensor, use pin 300.16 (VCC_ADC).

3.2.5 Connector X300 - Serial Communication

Caution: CAN2 currently cannot be used on the vSECC.single Board.

The vSECC.single Board offers the following serial communication interfaces:

- CAN1 on X300.23 and X300.25 with fixed termination, for communication with the power electronics
- CAN2 on X300.28 and X300.30 with fixed termination, currently not in use
- RS232 on X300.27 and X300.29, for connection of supported RFID-Readers (see section 5.21)
- RS485 on X300.24 and X300.26, for connection of Modbus RTU slaves to the Modbus gateway (see section 5.27)

3.2.6 Connector X300 - Safety Output

This output is used for safety purposes. It provides access to a specialized output that adds a layer of safety. It is intended to connect to the respective input of the power electronics circuitry.
Please be aware that the vSECC.single Board also includes supervision of two temperature sensors as described in Section 3.2.7. For further information on proper wiring please refer to Section 3.4 and Section 8.5.
Please see Section 2.2.5 on loss detection and CP/PP supervision for a general explanation of this mechanism.

3.2.7 Connector X301

Connector X301 contains all signals for charging communication and the temperature sensors. The whole pinout is shown in the table below, the detailed description is located in the following sections.

PIN	Signal Name	PIN	Signal Name
1	PP	2	CP
3	PP_PU	4	GND
5	GND	6	GND
7	GND_TEMP	8	GND_TEMP
9	AIN_TEMP_2	10	AIN_TEMP_1

For DC charging, the following pins are needed:

> Pin X301.1, PP: Proximity Pin for SAE J1772 Proximity Detection (only used for CCS Type 1).

> Pin X301.2, CP: Control Pilot line which corresponds to the respective pin of the CCS connector.

> Pin X301.4, GND: Must be connected to Protective Earth of the CCS connector.

Furthermore, as the vSECC.single Board does not allow to disable PP supervision by setting a switch or something similar, the following connections have to be made for CCS Type 2:

> Connect PP_PU (X301.3) with PP (X301.1).

> Add a resistor of 142 Ω between PP and GND (X301.4-6).

In contrast to the vSECC, the vSECC.single Board includes supervision of two temperature sensors directly with the hardware supervision circuitry. Thus, the safety output will only be active if the temperature sensors connected to the AIN_TEMP_1 (X301.10) and AIN_TEMP_2 (X301.9) are in the specified range (see Section 8.5).

3.2.8 Ethernet

This connector is used to connect network entities such as a Charging Station Management System (CSMS / Back End) or the Power Electronics Communication Controller (PECC) to the vSECC. This connector can also be used to configure the vSECC.single Board via the web configuration interface.

3.2.9 USB

Caution: The USB connector is currently not in use.

3.3 Factory Reset Button

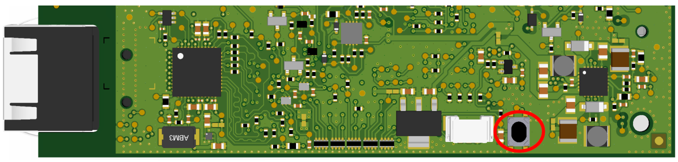


Figure 18: Factory Reset Button on vSECC.single Board

The factory reset button is located on the bottom of the vSECC.single Board. This button is used to reset the configuration to the factory defaults. See Section 6.1 for details.

3.4 Wiring Examples

In this section, some wiring examples for the vSECC.single Board in common use cases are shown.

3.4.1 CCS Type 1 Charging

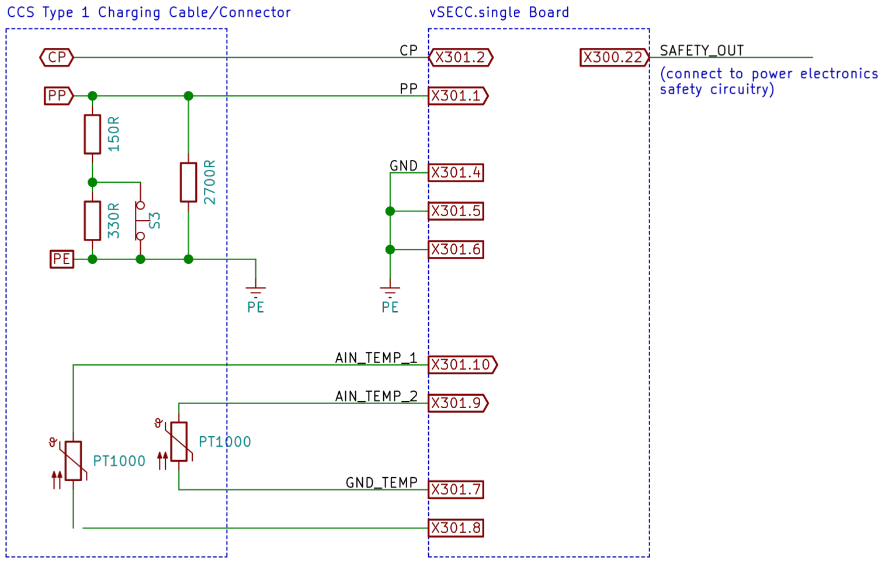


Figure 19: Wiring Diagram vSECC.single Board CCS Type 1

In order to use a CCS Type 1 charging connector, the following connections are necessary:

- CP: Connect X301.2 of the vSECC.single Board to the CP pin of the charging cable.
- PP: Connect X301.1 of the vSECC.single Board to the PP pin of the charging cable (usually, the resistors between PP and PE are included in the connector assembly).
- PE: Please make sure that the PE of the charging cable is connected to pins X301.4 through X301.6.
- Temperature sensors: Please make sure to connect the temperature sensors from the connector assembly to X301.10 and X301.9 and use X301.7 and X301.8 for GND.

3.4.2 CCS Type 2 Charging

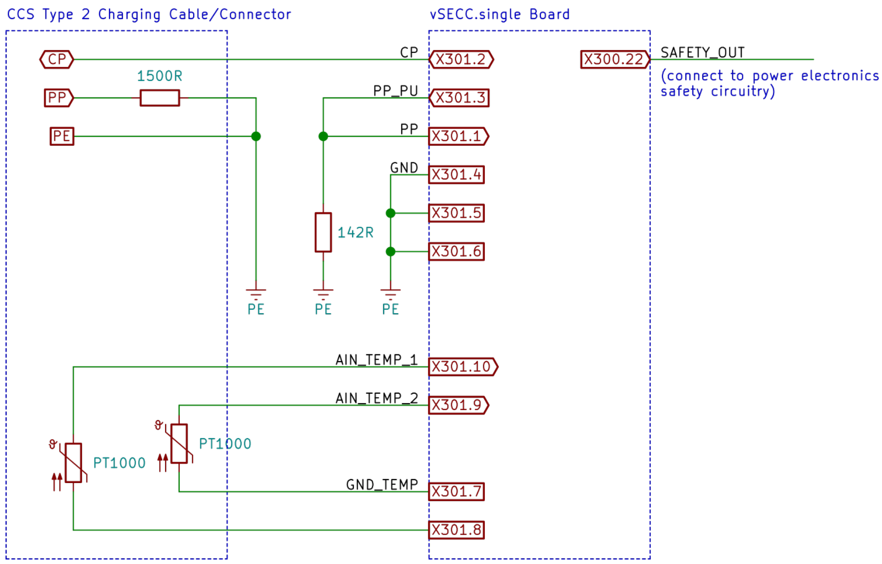


Figure 20: Wiring Diagram vSECC.single Board CCS Type 2

In order to use a CCS Type 2 charging connector, the following connections are necessary:

- CP: Connect X301.2 of the vSECC.single Board to the CP pin of the charging cable.
- PP: Check if the connector assembly has an internal resistor for PE. You may have to connect the resistor to PE manually or even provide the 1.5 kΩ resistor on your base board. Also make sure to deactivate the PP supervision as shown in the example.
- PE: Please make sure that the PE of the charging cable is connected to pins X301.4 through X301.6.
- Temperature sensors: Please make sure to connect the temperature sensors from the connector assembly to X301.10 and X301.9 and use X301.7 and X301.8 for GND.

4 Installation Guide vSECC.single

In this chapter you will find the following information:

4.1 Physical Mounting

The vSECC.single is equipped with a mounting bracket which allows for an easy installation on a top-hat rail. The vSECC.single Board is mounted through the connector interface X300 and X301.

Caution: The vSECC.single must be installed in such a way that it cannot be touched from the outside.

4.2 Electrical Connections

Figure 21 shows the top view of the vSECC.single with the available connectors. Each connector is described in detail below.

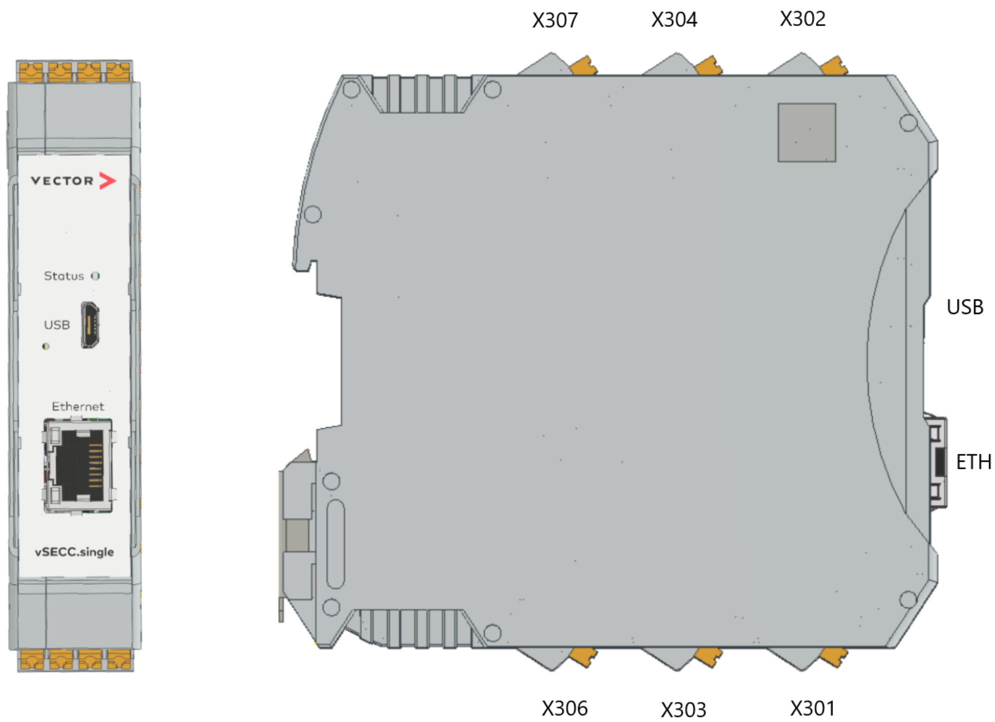


Figure 21: vSECC.single Front and Side View

All connectors on the vSECC.single are from the same manufacture type and ready to use for wiring. Following connnectors are populated on the vSECC.single:

Connector	Manufacturer	Part Number	Description
X301	Phoenix	2200319	4-pin, pitch: 5mm
X302	Phoenix	2200320	4-pin, pitch: 5mm
X303	Phoenix	2200319	4-pin, pitch: 5mm
X304	Phoenix	2200320	4-pin, pitch: 5mm
X306	Phoenix	2200319	4-pin, pitch: 5mm
X307	Phoenix	2200320	4-pin, pitch: 5mm

The whole pinout is shown in the figure below, the detailed description is located in the following sections.

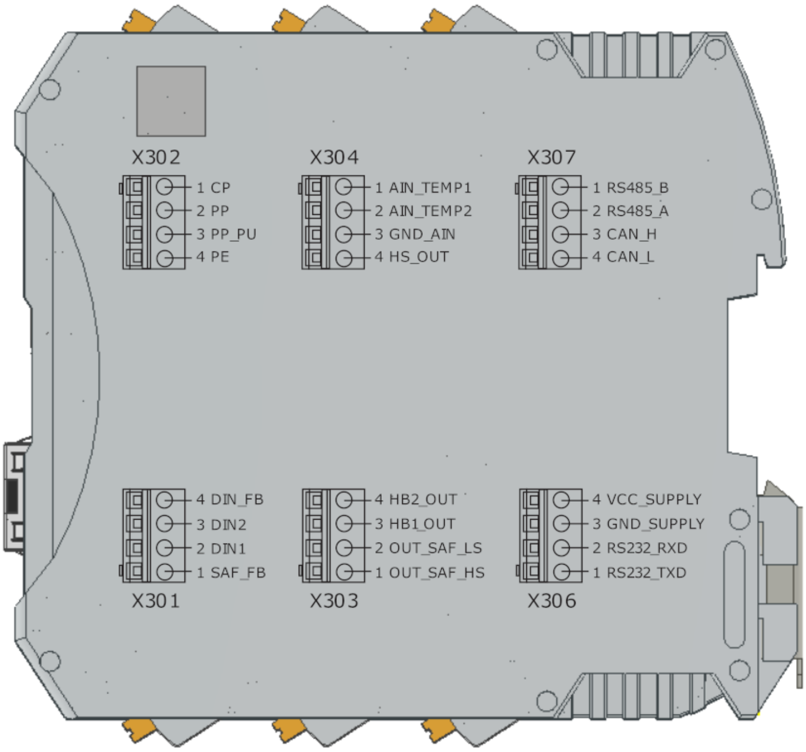


Figure 22: vSECC.single Pinout

4.2.1 Connector X301

Connector X301 contains all signals for digital inputs.

PIN	Signal Name
1	SAF_FB
2	DIN1
3	DIN2
4	DIN_FB

This connector is used for safety feedback and digital inputs, which requires the following pins:

- Pin 1, SAF_FB: Safety feedback
- Pin 2, DIN1: Digital input 1
- Pin 3, DIN2: Digital input 2
- Pin 4, DIN_FB: Digital input feedback

4.2.2 Connector X302

Connector X302 contains all signals for charging communication.

PIN	Signal Name
1	CP
2	PP
3	PP_PU
4	PE

This connector is used for CCS Charging. Today, only DC charging is supported, which requires the following pins:

> Pin 1, CP: Control Pilot line which corresponds to the respective pin of the CCS connector.
> Pin 2, PP: Proximity Pin for SAE J1772 Proximity Detection (only used for CCS Type 1).
> Pin 3, PP_PU: Only used for CCS Type 2.
> Pin 4, PE: Protective Earth for CCS connector.

Furthermore, as the vSECC.single does not allow to disable PP supervision by setting a switch or something similar, the following connections have to be made for CCS Type 2:

> Connect PP_PU (X302.3) with PP (X302.2).
> Add a resistor of 142 Ω between PP (X302.2) and PE (X302.4).

4.2.3 Connector X303

Connector X303 contains all signals for safety output (high side and low side switch) and digital outputs.

PIN	Signal Name
1	OUT_SAF_HS
2	OUT_SAF_LS
3	HB1_OUT
4	HB2_OUT

This connector is used for safety output and digital outputs:

> Pin 1, OUT_SAF_HS: Safety output (high side switch). For further information on proper wiring please refer to Section 4.4.
> Pin 2, OUT_SAF_LS: Safety output (low side switch). For further information on proper wiring please refer to Section 4.4.
> Pin 3, HB1_OUT: Half bridge 1 output
> Pin 4, HB2_OUT: Half bridge 2 output

4.2.4 Connector X304

Connector X304 contains all signals for temperature sensors and digital outputs.

PIN	Signal Name
1	AIN_TEMP1
2	AIN_TEMP2
3	GND_AIN
4	HS_OUT

This connector is used for external temperature senors and digital outputs.

> Pin 1, AIN_TEMP1: Analog input for temperature sensor 1.

> Pin 2, AIN_TEMP2: Analog input for temperature sensor 2.

> Pin 3, GND_AIN: Ground for analog input temperature sensor 1 and 2.

> Pin 4, HS_OUT: High side switch output

In contrast to the vSECC, the vSECC.single includes supervision of two temperature sensors directly with the hardware supervision circuitry. Thus, the safety output will only be active if the temperature sensors connected to the AIN_TEMP_1 (X304.1) and AIN_TEMP_2 (X304.2) are in the specified range (see Section 9.4).

4.2.5 Connector X306

Connector X306 contains all signals for power supply connection and RS232 serial communication.

PIN	Signal Name
1	RS232_TXD
2	RS232_RXD
3	GND_SUPPLY
4	VCC_SUPPLY

> RS232 on X306.1 and X306.2, for connection of supported RFID-Readers (see section 5.21).

> The vSECC.single is typically powered with 12 V. Connect pin X306.4 with the supply voltage. Connect pin X306.3 with the corresponding ground.

! **Caution:** For EMC reasons, the maximum cable length for RS232 and RS485 should be 3 meters.

4.2.6 Connector X307

Connector X307 contains all signals for RS485 and CAN communication.

PIN	Signal Name
1	RS485_B
2	RS485_A
3	CAN_H
4	CAN_L

The vSECC.single offers the following serial communication interfaces:

> CAN on X307.3 and X307.4 with fixed termination, for communication with the power electronics.

> RS485 on X307.1 and X307.2, for connection of Modbus RTU slaves to the Modbus gateway (see section 5.27).

! **Caution:** For EMC reasons, the maximum cable length for RS485 and RS232 should be 3 meters.

4.2.7 Ethernet

This connector is used to connect network entities such as a Charging Station Management System (CSMS / Back End) or the Power Electronics Communication Controller (PECC) to the vSECC.single. This connector can also be used to configure the vSECC.single via the web configuration interface.

! **Caution:** For EMC reasons, please use shielded Ethernet cables only.

4.2.8 USB

! **Caution:** The USB connector is currently not in use.

4.3 Factory Reset Button

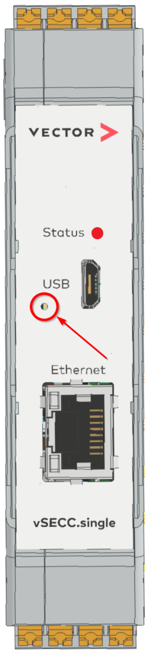


Figure 23: Factory Reset Button on vSECC.single

The factory reset button is located behind the small hole next to the USB port of the vSECC.single. This button is used to reset the configuration to the factory defaults. See Section 6.1 for details.

4.4 Wiring Examples

In this section, some wiring examples for the vSECC.single in common use cases are shown.

4.4.1 CCS Type 1 Charging

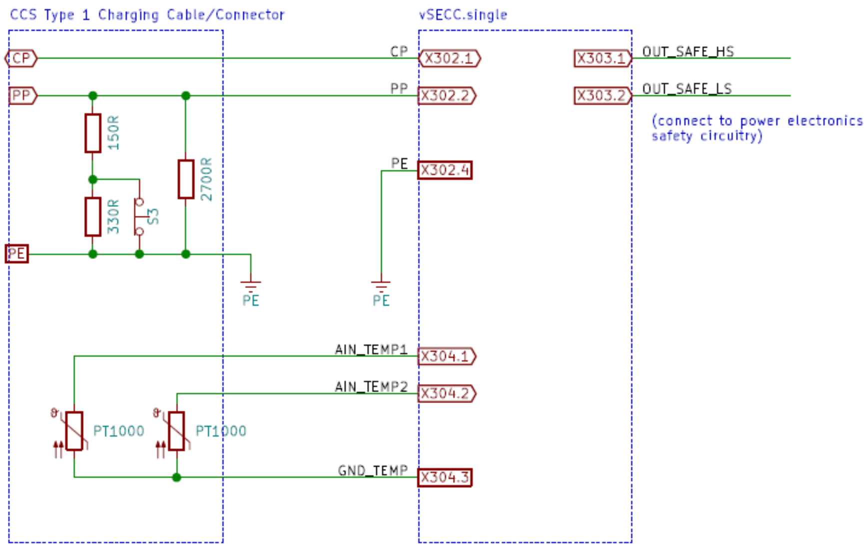


Figure 24: Wiring Diagram vSECC.single CCS Type 1

In order to use a CCS Type 1 charging connector, the following connections are necessary:

> CP: Connect X302.1 of the vSECC.single to the CP pin of the charging cable.

> PP: Connect X302.2 of the vSECC.single to the PP pin of the charging cable (usually, the resistors between PP and PE are included in the connector assembly).

> PE: Please make sure that the PE of the charging cable is connected to pin X302.4.

> Temperature sensors: Please make sure to connect the temperature sensors from connector assembly to X304.1 and X304.2 and use X304.3 for GND.

4.4.2 CCS Type 2 Charging

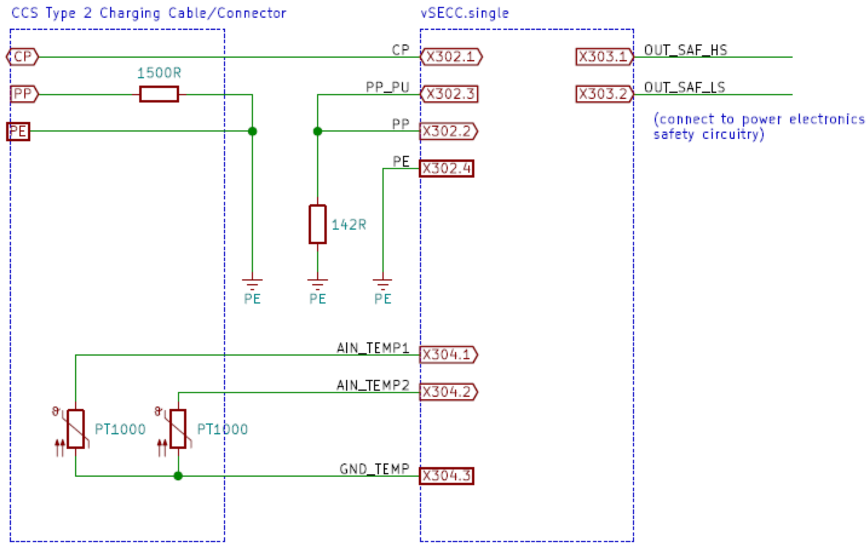


Figure 25: Wiring Diagram vSECC.single CCS Type 2

In order to use a CCS Type 2 charging connector, the following connections are necessary:

- CP: Connect X302.1 of the vSECC.single to the CP pin of the charging cable.
- PP: Check if the connector assembly has an internal resistor for PE. You may have to connect the resistor to PE manually or even provide the 1.5 kΩ resistor on your base board. Also make sure to deactivate the PP supervision as shown in the example.
- PE: Please make sure that the PE of the charging cable is connected to pin X302.4.
- Temperature sensors: Please make sure to connect the temperature sensors from the connector assembly to X304.1 and X304.2 and use X304.3 for GND.

5 User Guide

In this chapter you will find the following information:

In this chapter, you will find step-by-step instructions how to configure the vSECC Controllers and the interfaces, and how to use the features.

5.1 Configuring the vSECC Controller

The vSECC Controller can be configured either through the provided web interface or by exchanging OCPP messages with a CSMS. Because connecting to a CSMS usually requires setting its address first, the initial configuration setup takes place using the web interface instead.

5.1.1 Web Interface Configuration

To connect to the configuration web interface, open a web browser and enter the vSECC Controller's IP address (e.g. http://192.168.3.11). This will take you to the landing page as shown in Figure 26. When asked for credentials, please enter the username `"root"` and password `"rootpassword"` to gain access. If you want to make changes to the configuration, the maintenance mode must be enabled first by pressing the **[Enable maintenance mode]** button. The web interface will then wait for the application to shut down as shown in Figure 27.

The credentials required for accessing the web interface consist of username `"root"` and password `"rootpassword"`.

Caution: Putting the vSECC Controller into maintenance mode will immediately disrupt all ongoing transactions, regardless of the application's current state. Use this functionality with caution!

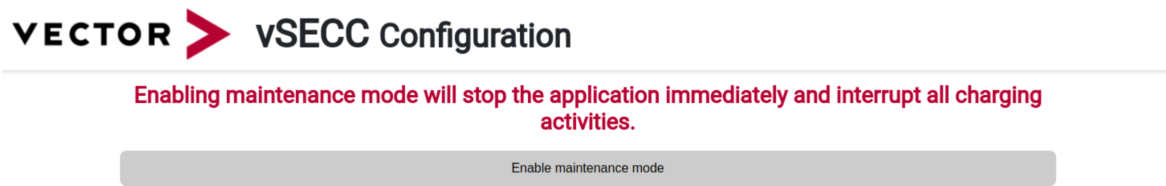


Figure 26: Maintenance Mode Off

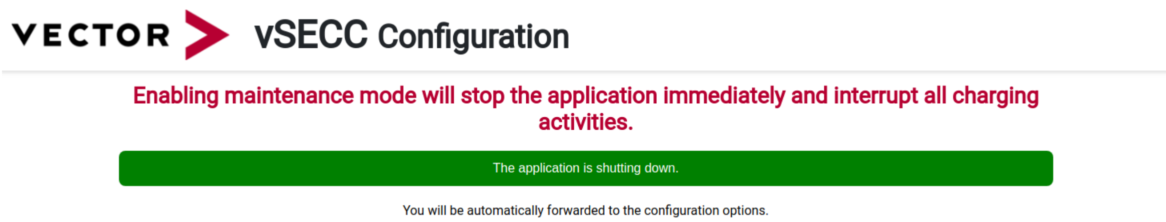


Figure 27: Waiting for Shutdown

After the application has shut down, you will enter the maintenance mode as shown in Figure 28.

There are various actions you can perform using the buttons in the upper screen area. Pushing **[Disable maintenance mode]** discards all unsaved changes and restarts the vSECC Software application. This will take you back to the view shown in Figure 26. Pushing **[Reboot vSECC]** causes a reboot of the whole system.

Rebooting the system may take up to two minutes.

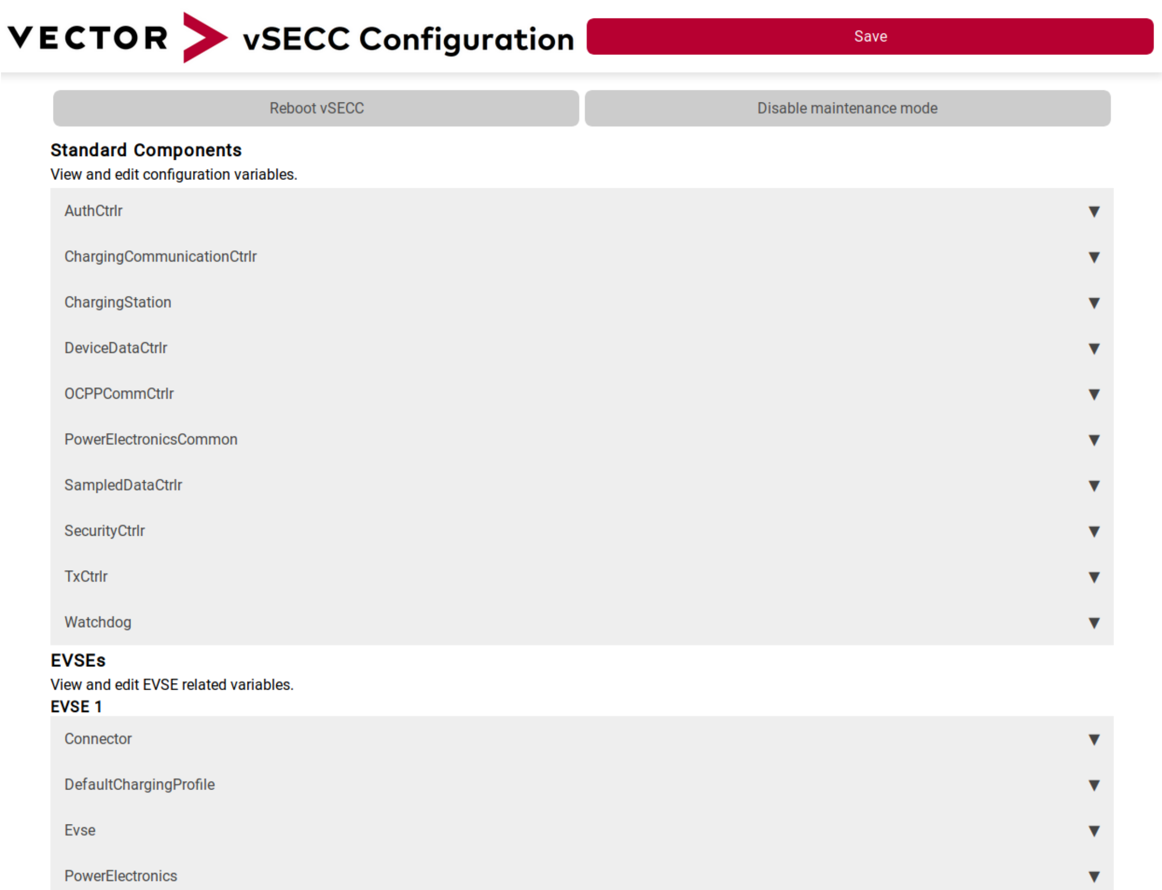


Figure 28: Maintenance Mode On

Use the **[Save]** button in the upper right corner to save your changes to the configuration. Other than the described buttons, the view also contains more sections:

> Standard Components
> EVSEs
> Log Files
> PLC Logging
> Certificate upload
> Date Settings
> IPv4 Settings

> Change Web Interface Password
> Remote Support Session
> Firmware Update

The **Standard Components** section contains configuration variables which apply to the entire vSECC Software application, such as the address of the CSMS. Chapter 5.7 gives an overview of the available variables. All settings specific to an EVSE can be found inside the **EVSEs** section. To assist technical support, the vSECC application's log files can be downloaded from the vSECC within the **Log Files** section. To assist analysis of the EV communication, trace logs of the power line communication can be activated in the **PLC Logging** section. The **Certificate upload** section allows installing additional Root-CAs on the vSECC. The internal date of the vSECC Controller can be set in the **Date Settings** section. The **IPv4 Settings** section allows to change the network configuration. The password to access the Web Interface can be changed in the **Change Web Interface Password** section. Providing the Vector Support access to your vSECC controller can be activated in the **Remote Support Session** section. Finally, the **Firmware Update** section allows to upload and run an update of the vSECC firmware.

5.1.2 OCPP Configuration

As an alternative to the web interface, the vSECC Controller can also be configured by using a CSMS. To initially connect to a CSMS, you must specify the CSMS' URI as well as the Charging Station Identity in the vSECC Controller's configuration using the web interface. The corresponding variables are called **BaseUri**/ **Identity** and can be found inside the **ChargingStation** section as seen in Figure 29.

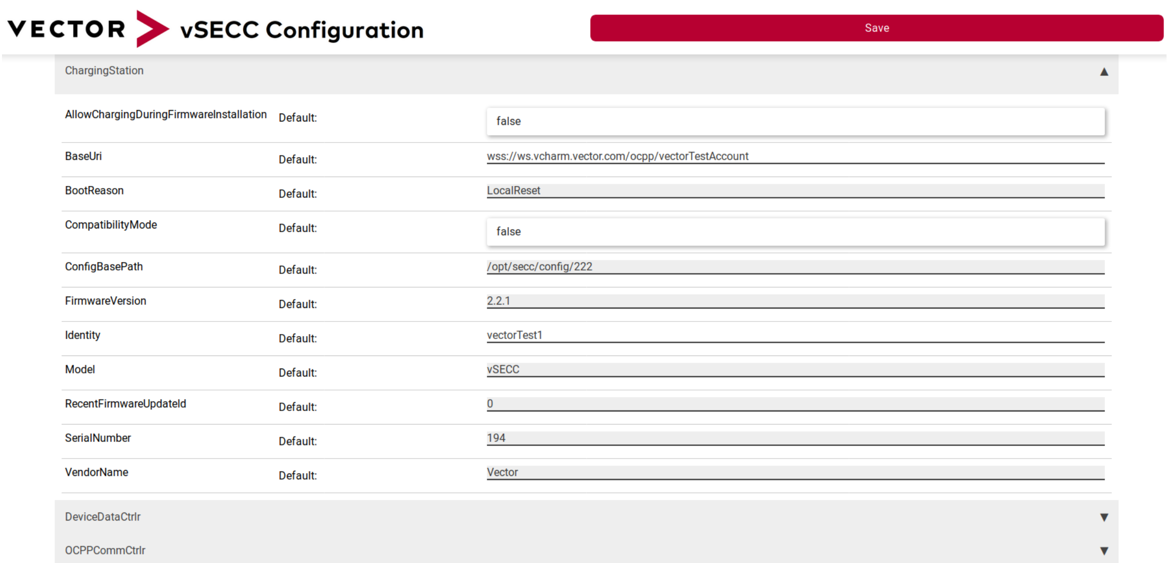


Figure 29: Variable "BaseUri"

The vSECC Software uses the OCPP 1.6 messages `GetConfiguration` and `ChangeConfiguration` / OCPP 2.0.1 messages `GetVariables`, `GetBaseReport` and `SetVariables` for configuration data exchange with the CSMS. For further information

about the structure and usage of those messages, please refer to appropriate OCPP specification.
Inside Vector's CSMS solution vCharM for example, the vSECC Controller's variables are presented as shown in Figure 30. The information about the available variables is gathered automatically when the vSECC Controller establishes its connection. Changes to any variables are sent to the vSECC Controller, where they are validated and then applied to its configuration.

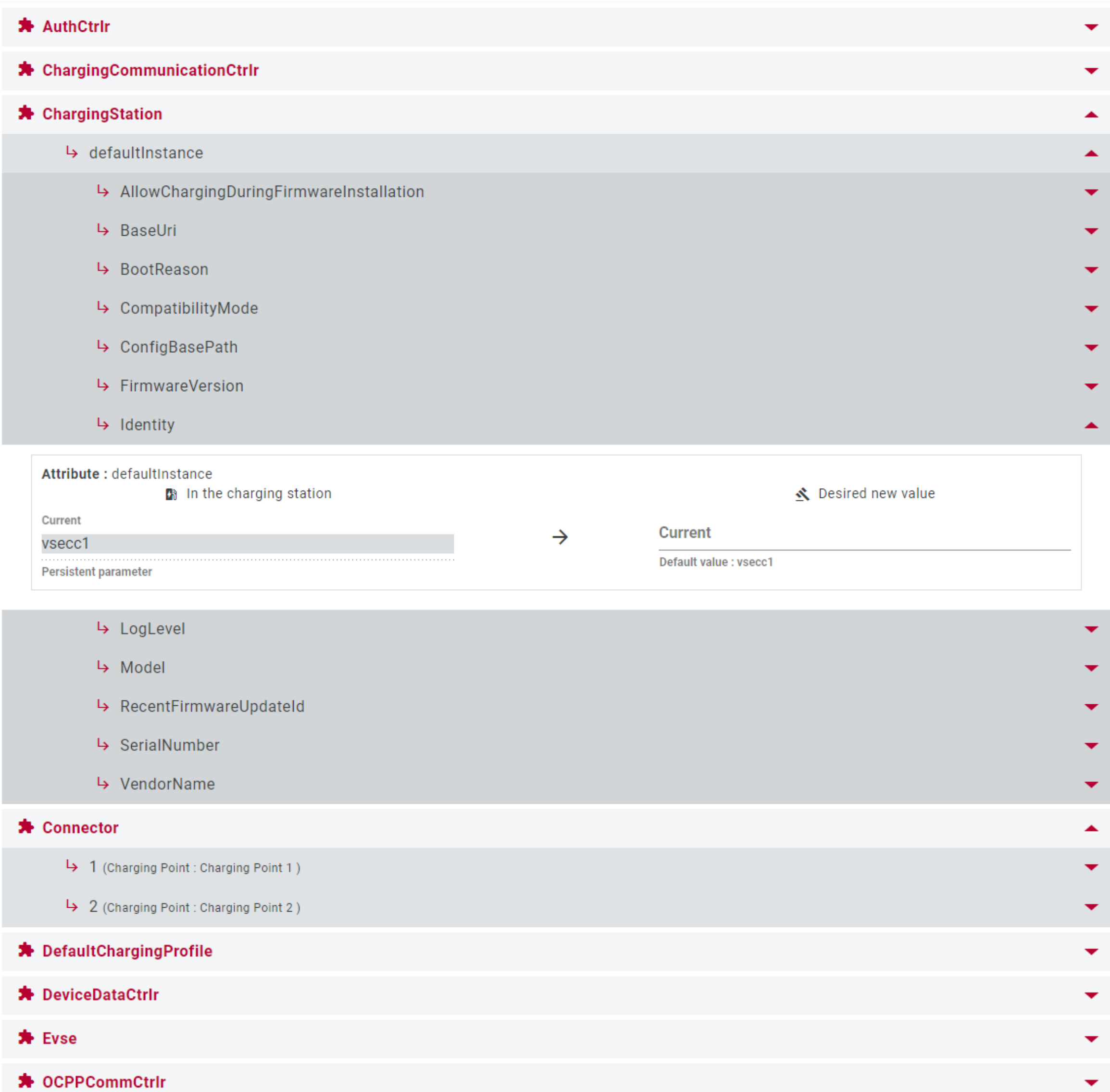


Figure 30: vCharM Charging Station Configuration

5.1.3 Configuration of the OCPP version

The vSECC Controller supports the following OCPP protocol versions:

> OCPP 1.6J
> OCPP 2.0.1

The OCPP version can be configured using the **ActiveOcppVersion** variable within the **SecurityCtrlr** component (see Section 5.7).

Only one version can be supported at a time. Changes to the configured version at runtime take effect after restarting the application.

Please note that not all features of newer OCPP versions are available in older versions of the standard. You can find more information about the supported features in Section 1.4.13

5.1.4 Authentication to a CSMS

The vSECC Controller authenticates to a CSMS by using Basic HTTP Authentication credentials.

All settings for authentication to the CSMS can be found under **SecurityCtrlr** in the web configuration interface, which is shown in Figure 31. In order to use the Basic HTTP Authentication the username has to be entered in the **Identity** field and the corresponding password in **BasicAuthPassword**. If OCPP 1.6 is used and the password is in hexadecimal, set the value of BasicAuthPasswordHexEncoded to true.

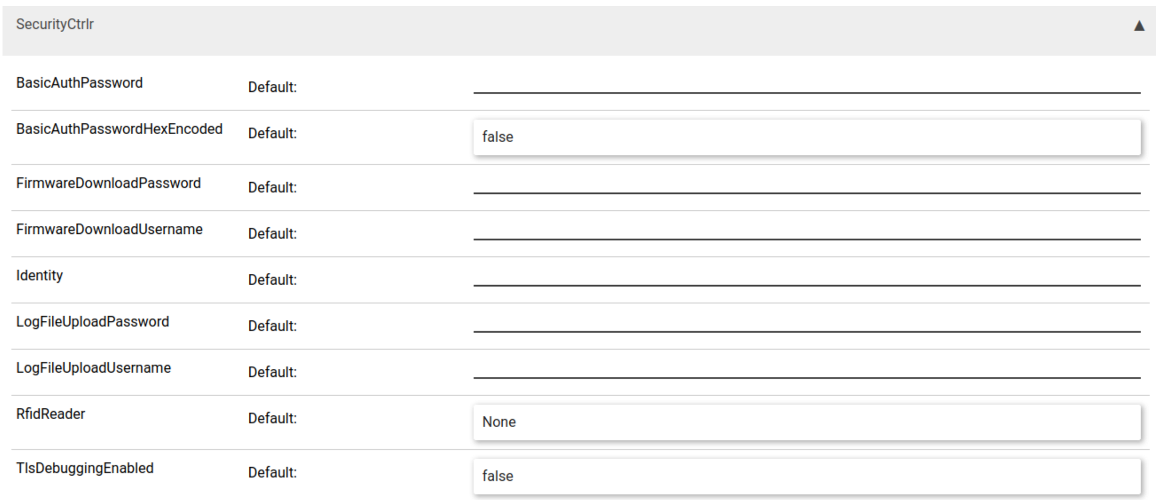


Figure 31: Settings for Authentication to a CSMS

5.2 Date Settings

In the web configuration interface, the current date of the vSECC Controller is shown in the corresponding section (see Figure 32). The current local time of the vSECC Controller is found under ”Current device time and date”. This field is updated in an interval of 5 seconds. The device time settings will be updated with the local host time when you click on **[Synchronize device time with local time]**. Then, the current time, date and time zone settings of the local host will be transferred to the vSECC Controller.

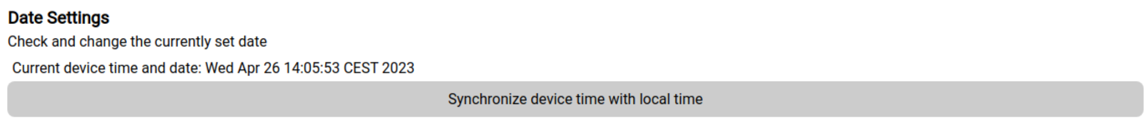


Figure 32: Synchronize device time in the web configuration interface

Furthermore, the vSECC Controller’s internal time can be synchronized with different types of mechanisms. Possible values for time synchronization are OCPP Heartbeat (Heartbeat), network time protocol (NTP) and real time clock (RealTimeClock). The default configured value is real time clock. The corresponding variables can be found inside the **ClockCtrl** section as seen in Figure 33.

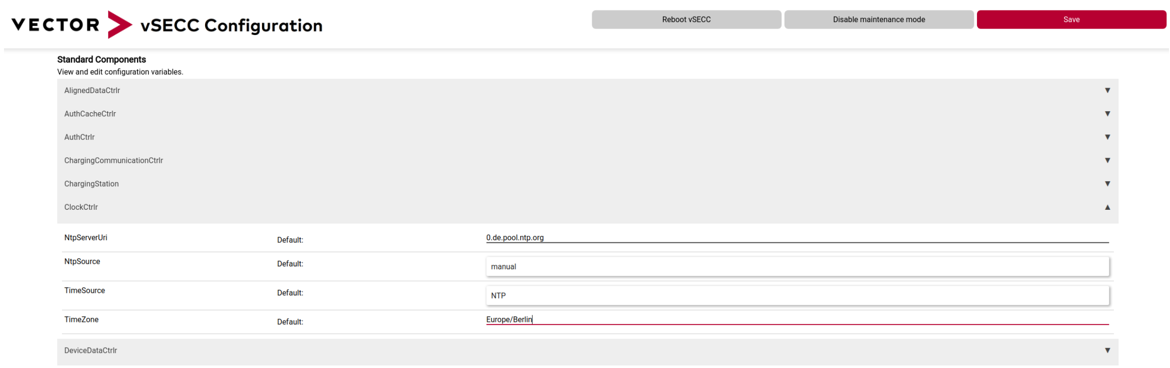


Figure 33: ClockCtrl configuration

!

Caution: After changing variables in the **ClockCtrl** section, a reboot of the vSECC Controller is necessary. After a restart, the changes are successfully applied and active.

5.2.1 Real Time Clock

If the **TimeSource** variable in section **ClockCtrl** is set to **RealTimeClock** the real time clock of the vSECC Controller for time synchronization is used. In this case, **NtpServerUri**, **NtpSource** and **TimeZone** can be set to the default value (see Section 5.7 for details).

The local time of the vSECC Controller is now synchronized with the internal real time clock.

The vSECC Controller does not have a valid time in the delivery state. The local time must be updated first (see Section 5.2).

5.2.2 OCPP Heartbeat

If the **TimeSource** variable in section **ClockCtrl** is set to **Heartbeat**, the OCPP Heartbeat is used for time synchronization. In this case, **NtpServerUri**, **NtpSource** can be set to the default value. The **TimeZone** value must be configured (see Section 5.7 for details).

The local time of the vSECC Controller is now synchronized with the OCPP Heartbeat.

The vSECC Controller's internal time is set by the CSMS it is connected to. The local time settings may not be appropriate if the vSECC Controller is not connected to a CSMS. Also, it may be necessary to set the time in order to be able to use certificates for the connection to the CSMS and meet their validity time span.

5.2.3 Network Time Protocol

If the **TimeSource** variable in section **ClockCtrl** is set to **NTP**, the network time protocol for time synchronization is used. In this case, **NtpServerUri**, **NtpSource** and **TimeZone** values must be configured (see Section 5.7 for details).

The local time of the vSECC Controller is now synchronized with a network protocol server.

The vSECC Controller's local time shall be synchronized with a network protocol server. A connection to this server is required for successful synchronization.

5.3 Change Network Configuration

The network settings for the Ethernet interfaces **[ETH1]** and **[ETH2]** can be changed in the web interface as shown in Figure 34. Select the interface to be changed via the drop down menu. You can choose between the modes **[DHCP]** and **[Static]**.

The default configuration modes are:
For ETH1 **[Static]** with the IP address 192.168.3.11;
for ETH2 **[DHCP]**.

If the IP address of ETH1 is changed, the web interface can be only reached under the new IP address. The settings are applied after pressing the **[Save]** button. Saving the settings will restart the network interfaces.

Caution: If you change the mode or IP address of ETH1, the web interface is no longer reachable under 192.168.3.11. Remember to use the new assigned IP address to reach the web interface.

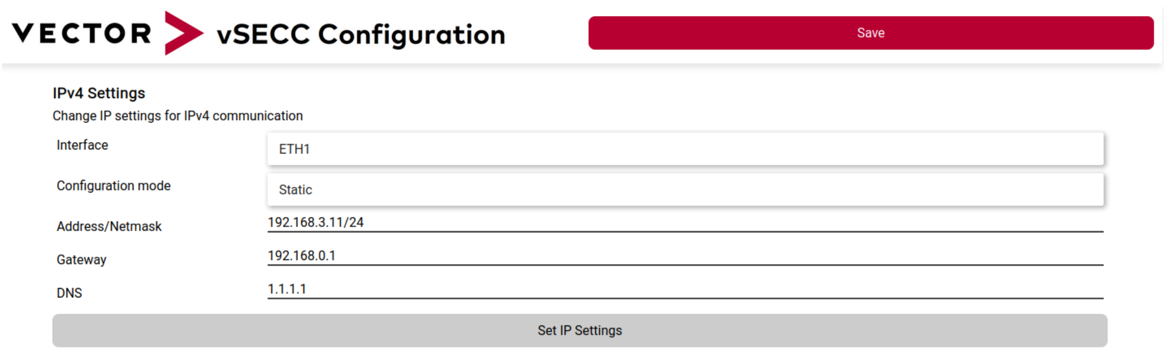


Figure 34: Change network settings

The execution of a factory reset (see 2.3.1) will restore the factory default network settings:

> Interface ETH1: Static 192.168.3.11/24

> Interface ETH2: DHCP

5.4 Change Password of Web Interface

Changing the default password of the Web User Interface is possible via the section shown in Figure 35. Therefore the vSECC Controller needs to be in maintenance mode.
First enter the new password in the field **New Password**. Afterwards enter it in the field **Verify Password**. If both input fields match, the new password will be set by pressing the button **[Set new password]**.

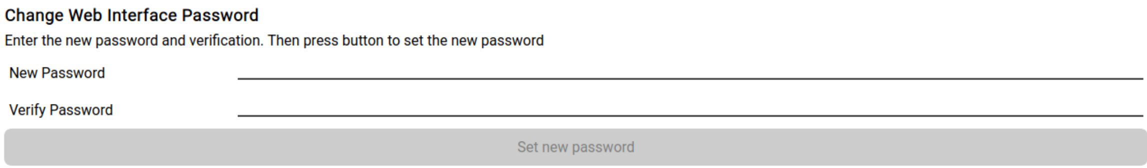


Figure 35: Change Web Interface password

5.5 Change User Name and Password of MQTT Interface

Changing the default user name and password of the MQTT Interface is possible via the web interface as shown in Figure 36. Therefore the vSECC Controller needs to be in maintenance mode.
First, enter the new user name in the field **New User Name**. Afterwards enter the new password in the field **New Password**. Repeat the new password in the field **Verify Password**. If the user name is available and the input fields for password match, the new user name and password will be set by pressing the button **[Set new user and password]**.

Caution: The vSECC Controller is coming without a valid user name and password for MQTT. A valid user name and password must first be set. The communication with external MQTT clients is not possible without these settings. Only one credential information can be configured at the same time. If a new user with corresponding password information is written, the old one will be deleted.

Figure 36: Change MQTT Interface Password

The execution of a factory reset (see chapter 2.3.1) will delete the MQTT credentials. After a factory reset the communication with external MQTT clients is not possible anymore until a new user name and password is set.

5.6 EVSE Topology

The configuration's structure is based on OCPP's 3-tier model which is also used by vCharM. This model describes the charging infrastructure on a logical level, consisting of three elements: *Charging Station*, *EVSE* and *Connector*.

Charging Station The term charging station describes a physical system where an EV can be charged. Each vSECC Controller corresponds to one charging station. This relationship is based on a unique charging station OCPP ID for each charging station. Figure 37 shows the edit menu of the charging station "vSECC" which consists of two EVSEs with one connector each.

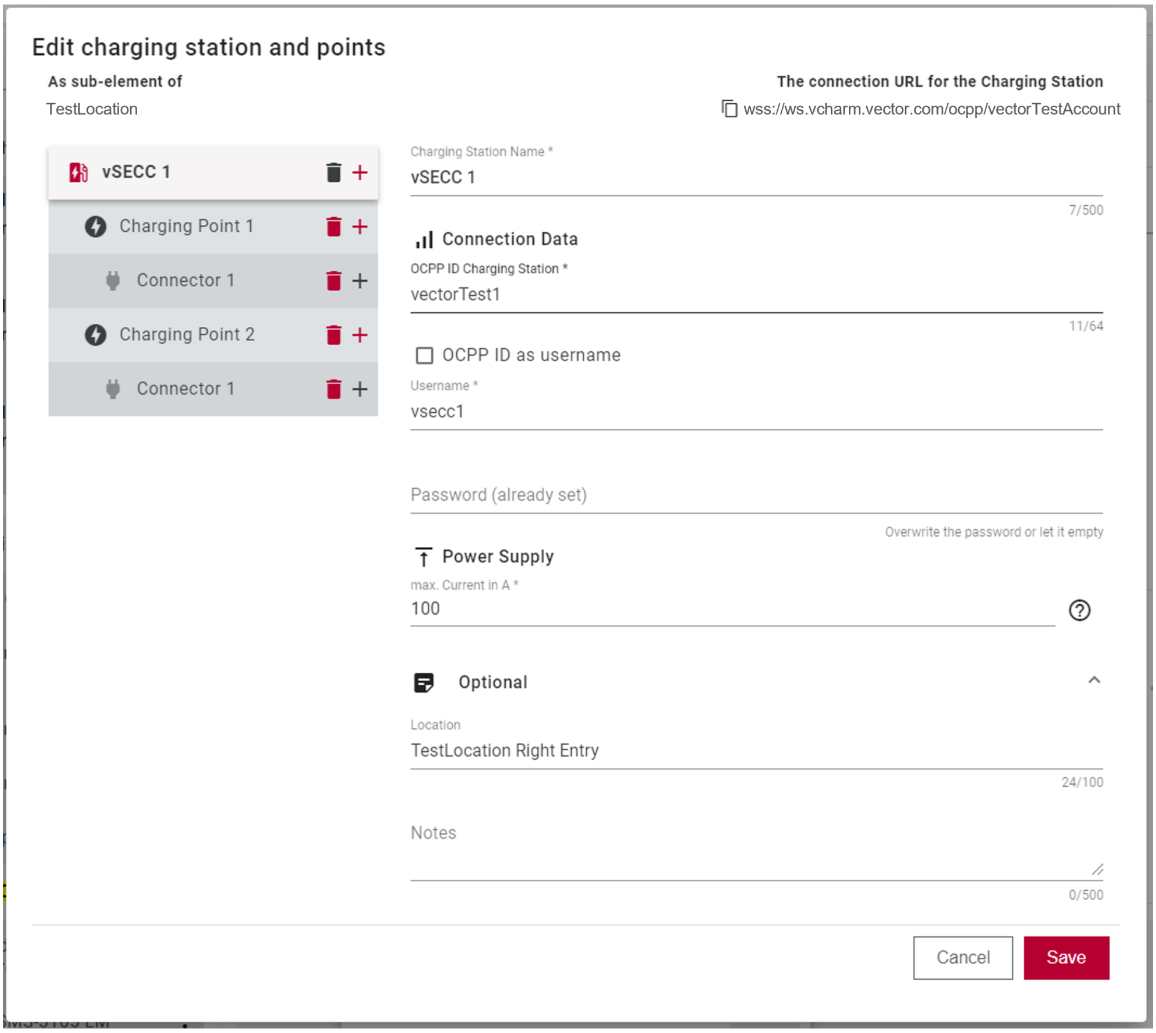


Figure 37: vCharM Charging Station Editing

EVSE An EVSE is defined by its ability to deliver energy to one EV at a time. A charging station can be connected to one or more EVSEs. Since the 3-tier model operates on a logical level, no assumptions are made about the physical hardware mapping. For example, the EVSE might be integrated into the charging station device itself. However, it could also be placed in a separate power electronics casing outside the charging station.

Connector The term connector describes an electrical outlet on a charging station. It is connected to a single EVSE. An EVSE can have multiple connectors attached to it, e.g. one CCS and one CHAdeMO compliant outlet. However, an EVSE will always use only one of its connectors exclusively. The complete 3-tier model is visualized in Figure 38.

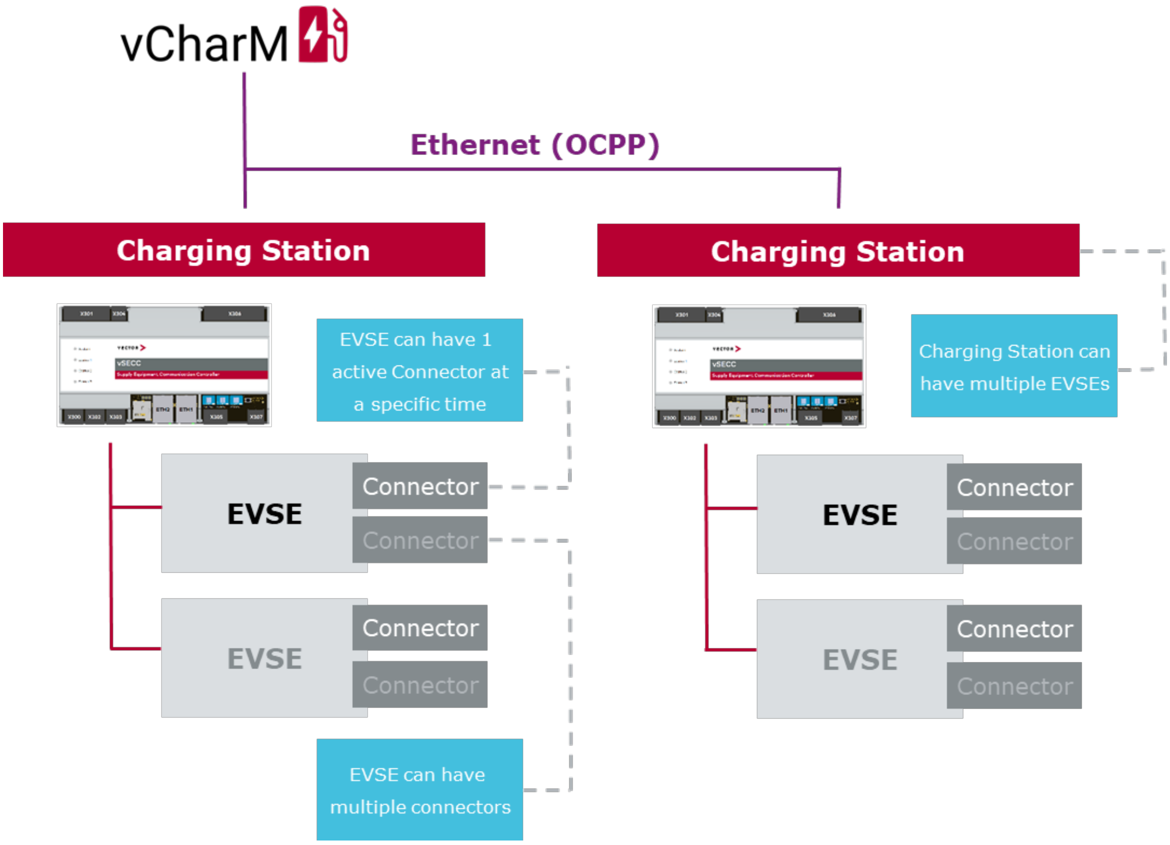


Figure 38: Overview according to OCPP 2.0: Part 1

5.7 Configuration Variable Reference

Standard Components

5.7.1 AlignedDataCtrl

Variable	Description	Default	Mutability
Available	Indicates if clock-aligned meter values are supported.	false	ReadOnly

5.7.2 AuthCacheCtrl

Variable	Description	Default	Mutability
Available	Indicates if a local cache for authorization is available.	false	ReadOnly

5.7.3 AuthCtrlr

Variable	Description	Default	Mutability
Authorization-Options	List of token types (as defined in the OCPP 2.0.1 standard) which get processed by the vSECC Software during authorization. If a token type does not appear on this list, it is ignored and not used for authorization. Commonly used values for the vSECC Controllers are: ”MacAddress” (AutoCharge), ”RFID” or ”Central” (remote authorization).	MacAddress, RFID, Central	ReadWrite

Authorize-RemoteStart	A transaction can be started remotely (i.e. not by the vSECC Controller) via a RequestStartTransactionRequest. If set to true, this RequestStartTransactionRequest is authorized before the start of the transaction, in the same way as if the request would originate from the vSECC Controller.	false	ReadOnly
Enabled	If set to true, the EV needs to be authorized to start charging. If set to false, no authorization is required to start charging.	false	ReadWrite
OfflineTxForUn-knownIdEnabled	If set to true, every ID token presented to the vSECC Controller is considered authorized while there is no connection to a CSMS, e.g. because the connection has been dropped.	false	ReadWrite
RejectRemote-Authorization-WithoutEvseId	If set to true, all OCPP 2.0.1 RequestStartTransactionRequests and OCPP 1.6 RemoteStartTransactionRequests without an EvseId/ConnectorId get rejected.	true	ReadOnly

5.7.4 ChargingCommunicationCtrlr

Variable	Description	Default	Mutability
AbortOnEnergy-MeterUnavailable	If set to true, the connector becomes inoperative when the connection to the energy meter is lost. This will abort the current charging process.	true	ReadWrite
AbortOnInvalid-RequestCurrent	At charging initialization, the EV and EVSE exchange their upper and lower limits for current, voltage and power. If the EV requests a current outside the current limits told by the EVSE and this variable is set to true, the charging session is aborted completely. If set to false, the charging session continues, but the current supplied is reduced to be within the power electronics' limits. See Appendix E for a detailed example. Note: If the requested voltage could not be supplied, the charging session is aborted.	false	ReadWrite

AbortOnInvalid-RequestPower	At charging initialization, the EV and EVSE exchange their upper and lower limits for current, voltage and power. If the EV requests a voltage and current that result in a requested power outside the power limit told by the EVSE, and this variable is set to true, the charging session is aborted completely. If set to false, the charging session continues, but the current supplied is reduced so that the resulting power is within the power electronics' limits. See Appendix E for a detailed example. Note: If the requested voltage could not be supplied, the charging session is aborted.	false	ReadWrite
PortTcp	The TCP port the vSECC Controller listens on for V2G messages. Must be a value greater than 1024 and lower than 65535.	61851	ReadWrite
TlsEnabled	When charging according to ISO15118, the V2G messages could be encrypted via TLS. This variable determines if TLS is considered when negotiating the charging protocol. Note: Using TLS requires a valid certificate chain with a signed leaf certifcate and corresponding private key ("EVSE leaf") to be installed on the vSECC Controller.	true	ReadWrite
TryRestart-AfterError	Determines the behavior if a specific error occurs while charging via CCS. When set to true and an error occured, the vSECC Controller tries to restart the charging session by executing a "BEB" toggle in an attempt to reset the EV and force it to reinitialize the charging session. Only TCP and TLS errors are handled this way. The reset of a charging session in this manner is specified in ISO 15118-3 requirement [V2G3-M06-13]. Note: The restart behavior via BEB toggle happens either before or after a charging session. If no charging session is running, the communication standard has not been negotiated yet. EVs charging according to ISO 15118-2 or -20 must support the BEB toggle restart. EVs charging according to DIN SPEC 70121, however, are expected but not required to behave the same way.	true	ReadWrite

VasInternet-ServiceEnabled	If set to true, the vSECC Controller will offer the Value Added Service (VAS) ”Internet” to the EV, as specified in ISO 15118.	false	ReadWrite

5.7.5 ChargingStation

Variable	Description	Default	Mutability
AllowCharging-DuringFirmware-Installation	If set to false, the vSECC Controller will wait for any ongoing transactions to finish before installing a firmware update.	false	ReadWrite
AllowNewSessions-Pending-FirmwareUp-date	If set to false, the vSECC Controller will not allow new charging sessions to start if a firmware update is about to be installed.	false	ReadOnly
BaseUri	The URI of the CSMS to connect to using OCPP over WebSocket.	https://192.-168.3.1:443/ocpp	ReadWrite
BootReason	Shows the reason why the vSECC Controller has booted, e.g. due to a firmware update or a remote restart.	LocalReset	ReadOnly
Compatibility-Mode	Enables or disables special behavior. When set to true, this includes: > When Charging with CCS, the maximum voltage reported to the EV is set to the lower value of the power electronics’ maximum voltage and the EV-reported maximum voltage: EVSEMaxVoltage = min(PEMaxVoltage, EVMaxVoltage). This may resolve problems with older EVs that do not handle higher values than their own maximum voltage correctly.	false	ReadWrite

FirmwareVersion	The firmware version currently installed on the vSECC Controller.	vX.X.X [Currently installed Firmware Version, e.g. v2.8.0]	ReadOnly
Identity	The OCPP charging station ID which identifies a charging station at the CSMS. Each vSECC Controller represents one charging station.	vectorTest1	ReadWrite
LogLevel	Sets the lowest log level that will still be stored. Based on the selected value, the associated messages and messages with lower severity are logged. Consequently, for a smaller logfile, WARN or ERROR should be used.	TRACE	ReadWrite
Model	Shows the model of the vSECC Family.	vSECC	ReadOnly
MonitorEvent-Counter	Persistent counter for every OCPP monitoring event sent to the CSMS.	0	ReadOnly
MonitorIdCounter	Persistent counter for every created OCPP monitor.	1	ReadOnly
RecentFirmware-UpdateId	OCPP ID of the most recent firmware update.	0	ReadOnly
SelfCheck-Enabled	If set to true, the vSECC Controller will become unavailable at startup while it checks the status of its components. Then, it transitions to ”available” or ”faulted” based on the self-check’s result.	true	ReadOnly
SerialNumber	Shows the serial number of the vSECC Controller.	individual, e.g. 012345	ReadOnly
SignedFirmware-UpdateInstallation	Indicates whether the latest firmware update has been signed.	false	ReadOnly
VendorName	Vendor of the vSECC Controller.	Vector	ReadOnly

5.7.6 ClockCtrlr

Variable	Description	Default	Mutability
NtpServerUri	The URI of the network time protocol server. The default value is empty. If NtpSource is set to manual, a valid address for an NTP server shall be defined here.	””	ReadWrite
NtpSource	If set to DHCP, the network time protocol setting of the DHCP server is used. If set to manual, the NTP server of NtpServerUri variable is used.	manual	ReadWrite
TimeSource	Indicates which time source the vSECC Controller uses for time synchronization. Possible values for time synchronization are OCPP Heartbeat (Heartbeat), network time protocol (NTP) and real time clock (RealTimeClock). The default value is RealTimeClock. > Heartbeat: The OCPP Heartbeat is used for time synchronization. The local time of the vSECC Controller will be updated with every OCPP heartbeat. > NTP: The time synchronization is done with the network time protocol. If this option is selected, the NtpSource and NtpServerUri shall be configured as well. The local time parameters are updated with a network time protocol server. > RealTimeClock: The real time clock of the vSECC Controller for time synchronization is used. The local time must be updated at the first startup (see Section 5.2 for details).	RealTimeClock	ReadWrite
TimeZone	The time zone of the vSECC Controller. The default value is empty. All time zones are defined as offsets from the universal time (UTC). The time zones have unique names in the form ”Area/Location”, e.g. ”Europe/Berlin”. A list of valid time zone identifiers can be found under https://en.wikipedia.org/wiki/List_of_tz_database_time_zones.	””	ReadWrite

5.7.7 DeviceDataCtrlr

Variable	Description	Default	Mutability
ItemsPerMes-sage	Defines the maximum number of entries that can be sent in one OCPP `NotifyReportRequest` message.	GetReport: 10	ReadWrite

5.7.8 DisplayMessageCtrlr

Variable	Description	Default	Mutability
Available	Indicates if interfacing with a display is supported.	false	ReadOnly
Enabled	Indicates if interfacing with a display is currently activated.	true	ReadOnly
SupportedFor-mats	Lists the supported formats.	ASCII, HTML, URI, UTF8	ReadOnly
SupportedPriori-ties	Lists the supported priorities.	AlwaysFront, In-Front, NormalCycle	ReadOnly

5.7.9 ISO15118Ctrlr

Variable	Description	Default	Mutability
Available	Indicates if ISO 15118 functionality is supported.	true	ReadOnly
CentralContract-ValidationAllowed	If set to true, the vSECC Controller will forward contract certificates to the CSMS for validation.	true	ReadOnly

Contract-Certificate-Installation-Enabled	If set to true, the vSECC Controller allows to install contract certificates on the EV according to ISO 15118.	false	ReadOnly
Contract-ValidationOffline	If set to true, the vSECC Controller will attempt to verify a contract certificate even when there is no connection to the CSMS.	false	ReadOnly
CountryName	Used as the countryName (C) in the SECC leaf certificate.	””	ReadWrite
Enabled	Indicates if ISO 15118 functionality is enabled.	true	ReadOnly
Organization-Name	Used as the organizationName (O) in the SECC leaf certificate.	””	ReadWrite
PnCEnabled	If set to true, the vSECC Controller will offer Authorization with Plug and Charge (PnC) to the EV.	false	ReadWrite
RequestMetering-Receipt	If set to true, the vSECC Controller will request a metering receipt from the EV before sending a final meter value to the CSMS.	false	ReadOnly
SeccId	Used as the commonName (CN) in the SECC leaf certificate.	””	ReadWrite
V2GCertificate-Installation-Enabled	If set to true, the vSECC Controller allows to generate and update its leaf certificate using OCPP.	true	ReadOnly

5.7.10 LocalAuthListCtrlr

Variable	Description	Default	Mutability
Available	Indicates if local authorization lists are supported.	false	ReadOnly

5.7.11 MonitoringCtrlr

Variable	Description	Default	Mutability
Available	Indicates if OCPP monitors are supported.	true	ReadOnly
Enabled	Indicates if OCPP monitor functionality is enabled.	true	ReadOnly

5.7.12 OCPPCommCtrlr

Variable	Description	Default	Mutability
ActiveOcpp-Version	Sets the OCPP version which will be used by the vSECC Software when connecting to a CSMS. Only one version can be supported at a time. A change of this value during runtime takes effect after a restart of the application.	ocpp2.0.1	ReadWrite
BackendCom-Activated	It is possible to operate the vSECC Controller without connecting to a CSMS. Setting this variable to false will disable communication to any CSMS. It is advisable to properly configure the DefaultChargingProfile when no CSMS is in use.	true	ReadWrite
FileTransfer-Protocol	Shows the supported file transfer protocols.	HTTP, HTTPS, FTP	ReadOnly
HeartbeatInterval	Defines the duration (in seconds) of an inactive period without an OCPP message exchange with the CSMS, i.e. after how many seconds the charging station should send a HeartbeatRequest.	30	ReadWrite
MaxConsecutive-Timeouts	Defines the maximum number of allowed consecutive timeouts of OCPP messages. When exceeding that number, a disconnect will be forced.	5	ReadWrite

MessageAttempt-Interval	Defines the time interval (in seconds), how long the charging station should wait before submitting another OCPP `TransactionEventRequest` message, that the CSMS previously failed to process.	BootNotification-RequestEvent: 30, TransactionEvent: 30	ReadWrite
Message-Attempts	Defines the number of attempts a charging station should try to send an OCPP `TransactionEventRequest` message, when the CSMS fails to process it.	TransactionEvent: -10	ReadWrite
MessageTimeout	Defines the amount of seconds after which the vSECC Controller considers an OCPP message as timed-out, if no response has been received from the CSMS.	60	ReadWrite
MinimumStatus-Duration	Minimum duration in seconds that a connector status has to be stable before a Status-NotificationRequest is sent to the CSMS. During OCPP 2.0.1 operation, the Minimum-StatusDuration is always ”0”.	0	ReadWrite
OfflineThreshold	If the connection to the CSMS gets dropped for longer than the configured offline threshold (in seconds), the vSECC Controller will send an additional StatusNotificationRequest for each connector.	60	ReadWrite
QueueAllMes-sages	If set to true, the vSECC Controller will queue all OCPP messages until they are delivered to the CSMS.	true	ReadOnly
ResetRetries	Number of times the vSECC Controller tries to initiate a reboot, if a reset was unsuccessful.	0	ReadOnly
RetryBackOff-RandomRange	When the Charging Station is reconnecting after a connection loss, it will use this variable as the maximum value for the random part of the back-off time. It will add a new random value to every increasing back-off time, including the first connection attempt (with this maximum), for the amount of times it will double the previous back-off time. When the maximum number of increments is reached, the Charging Station will keep connecting with the same back-off time.	10	ReadWrite

RetryBackOff-RepeatTimes	Defines the amount of times that the CSMS connection retry interval gets increased after a failed attempt.	2	ReadWrite
RetryBackOff-WaitMinimum	Defines the minimum connection retry interval in seconds after losing connection to the CSMS.	10	ReadWrite
UnlockOnEVSide-Disconnect	If set to true, the vSECC Controller will unlock the cable on the charging station side when the cable is unplugged at the EV.	false	ReadOnly
WebSocketPing-Interval	Number of seconds between WebSocket pings for the CSMS connection. Setting this variable to ”0” disables pings.	0	ReadWrite

5.7.13 PowerElectronicsCommon

Variable	**Description**	**Default**	**Mutability**
CanBase-AdressInOut	Sets the CAN base address for I/O-related messages.	0x500	ReadWrite
CanBaudRate	Baudrate of the power electronics communication via CAN (in baud).	500,000	ReadWrite
CanDlc-EmptyMessages	Data Length Code of CAN messages sent by the vSECC Controller which do not contain data, e.g. ”Reset”.	0	ReadWrite
SimulatedPeMax-CurrentAmperes	Only relevant if PowerElectronicsType is set to ”Simulation”. Maximum current of simulated power electronics (in Amperes).	200	ReadWrite
SimulatedPeMax-PowerWatts	Only relevant if PowerElectronicsType is set to ”Simulation”. Maximum power of simulated power electronics (in Watts).	100,000	ReadWrite
SimulatedPeMax-VoltageVolts	Only relevant if PowerElectronicsType is set to ”Simulation”. Maximum voltage of simulated power electronics (in Volts).	950	ReadWrite

5.7.14 ReservationCtrlr

Variable	Description	Default	Mutability
Available	Indicates if reservations are supported.	false	ReadOnly

5.7.15 SampledDataCtrlr

Variable	Description	Default	Mutability
Available	Indicates if meter values are supported.	true	ReadOnly
Enabled	Indicates if meter values are enabled.	true	ReadOnly
TxEndedMeasurands	Measurands which are sent when an OCPP transaction ends.	SoC, Energy.Active.Import.Register	ReadWrite
TxStartedMeasurands	Measurands which are sent when an OCPP transaction starts.	SoC, Energy.Active.Import.Register	ReadWrite
TxUpdatedInterval	Interval in seconds for sending OCPP MeterValues periodically.	600	ReadWrite
TxUpdatedMeasurands	Measurands which are sent during an OCPP transaction.	SoC, Current.Import, Voltage, Power.Active.Import, Energy.Active.Import.Register	ReadWrite

5.7.16 SecurityCtrlr

Variable	Description	Default	Mutability
BasicAuthPassword	Password used for HTTP Basic Authentication when connecting to the CSMS.	””	ReadWrite
BasicAuthPasswordHexEncoded	Specifies whether the HTTP Basic Authentication password is represented in hexadecimal format. Used for OCPP 1.6 only.	false	ReadWrite
FirmwareDownloadPassword	Password used for HTTP Basic Authentication when updating the firmware. If left empty, no HTTP Basic Authentication is used. If the CSMS supplies the username/password embedded in the firmware URL, this field is ignored.	””	ReadWrite
FirmwareDownloadUsername	Username used for HTTP Basic Authentication when updating the firmware. If left empty, no HTTP Basic Authentication is used. If the CSMS supplies the username/password embedded in the firmware URL, this field is ignored.	””	ReadWrite
Identity	Username used for HTTP Basic Authentication when connecting to the CSMS. If left empty, the username defaults to the value set inside the ChargingStation/Identity variable.	””	ReadWrite
LogFileUploadPassword	Password used for HTTP Basic Authentication when uploading log files. If left empty, no HTTP Basic Authentication is used. If the CSMS supplies username/password embedded in the upload URL, this field is ignored.	””	ReadWrite
LogFileUploadUsername	Username used for HTTP Basic Authentication when uploading log files. If left empty, no HTTP basic authentication is used. If the CSMS supplies username/password embedded in the upload URL, this field is ignored.	””	ReadWrite
RfidReader	Defines which RFID reader is connected to the vSECC Controller for authorization of users. Use ”None” if you do not intend to interface with any RFID reader.	None	ReadWrite

TlsDebuggingEn-abled	**Only for development!** Enables the output of ClientRandom and MasterSecret of TLS communication to allow for debugging of PLC traces.	false	ReadWrite

5.7.17 SmartChargingCtrlr

Variable	Description	Default	Mutability
Available	Indicates if smart charging is supported.	true	ReadOnly
Enabled	Indicates if smart charging is enabled.	true	ReadOnly
LimitChange-Significance	If the power changes by more than the configured value (in Watts), an additional OCPP meter value will be sent even if the TxUpdatedInterval has not yet expired.	10000000	ReadWrite
PeriodsPer-Schedule	The maximum amount of periods in a charging profile's schedule.	1024	ReadOnly
ProfileStackLevel	The maximum stack level in a charging profile.	20	ReadOnly
RateUnit	The supported charging rate units in a charging profile.	W	ReadOnly
WaitForCharging-ProfileTimeout	Time in seconds to wait in the ChargeParameterDiscovery (CCS) for a charging profile from the CSMS. Maximum Value: 59.	0	ReadWrite

5.7.18 TariffCostCtrlr

Variable	Description	Default	Mutability
Available	Indicates if the functionality is supported.	Tariff: true, Cost: true	ReadOnly

<table>
<tr><td>Enabled</td><td>Specifies if the functionality is enabled.</td><td>Tariff: true, Cost: true</td><td>ReadOnly</td></tr>
<tr><td>TariffFallback-Message</td><td>Specifies the fallback tariff presented by the charging station, for instance ”Charging costs 0.5$/kwh” or more complex messages like specified in the OCPP & California Pricing Requirements.</td><td>””</td><td>ReadWrite</td></tr>
<tr><td>Currency</td><td>Specifies the currency for tariffs and cost. Value must conform to ISO 4217.</td><td>EUR</td><td>ReadWrite</td></tr>
<tr><td>TariffExtraction-Regex</td><td>Specifies the Regular Expression (regex) to be used on the <code>TariffFallbackMessage</code> variable value. The regex must match exactly two capture groups. The first group must collect the numerical value of the tariff. The second group must collect the currency. The default regex matches dot separated decimals and cuts after the second decimal place, if applicable. Only the symbols and 3-letter codes of US-Dollar, Euro, Sterling and Japanese Yen are supported. Optional whitespaces are allowed between the value, currency and case-insensitive kWh denominator. Backslashes must be escaped once.</td><td>.*?(\\d+(?:\\.\\d{1,2})?)\\d*?\\s?(€|(?:EUR)|\\$|(?:USD)|¥|(?:JPY)|£|(?:GPD))\\s?\\/\\s?[kK][wW][hH].*</td><td>ReadWrite</td></tr>
<tr><td>PaymentTerminalId</td><td>ID of the Payment Terminal that is connected to the vSECC Controller. This value is not checked by the vSECC Controller. The ID is reported to the OCPP backend, which can use it to verify that the payment transaction really belongs to the installed payment terminal.</td><td>””</td><td>ReadWrite</td></tr>
</table>

5.7.19 TxCtrlr

Variable	Description	Default	Mutability
EVConnection-TimeOut	Specifies the maximum time (in seconds) between presenting an RFID token and plugging in an EV. If no EV gets plugged-in within the timeout, the RFID token gets discarded.	300	ReadWrite

StopTxOn-EVSideDisconnect	If set to true, the vSECC Controller deauthorizes the transaction when the cable is unplugged from the EV.	false	ReadOnly
StopTxOnInvalidId	If set to true, the vSECC Controller will deauthorize the transaction if the token gets rejected in the CSMS' "TransactionEventResponse".	true	ReadOnly
TxBefore-AcceptEnabled	If set to true, transactions are allowed to start before the vSECC Controller was accepted by the CSMS.	true	ReadOnly
TxStartPoint	List of events that cause an OCPP transaction to start.	PowerPathClosed, EnergyTransfer	ReadWrite
TxStopPoint	List of events that cause an OCPP transaction to end.	EVConnected, Authorized, PowerPath-Closed, Energy-Transfer	ReadWrite

5.7.20 Watchdog

Variable	Description	Default	Mutability
HealthCheck-Interval	Interval in seconds at which components must report their status to the software watchdog.	30	ReadOnly

EVSEs

5.7.21 Connector

Variable	Description	Default	Mutability
AvailabilityState	Indicates the current availability state of the connector.	””	ReadOnly
CcsType	Configures the CCS Connector Type. Make sure to configure the DIP switches for hardware safety supervision accordingly. See Section 2.3.2 for details.	Type2	ReadWrite
ConnectorType	This field specifies the connector type in accordance with the purchased software option. Options are: cCCS2 for CCS, cG105 for CHAdeMO, OppCharge for inverted pantograph.	cCCS2	ReadOnly
EnergyMeterType	Energy meter to use for this connector. Defines which energy meter interfaces to this connector for energy measurement. Use ”None” if you do not intend to interface with any energy meter.	None	ReadWrite
EnergyMeterUrl	URL of the energy meter for this connector. Currently only used for LEM DCBM.	http://192.-168.3.21:80, http://192.-168.3.22:80	ReadWrite
EnergyTransfer-Modes	The offered EnergyTransferModes according to ISO 15118-2 Table 63.	DC_EXTENDED	ReadWrite
OfferedCharging-StandardsCcs	Specifies the charging standards offered by the vSECC Controller to the EV.	ISO15118_2, DIN70121	ReadWrite
Pantograph-ControlType	When using OppCharge, this variable defines how the pantograph is controlled. See Section 5.16 for details.	Simulation	ReadWrite

PhysicalStop-Button	Enables a physical button for stopping the charging session for the corresponding connector. See Section 5.20 for details.	false	ReadWrite
connectorid	OCPP ID of the connector.	1	no
evseid	OCPP ID of the EVSE the connector belongs to. Note: EvseId cannot be 0.	1	ReadOnly

5.7.22 DefaultChargingProfile

Variable	Description	Default	Mutability
SerializedDefault-Profile	Serialized default charging profile. Used by the vSECC Controller to persist profiles across reboots.	” ”	ReadOnly
evseid	OCPP ID of the EVSE the serialized charging profile belongs to.	1	ReadOnly

5.7.23 Evse

Variable	Description	Default	Mutability
AllowReset	Indicates if the EVSE can be reset individually, independent of the charging station.	false	ReadOnly
DIN70121EvseId	Unique charge point ID advertised to the EV when charging according to DIN SPEC 70121. The format is specified in DIN SPEC 91286. It must not be confused with the OCPP EVSE ID which is a single number and NOT used in EVSE-to-EV communication.	00	ReadWrite
Enabled	If set to true, the EVSE is available and operational.	true	ReadOnly
HardwareConfig-Index	Information about the hardware configuration. Maps the logical (OCPP) EvseId to the corresponding charging port. This can be helpful when support is needed.	1	ReadOnly

ISO15118EvseId	Unique charge point ID advertised to the EV when charging according to ISO 15118. The format is specified in ISO 15118-2, Section H.2. It must not be confused with the OCPP EVSE ID which is a single number and NOT used in EVSE-to-EV communication.	ZZ00000	ReadWrite
OppChargeEv-seId	Unique charge point ID advertised to the EV when charging according to the OppCharge protocol. Table 27_1 of the OpportunityCharging specification defines that up to 32 ASCII characters could be used with otherwise no special formatting. It must not be confused with the OCPP EVSE ID which is a single number and NOT used in EVSE-to-EV communication.	ABCDEFGH	ReadWrite
evseid	Identifier of the EVSE.	1	ReadOnly

5.7.24 PowerElectronics

Variable	Description	Default	Mutability
CanBaseAddress	Base address of CAN message IDs for this connector. E.g. base address 0x300 means that `VehicleStatus` message has CAN ID 0x301.	0x300 (Connector 1), 0x400 (Connector 2)	ReadWrite
ConfigPollInterval	Only relevant for websocket communication. Time (in seconds) between `request-configuration` messages are sent to the power electronics. If set to 0, the request is only sent once when a connection to the power electronics is established.	0	ReadWrite
HeartbeatInterval	Time (in seconds) after which the charging station sends a heartbeat message so that the power electronics connection doesn't run into a timeout.	2	ReadWrite
MessageTimeout	Duration in seconds after which a sent message is considered timed-out after not receiving a response.	2	ReadWrite
Password	The password to authenticate with the power electronics via websocket basic auth. If both username and password are empty, no authentication is used.	vector	ReadWrite

SetUpTime	Time interval in seconds the power electronics needs to be setup after reboot.	18	ReadWrite
Type	If set to ”Simulation”, the vSECC Controller communicates with an internal power electronics simulation. If set to ”Websocket”, the vSECC Controller will communicate with a PEP-WS compliant websocket server through its Ethernet interface. If set to ”Can”, the vSECC Controller will communicate with a PEP-CAN compliant controller through CAN interface 2 (see Section 2.2.6).	Simulation	ReadWrite
Uri	The URI of the PECC (Power Electronics Communication Controller) to connect to using WebSocket.	http://localhost:-8080/Power-Electronics	ReadWrite
Username	The username to authenticate with the power electronics via WebSocket basic authentication. If both username and password are empty, no authentication is used.	vectortest1@vector	ReadWrite
evseid	OCPP ID of the EVSE the power electronics belongs to.	1	ReadOnly

5.7.25 V2XChargingCtrlr

Variable	Description	Default	Mutability
Setpoint	The dynamic target power (in Watts) that is used for BPT dynamic control mode. Negative values represent discharging. This value should only be set through the CSMS, not through the web interface. It does not persist across reboots.	0	ReadWrite
evseid	Optional EVSE Identifier.	1	ReadOnly

5.7.26 Reporting of configuration variables using OCPP 1.6J

OCPP 1.6J does not support the concept of a device model to report a charging station's configuration as specified within OCPP 2.x. However, the CSMS still has the possiblity to request the configured variables using the `GetConfiguration.Req` message.

If a variable within the device model can be mapped to a specified OCPP 1.6J variable, the vSECC Software will report the variable under that name. If a variable within the device model does not have an equivalent within OCPP 1.6J or is custom to the vSECC Controller's configuration, the variable is reported using the following naming scheme:

> Component (max. 15 characters)

> Component Instance or EVSE-ID (max. 3 characters)

> Variable (max. 25 characters)

> Variable Instance (max. 3 characters)

All parts are separated using forward slashes (`/`). Empty parts, for example if no instance name exists, map to empty strings. The slash is not ommitted in that case. Some examples:

> Component ”AuthCtrlr” with variable ”Enabled”:
”AuthCtrlr//Enabled/”

> Component ”Connector” of EVSE ”1” with variable ”ConnectorType”:
”Connector/1/ConnectorType/”

> Component ”SmartChargingCtrlr” with variable ”LimitChangeSignificance”:
”SmartChargingCt//LimitChangeSignificance/”

> Component ”SampledDataCtrlr” with variable ”TxUpdatedInterval” which maps to an OCPP 1.6J specified variable:
”MeterValueSampleInterval”

5.7.27 OCPP 1.6J Configuration Keys

The following configuration keys of the OCPP 1.6J specification are supported:

> AllowOfflineTxForUnknownId

> ConnectionTimeOut

> GetConfigurationMaxKeys

> HeartbeatInterval

> MeterValuesSampledData

> MeterValueSampleInterval

> MinimumStatusDuration

> NumberOfConnectors

> StopTransactionOnEVSideDisconnect

> StopTransactionOnInvalidId

> StopTxnSampledData
> TransactionMessageAttempts
> TransactionMessageRetryInterval
> WebSocketPingInterval
> AuthorizationKey
> CpoName

5.8 Firmware Update

A new firmware can be installed on the vSECC Controller either via the web interface or via an OCPP based charging station management system like vCharM.

5.8.1 Firmware Update via web interface

To update the firmware, put the vSECC Controller into maintenance mode as described in chapter 5.1.1. Head over to the **Firmware Update** section shown in Figure 39.

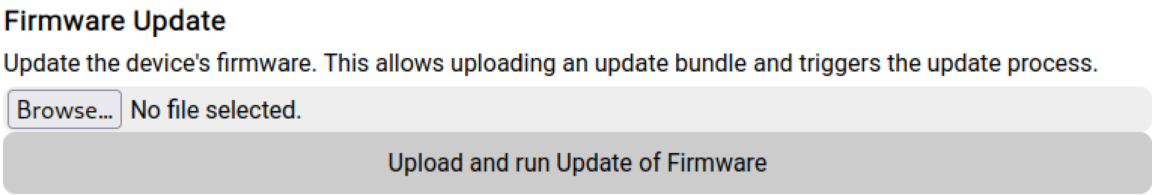


Figure 39: Firmware Update via web interface

Select the new firmware update file that you have stored on your PC by pressing on the **[Browse...]** button. Then press the **[Upload and run Update of Firmware]** button to initiate the update process. The entire update process including the upload takes about 90 seconds. Please do not turn off the device while the update is running.
After the update is successfully completed, restart the device by clicking on the **[Reboot]** button on top of the page. With the reboot, the device boots into the new installed firmware.

5.8.2 Firmware Update via CSMS

Updating the vSECC Controller's firmware via OCPP utilizes the `UpdateFirmware` messages. The firmware will be downloaded from the URI specified inside the CSMS' request. After a successful download, it will then install the firmware update and reboot. For further information about the structure and usage of those messages, please refer to the appropriate OCPP specification.
Inside vCharM, a firmware update can be requested via the **Update Firmware** dialog as seen in Figure 40. You can then upload the firmware file or specify the file's location using an URI. After scheduling the update to a certain point in time, the request is sent to the vSECC Controller, which initiates the update process. If the server where the firmware update file is located requires credentials, they can be set via the
SecurityCtrlr/FirmwareDownloadUsername and

SecurityCtrlr/FirmwareDownloadPassword configuration variables. If the CSMS sends its own credentials embedded in the firmware URL, the configuration variables are ignored. Special characters like "@" must be encoded in URL embedded credentials. Credentials set in the configuration must not be encoded. Anonymous logins are possible by leaving credentials in the URL and the configuration variables empty. In the case of FTP, setting the user to "anonymous" via the URL credentials allows to explicitly override configuration credentials in order to log into the server anonymously. Non-default ports can be chosen by an appropriate URL modification, too.
For use with vCharM, set the configuration variables
SecurityCtrlr/FirmwareDownloadUsername equal to **SecurityCtrlr/Identity** and
SecurityCtrlr/FirmwareDownloadPassword equal to **SecurityCtrlr/BasicAuthPassword**.

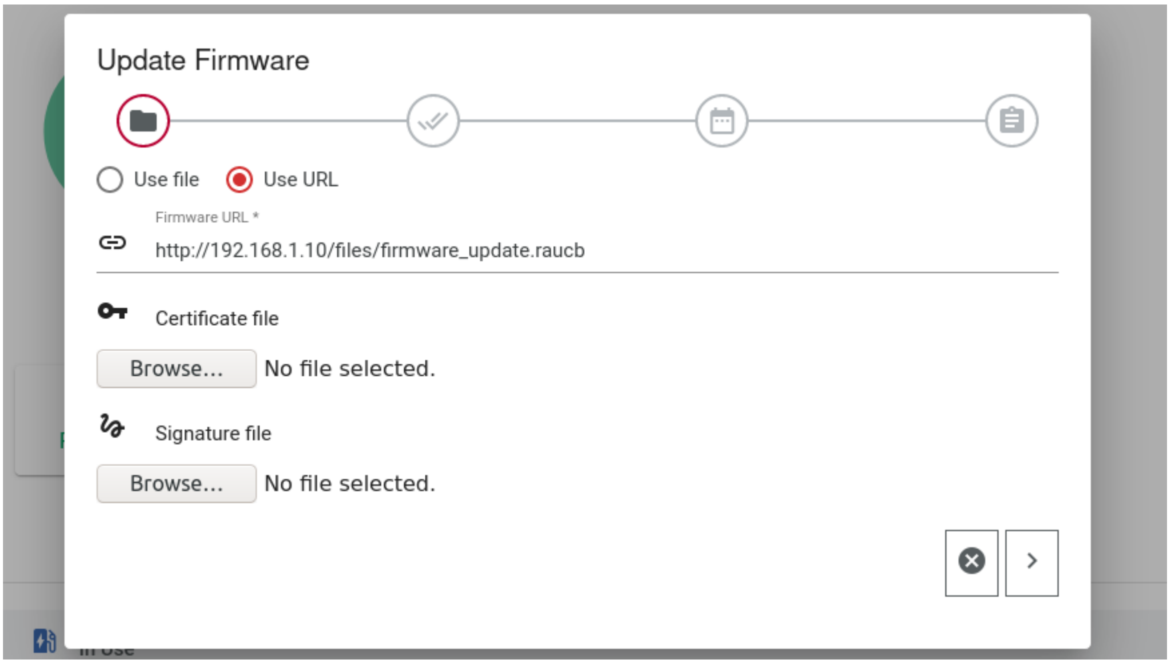


Figure 40: vCharM Firmware Update

5.9 Uploading and Checking of a License

To use certain features, a special license is required. To purchase a license and receive the license file, please get in touch with your sales contact.
In order to install the license and check if it has been correctly installed, perform the following steps:

> Upload the license file, as described in the Email that delivers the license

> Put the vSECC Controller out of maintenance mode at least once, so the license gets read by the software

> Download the log files (see Section 5.10)

> Inspect the `vsecc.log` file for the `Licensed Options` field. To use e.g. bidirectional power transfer with ISO 15118-20, it must contain `ISO-20` and `BPT`

> As an alternative, the license can be checked via entering http://<IP of vSECC>/info.php in the web browser when connected to the vSECC Controller.

```
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:110] Configuration:
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:113] BackendCom activated: true
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:114]   Base Uri: http://192.168.3.1/ocpp
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:115]   Identity: vectorTest1
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:116]   Username:
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:117]   Version:  ocpp2.0.1
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:127] Connector 1: CCS_2 @ eth2
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:149]   Licensed Options: ISO-20, BPT
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:160]   Offered CCS standards: ISO15118_2, ISO15118_20, DIN70121
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:164]   TLS: enabled
2022-10-12 14:26:13.468 [DEBUG]: [initialization.cpp:167]   VAS: enabled
```

Figure 41: vsecc.log

5.10 Downloading Log Files

To assist technical support, the vSECC Software application's log files can be downloaded from the vSECC Controller either by using the web interface or via OCPP. Additionally, all log files can be deleted via the web interface to clean up the log file memory.

The log files are stored for 1 week on the vSECC Controller, and then deleted automatically.

To download log files using the web interface, put the vSECC Controller into maintenance mode as described in chapter 5.1.1. Head over to the **Log Files** section shown in Figure 42. Then press the **[Download]** button to download the log files.
To delete log files, use the button **[Delete all log files (clean-up)]** next to the download button.

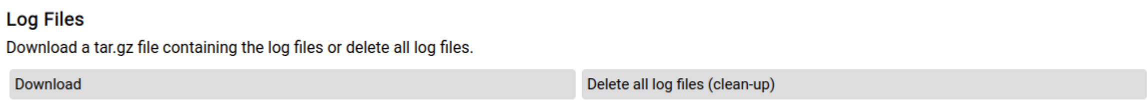


Figure 42: Downloading Log Files

Downloading log files via OCPP uses the `GetLog` messages. The vSECC Software will compress its log files into an archive and upload it to the URI specified by the CSMS. The URI must point to a directory and not a file. A URI pointing to a file is interpreted to rename the uploaded file by some file transfer protocols. This is not intended, as the vSECC Controller is responsible to choose a name and notify the CSMS about it.
For further information about the structure and usage of those messages, please refer to the appropriate OCPP specification. In vCharM for example, the log files can be requested via the **Request Logs** dialog. The uploaded log files can then be retrieved from vCharM and downloaded as a local copy, as can be seen in Figures 43 and 44.
If the target server of the log file upload requires credentials, they can be set via the **SecurityCtrlr/LogFileUploadUsername** and **SecurityCtrlr/LogFileUploadPassword** configuration variables. If the CSMS sends its own credentials embedded in the download URL, the configuration variables are ignored. For further details on credential options, please refer to subsection 5.8.2. For use with vCharM, set the configuration variables **SecurityCtrlr/LogFileUploadUsername** equal to **SecurityCtrlr/Identity** and **SecurityCtrlr/LogFileUploadPassword** equal to **SecurityCtrlr/BasicAuthPassword**.

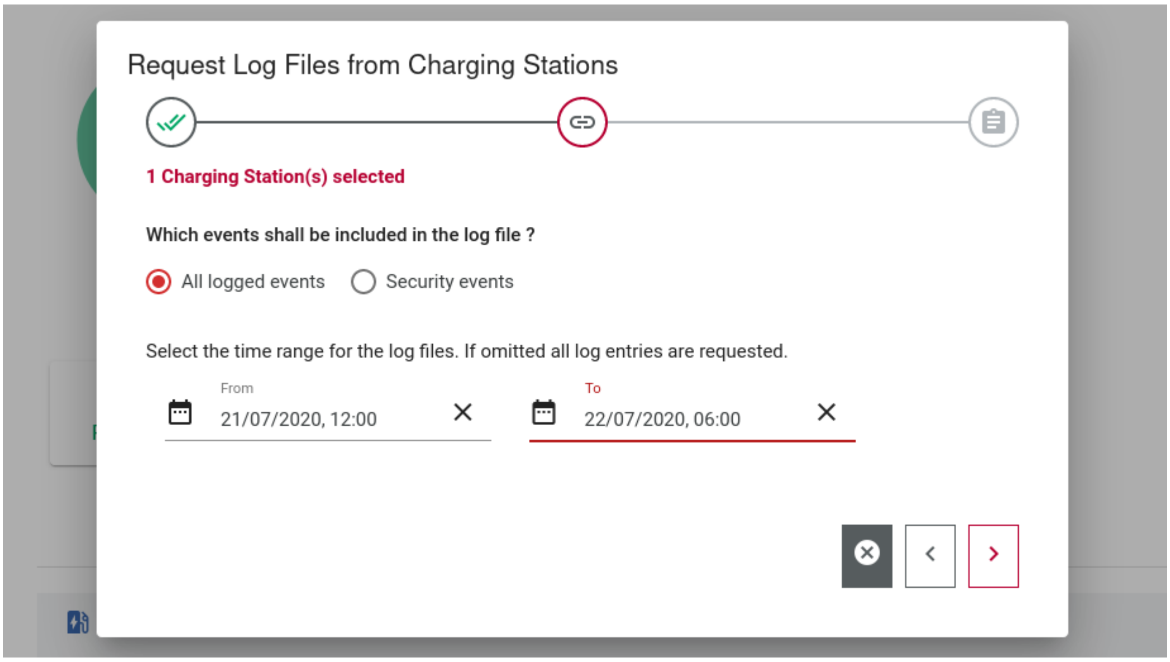


Figure 43: vCharM Requesting Log Files

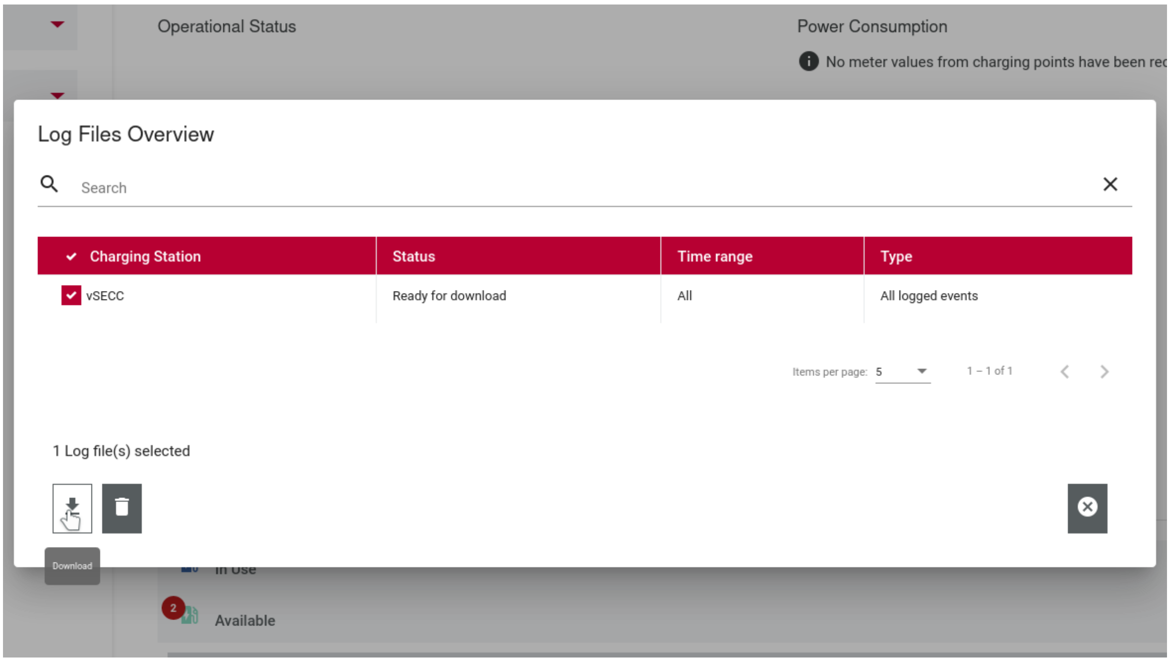


Figure 44: vCharM Downloading Log Files

5.11 PLC Logging

To assist analysis of the EV communication, the vSECC Software allows to write trace logs of the power line communication (PLC) between charging station and EV. The communication is written into pcap trace files on the vSECC Controller. Later, the files can be opened with tools such as CANoe or Wireshark to analyze the complete high level traffic.

To start PLC logging using the web interface, put the vSECC Controller into maintenance mode as described in chapter 5.1.1. Head over to the **PLC Logging** section shown in Figure 45. Then press the **[Start PLC logging]** button to start writing traces of the PLC communication. The button changes from **[Start PLC logging]** to **[Stop PLC logging]**.
After the activation of tracing, leave the maintenance mode and initiate a charging session.
To deactivate and download the tracing go back to maintenance mode and press the **[Stop PLC logging]** button in the **PLC Logging** section.
To download the trace files use the download log files feature as described in section 5.10.
The compressed log file package includes also the new pcap trace files.

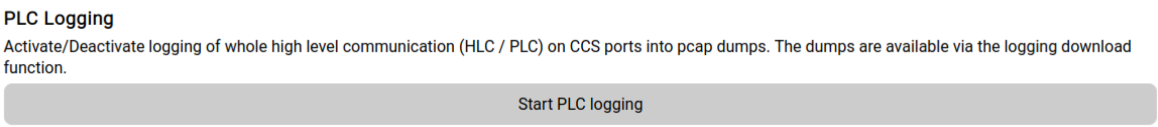


Figure 45: Start/Stop PLC Logging

Caution: Use this feature only for development purposes or to analyze issues. As long as the PLC logging is activated, the complete PLC traffic is written to vSECC Controller's memory and could fill up the entire available space for log files. Therefore, the logfiles are rotated after running for about 2 days (20 MB size). Nevertheless, the activated feature reduces the lifetime of the device's memory. Always turn off the logging if you don't need it. To reduce the used space, clean up the log files after you have downloaded them (see section 5.10 to understand how you can delete log files).

5.12 Installing Certificates

5.12.1 Installing Root Certificate Authorities (CAs)

When connecting to a CSMS using a secured TLS connection, the vSECC Controller uses its installed root certificate authorities (Root-CAs) for verifying the server's certificate chain. The vSECC Controller already comes with the mozilla root certificate store pre-installed. Additional Root-CAs can be installed either by using the web interface or via OCPP.

To install a Root-CA using the web interface, put the vSECC Controller into maintenance mode as described in chapter 5.1.1. Head over to the **Certificate upload** section as seen in Figure 46. Select **CSMS Root Certificate** from the drop down menu, then press the **[Browse...]** button to select a certificate you would like to install. Pressing the **[Upload]** button finishes the installation of the certificate. Please keep in mind that root certificates installed through the Web Interface are not taken into account when verifying Certificate Signing Requests (CSRs). Instead, they are only used for verifying a server's certificate during the websocket connection's TLS handshake.

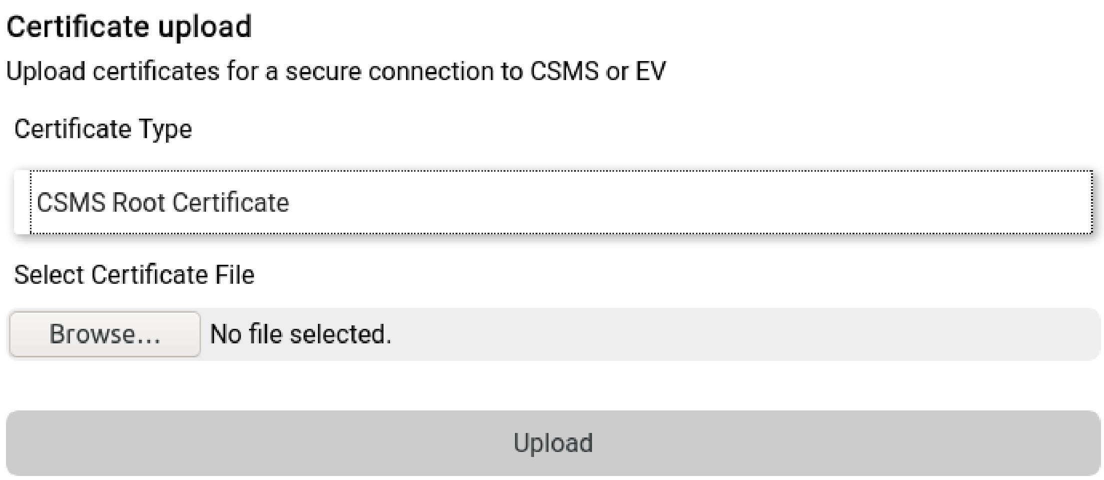


Figure 46: Installing Root-CAs

Installing a Root-CA via OCPP uses the `InstallCertificate` messages. The vSECC Controller will store the transmitted certificate inside its trusted storage. The `DeleteCertificate` OCPP messages can be used for deleting a previously installed certificate. For further information about the structure and usage of those messages, please refer to the appropriate OCPP specification. Root certificates installed via OCPP are used for both the websocket connection's TLS handshake and verifying Certificate Signing Requests (CSRs).

5.12.2 Installing EVSE Leaf Certificates

To establish a secured TLS connection between EV and EVSE, a leaf certificate (chain) has to be provided. The leaf certificate will be validated against its corresponding private key during upload. After uploading the private key once, it is possible to upload new certificates signed by the private key without uploading the key again.
The vSECC Controller does not provide any EVSE certificates by default. The vSECC supports only one EVSE leaf certificate (chain's) private key pair at the same time. Any new upload will replace the old certificate and private key. When uploading a certificate chain, the certificate file has to contain the leaf certificate and all sub certificates.

Caution: The uploaded private key is neither transferred nor stored in a secure manner yet. Use this for development purpose only. Don't use for public or productive applications.

To install an EVSE leaf certificate (chain) using the web interface, put the vSECC Controller into maintenance mode as described in chapter 5.1.1. Head over to the **Certificate upload** section as seen in Figure 47 and select **EVSE Leaf Certifcate** from the drop down menu.

Then press the **[Browse...]** buttons to select a certificate (chain) and the corresponding key you would like to install. Pressing the **[Upload]** button finishes the installation of the certificate chain and validates it against the provided key. After the upload, the current installed certificate is shown in the text field below.

Certificates according to X.509 are supported. The certificate has to be signed according to ISO 15118-2 requirement [V2G2-006].

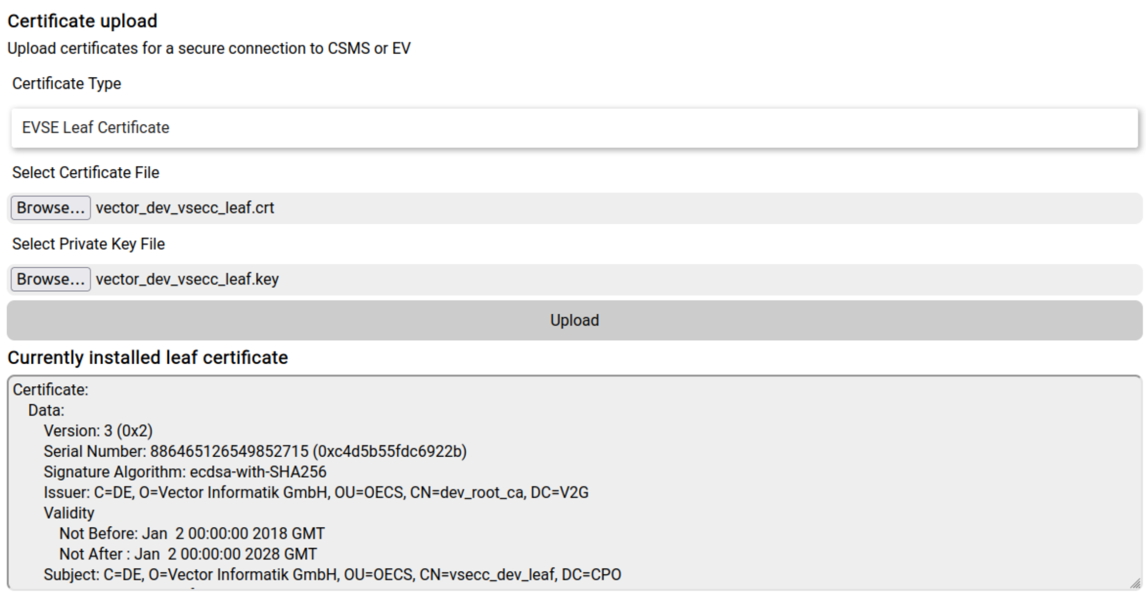


Figure 47: Installing EVSE leaf certificate

5.13 Start of a Remote Support Session

This feature is only usable if the Vector support requests you to use it.

In the case that Vector's support team needs access to the device via a terminal connection, you can start a remote support session. The start of such a session opens a connection to Vector's support servers and allows access to the device for the support team.

Prerequisites for a remote support session

> The device has internet access (via routing: IP, Gateway, DNS set by a DHCP server)
> Connection to a remote (internet) host on TCP port 22 is possible (without any kind of proxy or firewall in-between)
> The device is in **Maintenance Mode**
> Vector's support team has sent you a key and port

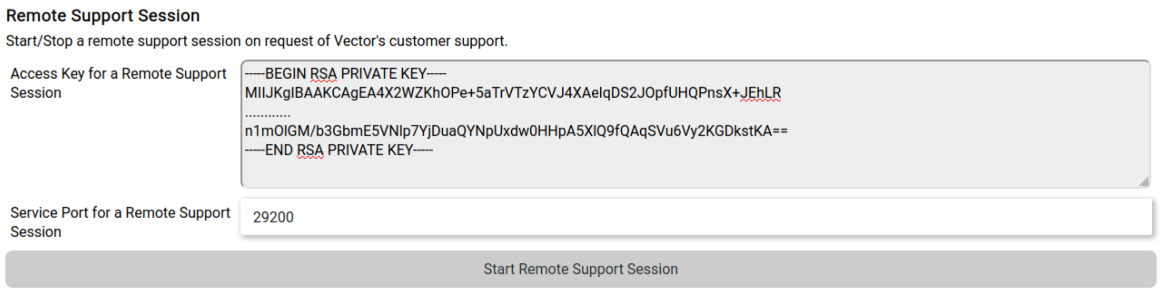


Figure 48: Start a remote support session

When Vector’s support team wants to activate this feature, you will get a key in ASCII format that needs to be copied into the text field **Access Key**. Furthermore, a port number is provided to you, that needs to be selected in the drop down menu **Service Port**. Finally, a support tunnel is opened by pushing the button **[Start Remote Support Session]**.

5.14 ISO 15118-20 BPT Prototype

To use this feature you need a separate license. Please consult your Vector sales contact for details.

For performing bi-directional power transfer (BPT) as standardized in the ISO 15118-20, the following prerequisites must be met:

- A license for ISO 15118-20 and BPT must be installed on the vSECC Controller
- ISO 15118-20 must be selected in the **Connector/OfferedChargingStandardsCcs** configuration variable in the web interface
- The power electronics must be able to discharge
- The PECC must implement the new fields in the `response-configuration` and `info-chargingSession` messages for PEP-WS or the `PeccLimits` and `Charging-SessionInfo` messages for PEP-CAN
- An EV supporting ISO 15118-20 BPT with TLS 1.2 (certificates required) or without TLS (TLS 1.3 currently not supported by the vSECC Software) must be available
- A CSMS connection with OCPP 1.6 or 2.0.1 should be used, if you want to remotely control the BPT setpoint (charge/discharge power)

5.14.1 BPT dynamic setpoint

In BPT dynamic control mode (scheduled mode currently not supported), the vSECC Controller instead of the EV computes the target values for how much power is charged/discharged to/from the EV. This value can be influenced by a CSMS via the `V2XCharging-Ctrlr/Setpoint` (OCPP 2.0.1) device model variable.
In OCPP 1.6 the variable is called `V2XChargingCtrl/1/Setpoint/` for the first connector. **Please note** the missing ”r” of ”Ctrlr”.

Negative values will represent discharging. The value will not persist through restarts of the vSECC Controller.
The vSECC Controller will then send `request-targetValues` messages to the PECC based on the setpoint and the limits given by the EV and the PECC.

5.14.2 Power Electronics

The power electronics must have the capability to discharge the EV. Furthermore, the PECC must report the corresponding charge and discharge limits via the `request-configuration` or `PeccLimits` messages.
In a scenario where the PECC takes control of the charging/discharging process, the target values provided by the vSECC Controller can be ignored. The vSECC Controller will not check if the target values are applied or if the EV limits (provided in the `info-charging-Session` or `ChargingSessionInfo` messages) are respected, this is the responsibility of the PECC.
To determine if the connected EV is in dynamic control mode, the `chargeMode` field of the `info-chargingSession` /`ChargingSessionInfo` message contains the `dynamicBpt` value. In scheduled control mode (only for ISO 15118-2 and DIN SPEC 70121 at the moment), the target values are coming from the EV and must be respected.

5.15 CHAdeMO Support (vSECC only)

This section provides an overview of the CHAdeMo charging sequence, the currently supported features and safety considerations.

Caution: The current support for CHAdeMO charging is experimental. Thus, unexpected behavior may occur and safety mechanisms could not work properly. Use this feature with caution.

CHAdeMO is not yet supported on the vSECC.single.

5.15.1 General Behavior of a CHAdeMO Charging Station

A charging station supporting CHAdeMO has at least three buttons: The **[START]**, **[STOP]** and **[EMERGENCY STOP]** button.

If an EV connects to the station, the charging process is not started automatically. Although the station detects the EV's proximity, the charging process initialization commences only after the **[START]** button has been pressed.

The **[STOP]** button could be pressed anytime. This is intended as a graceful stop of the charging process. The two buttons **[START]** and **[STOP]** are connected through the X306 connector. See Section 2.2.7 for the correct pin usage.

The **[EMERGENCY STOP]** button is not connected to the vSECC itself, see the following section 5.15.2 for more details.

5.15.2 Safety Considerations, Emergency Stop Button

On a very coarse level, two safety mechanisms must be supported for CHAdeMO charging: The latch locking and the emergency stop.

Latch Locking: The latch locking is a means to secure the charging plug to the socket of the EV. It is implemented by a mechanism that locks the plug physically in place. This connector lock is controlled and monitored by the charging station.

Emergency Stop: Pressing the **[EMERGENCY STOP]** button must lead to a fast shutdown of the whole charging process, especially of the power supply. This shutdown must occur within tight timing boundaries.
Therefore, the **[EMERGENCY STOP]** must be connected directly to the power electronics. In case of a button press, the PE handles the shutdown of the power supply by itself and informs the vSECC of this incident through the Power Electronics Protocol (PEP). This is done by sending a PEP `status message` with the value set to INOPERATIVE to the vSECC.
The vSECC then stops the charging process communication and disables the respective output (i.e., the EVSE that belongs to the output that has been shut down is rendered inoperative, too. This inoperative state is then communicated to the CSMS.).

This state exists until the power electronics sends another `status message` containing the OPERATIVE value. This indicates that the PE is able to provide power again.

5.16 OppCharge Support (vSECC only)

This section provides an overview of the OppCharge feature and pantograph control.
OppCharge is only available on charging port 1, which means that the control pilot line needs to be connected to the corresponding pin (see Section 2.2.4) and the Wi-Fi access point for vehicle communication needs to be connected to Ethernet port ETH1 (see Section 2.2.9).

Caution: The current support for OppCharge charging is experimental. Thus, unexpected behavior may occur and safety mechanisms may not work properly. Use this feature with caution.

OppCharge is not yet supported on the vSECC.single (Board).

5.16.1 Pantograph Control

The pantograph is controlled via four signals: One output signal to request changes of the pantograph position and three input signals to inform the vSECC about the state of the pantograph.

- `panto_control (output)`: This signal is used to request pantograph movement: `0` for up, `1` for down.
- `panto_up (input)`: This signal, when set to `1`, informs the vSECC that the pantograph is in its upper endposition.
- `panto_down (input)`: This signal, when set to `1`, informs the vSECC that the pantograph is in its upper endposition.
- `panto_error (input)`: This signal, when set to `1`, informs the vSECC that charging is not allowed. (e.g.: vehicle not in position, wind speed limit exceeded, mechanical problems, …)

If both `panto_up` and `panto_down` are set to `0`, the vSECC assumes that the pantograph is currently moving. A charging session can only be started if the pantograph is in its upper endposition and no pantograph error is signaled.
There are three possibilities to configure pantograph control via the web interface:

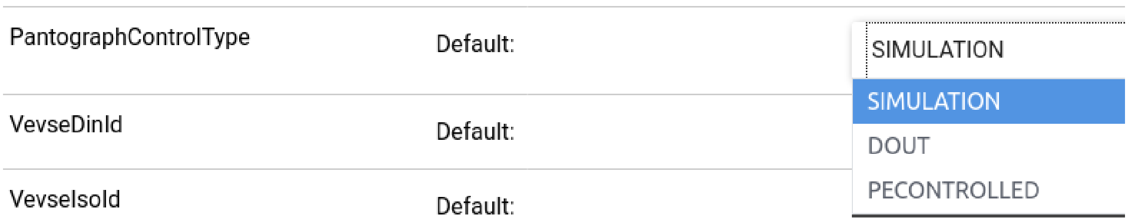


Figure 49: PantographControlType

- `Simulation`: For development only. The pantograph is simulated internally: it moves down during `CableCheck` and up again during `SessionStop`.
- `Dout`: The pantograph is controlled via digital inputs and outputs of the vSECC. Refer to Section 2.2.7 for wiring information.
- `PeControlled`: The pantograph is controlled via virtual inputs and outputs of the PEP-WS protocol (this option is not available via PEP-CAN). The `getInput` message must be sent regularly with the `panto_control` identifier to get notified about requests to move the pantograph. Use the `setOutput` message to inform the vSECC about changes regarding the state of the pantograph. Make sure to send all three input signals at startup, so the vSECC knows the state of the pantograph. Refer to Section 5.25.9 for details about the virtual input/output identifiers.

5.17 Value Added Services

The vSECC Controllers support internet access via value-added services (VAS) as specified in the ISO 15118 standard. The service ”internet access” is announced in the service discovery phase of the charging session. The vSECC Controller by itself does not provide any VAS-back ends/endpoints. Therefore, it only acts as a router between the EV and an existing VAS-Endpoint. The VAS-backend must be connected to the ETH1 network interface. (see Section 2.2.9) See the following enumeration for a brief overview over the prerequisites. For further information consult the subsequent description.

Caution: The vSECC Controller only supports IPv6 routing. IPv4 is not supported.

5.17.1 Prerequisites

> Customer provided VAS-Back End

> VAS is activated on the vSECC Controller using a CSMS or the Web Interface

> Existing IPv6 route between the vSECC Controller and the VAS-Back End

> TLS encrypted V2G communication between EV and vSECC Controller according to ISO 15118

> The EV obtains an IPv6 address according to ISO 15118 utilizing SLAAC and NDP

> The vehicle connects to the VAS-Back End via IPv6

Caution: No DNS is provided.

5.17.2 Networking

The vSECC Controller should be connected to a network with an IPv6 capable router. This router should provide an IPv6 prefix to the vSECC Controller via NDP router advertisement. Using this address, the VAS-Endpoint can be reached by the vSECC Controller.

5.17.3 Activate VAS via Web Interface

Value Added Services can be toggled via the **VasInternetServiceEnabled** variable. Also make sure that **TlsEnabled** is set to **true**. These variables are located in the **Charging-CommunicationCtrlr** section (consult Fig. 50). To access the configuration put the vSECC Controller in maintenance mode as described in the Web Configuration Interface section of this manual (see Section 5.1.1).

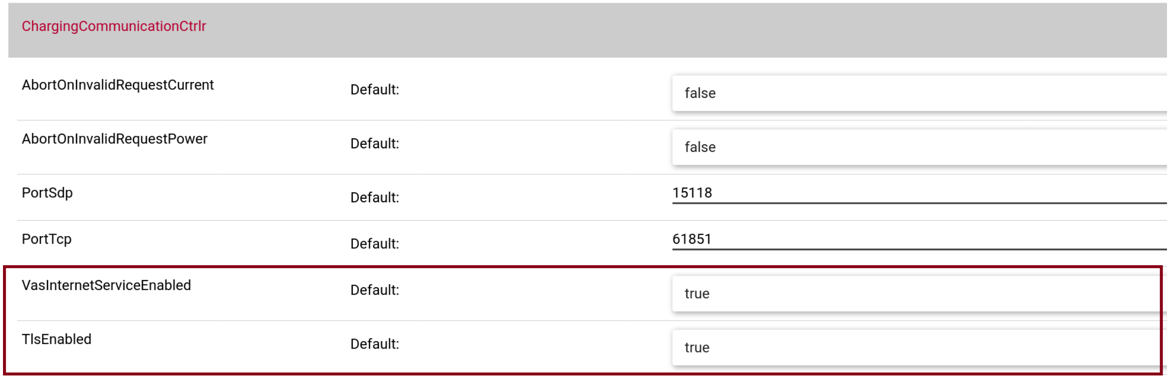


Figure 50: Value Added Services activation via Web Interface

5.17.4 TLS certificate for V2G

An encrypted high level communication is mandatory to offer the internet access services as well as the Plug & Charge (PnC) authorization service (see ISO 15118-2). For this to work, a certificate chain with the public key and the corresponding private key needs to be installed on the vSECC Controller. The installation of the certificate chain and key is possible in two ways:

> Via OCPP using a CSR.

> Via the Web Interface by uploading a certificate chain and private key file. This process is similar to the one described in Section 5.12.1. The section in the Web Interface is called ”Certificate upload”. Select ”EVSE Leaf Certificate” from the drop-down menu. Both the certificate chain (including the public key) and private key must be given in (human-readable) PEM format. The certificate chain has the following structure: The most specific certificate, i.e., leaf certificate of the EVSE, is placed first, followed by other certificates higher up in the hierarchy of CAs. Please see Figure 51 for reference.

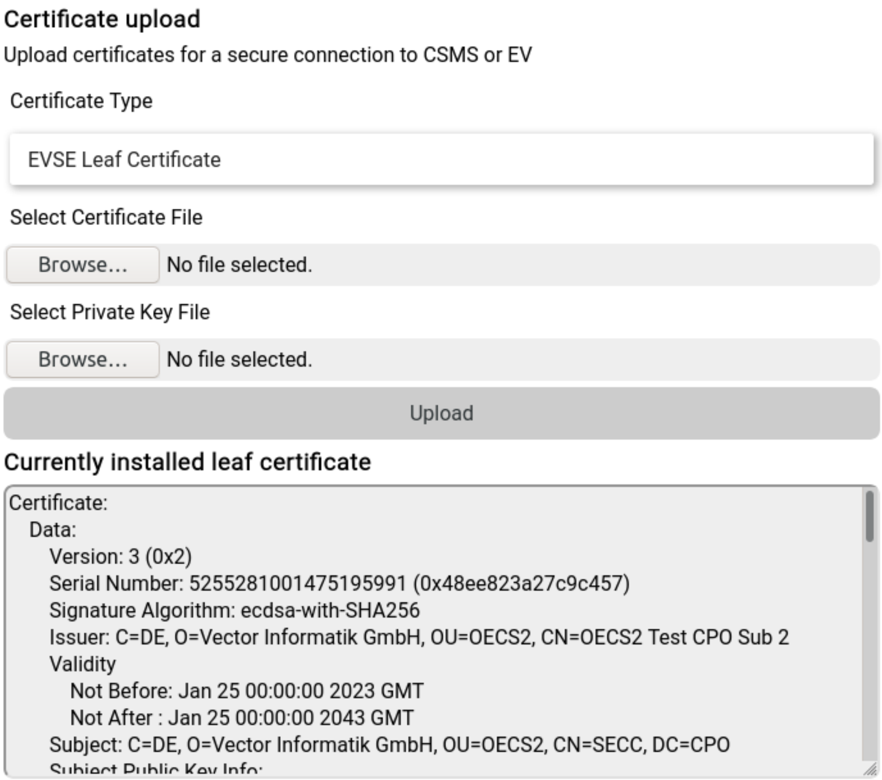


Figure 51: Upload V2G certificate and key for TLS encrypted ISO 15118-2 HLC

5.18 TLS Debugging

Caution: This feature is only for debugging/development purposes and should never be enabled in a production environment.

This feature assists the debugging of TLS-encrypted communication. When enabled, the ClientRandom and MasterSecret values of the TLS connection are written into the charging manager log file. Furthermore, they are sent out as a UDP packet in the NSSKeyLog format. This information can be used to decrypt the PLC traces with e.g. CANoe or Wireshark.

5.19 Charging Schedules

Since the available power for charging may change over time, charging schedules are advertised to the connected EV. These schedules can either be set to statically contain the power electronics maximum power, or to be computed from charging profiles provided by a CSMS via the OCPP interface. If configured to use charging profiles provided by a CSMS, the vSECC Controller will persist default charging schedules created from default charging profiles, and use these in case no transaction specific charging profile could yet be retrieved from the CSMS. In order to advertise a valid charging schedule, gaps existing in a transaction specific profile are filled with the default schedule. When generating a default charging schedule from a default charging profile provided by the CSMS, gaps are filled with entries advertising the power electronics maximum power. Charging schedules are cropped by the vSECC Software so that the last entry is active 48 hours after schedule start, leading to a maximum schedule duration of ca. 72 hours. If the provided charging profiles lead to a charging schedule not reaching 24 hours, the schedule is prepended a default entry to reach a duration of 24 hours, as required by ISO 15118-2 and DIN SPEC 70121. Scheduled power values are capped at the maximum power the power electronics reported to support.

On the reception of a new default or transaction specific charging schedule issued by the CSMS, the vSECC Controller behaves in the following way:

> During ISO 15118-2 charging the renegotiation process is triggered and the new schedule is advertised to the EV. If the charging is paused, an EV wakeup is executed beforehand
> During DIN SPEC 70121 charging, the communicated EVSE power limit is adapted to the updated schedule values
> During CHAdeMO charging the charging schedule is not communicated to the EV, the most recently created charging schedule is used to schedule charging power
> During OppCharge charging, charging schedules are ignored. The power electronics maximum power limit is used as EVSE max power limit

During a charging session, the lowest value of the currently scheduled charging power, the maximum power the EV reported to support and the maximum power the power electronics reported, is communicated to the power electronics to adapt accordingly.

For further details how a specific charging schedule is considered at derating, please refer to appendix E.

Charging Pause (Sleep) and Wake-Up

An EV with ISO 15118 support may request a charging pause which may enable the opportunity for power saving functionality. This is often the case if a charging schedule contains periods with 0 W scheduled power.

A charging session is paused by stopping it according to the procedure defined by the standard used for communication between EV and EVSE. In addition, one of the last messages sent by the EV triggers the pause sequence for both the vehicle and the EVSE. During a pause, the communication is reduced to a minimum by terminating the high-level communication session completely. The EV may decide to turn off the PLC device, too.

A previously paused charging session is resumed either by the EV or EVSE. This may happen due to the expiration of the sleep period or due to a new charging profile sent by the CSMS. The EV triggers the resumption by executing a BCB toggling sequence of the Control Pilot (CP) line. The EVSE detects this CP state change and sets the PWM duty cycle to 5 % to trigger and force the setup of a high-level communication. The EV is then expected to resume the session by using the same SLAC key (NMK) as previously. In turn, the EVSE triggers the resumption by skipping the BCB toggling and directly setting the duty cycle accordingly. The setup of the high-level communication is the same as it would be without the pause period except for the session ID provided by the EV. Normally, this ID would be regenerated for each HLC setup. When resuming a paused session, though, this ID is expected to remain the same across the two V2G sessions. If the wake-up procedure does not complete in time, a reset of the EV is done. The EVSE executes a BEB toggling sequence to force the EV to restart the whole charging session initialization. This toggle can also be triggered by an external device using the MQTT interface (see ”Reinit EV to start charging” in section G). In this case the session ID is not expected to remain the same.

5.20 Stop Charging

A running charging session can be gracefully terminated by the vSECC Controller using the following means:

- Physical button connected to the vSECC (not yet available on vSECC.single)
- Power electronics message via PEP-WS or PEP-CAN
- CSMS message

5.20.1 Physical Button (vSECC only)

This feature can be enabled via the `PhysicalStopButton` configuration option for the respective connector in the Web Interface. For physical wiring details on connector X306, refer to Section 2.2.7.

5.20.2 Power Electronics

To stop charging via power electronics, use the `stopCharging` message via PEP-WS or PEP-CAN. Refer to the PEP manuals for details.

5.20.3 CSMS

A charging session can be stopped via CSMS by sending a `RequestStopTransactionRequest` message.

5.21 RFID Authorization

The vSECC Controller supports authorizing a transaction using RFID tokens. Additionally, the transaction can also be stopped by presenting the same RFID token which started the transaction.

5.21.1 Supported RFID Readers

At this moment, two RFID readers are supported to directly interface to the vSECC Controllers. These are the MCRN2 of Minova GmbH [1] and TWN4 Multitech (2) Series of Elatec GmbH [2].
Both readers support RS232 and can be connected to the corresponding pins of the vSECC Controller (for vSECC see X305 in Section 2.2.6; for vSECC.single Board X300 in Section 3.2.5). An example circuit for connecting an RFID reader with the vSECC Controller is shown in D).
To configure the vSECC Controller to use the connected reader, the variable ”RfidReader” (see Section 5.7) has to be set accordingly. Possible values are listed in the configuration interface, e.g. ”Minova-MCRN2” and ”Elatec-TWN4”.
Before usage, the TWN4 Multitech reader has to be flashed with the right firmware set. These are provided by Elatec in their ”DevPack” [3]. Compatibility was tested with:

> ”TWN4_xCx450_STD204_Multi_CDC_Standard.bix”

The firmware can be flashed onto the TWN4 reader with the ”AppBlaster” tool, also included in Elatec’s DevPack. For the Minova MCRN2 reader, no configuration is necessary.

5.21.2 Authorization Sequence

This authorization sequence is mandatory with the supported RFID readers. To use a more flexible sequence, ”external authorization” (see Section 5.21.4) is recommended.

To start the authorization sequence, the driver must present the token at the RFID reader. From this moment on, the token is considered ”pending”. The driver must then connect the vehicle at one of the available EVSEs within ”EVConnectionTimeout” seconds. The timeout can be set in the vSECC Controller’s configuration (see Section 5.7). If no EV gets connected within the timeout, the pending token is discarded. As soon as the vehicle gets connected, an authorization request is sent to the CSMS using the pending token. Figure 52 shows an example of the described authorization sequence.

The presented token gets ignored if another token is still pending or if all EVSEs are currently occupied. Please note that it is not possible to trigger the authorization by plugging in the EV first and then presenting the token. Figure 53 shows an authorization sequence where the EV gets plugged-in first.

[1] https://minova-rfid.com/en/mcrn2-nfc-rfid-rs232.html
[2] https://www.elatec-rfid.com/int/product-detail/twn4-multitech-2
[3] https://www.elatec-rfid.com/int/twn4-dev-pack

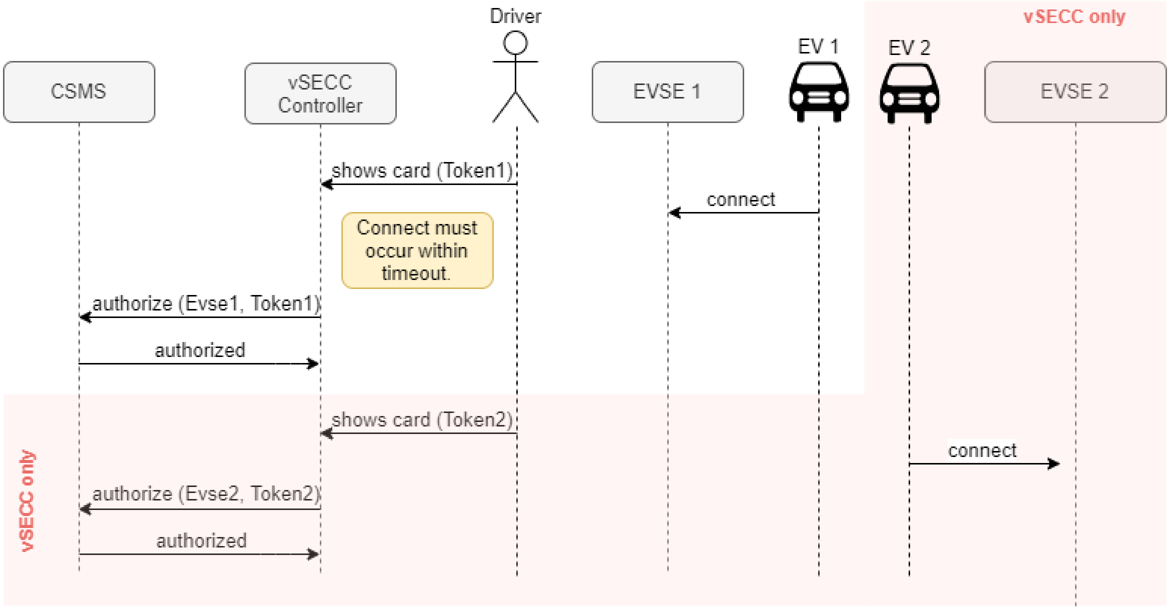


Figure 52: Basic RFID Authorization Sequence

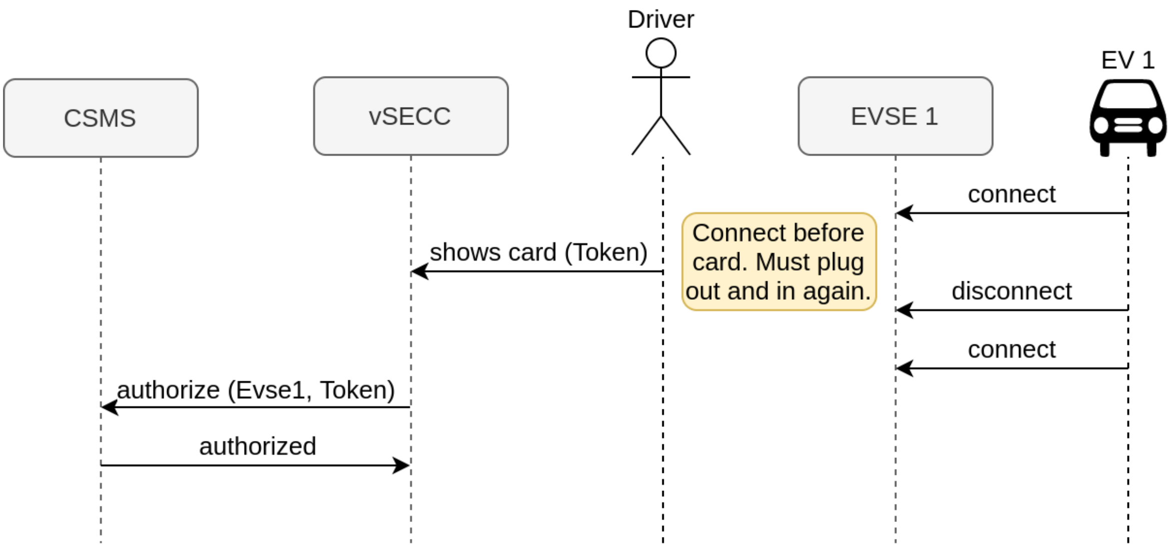


Figure 53: EV Plugged-In First Authorization Sequence

If you want to make use of RFID authorization, make sure to add ”RFID” as an authorization option (”AuthorizationOptions”) in the vSECC Controller’s configuration. You may also turn off other authorization options such as ”MacAddress” if you want to authorize only using RFID tokens.

5.21.3 Deauthorization

If a driver has previously authorized and started a transaction using an RFID token and presents the same token again, the vSECC Software will deauthorize that token and stop the charging sequence.

5.21.4 External authorization

To support a wider range of RFID readers and other authorization hardware, the MQTT interface can be used to pass tokens. These tokens can already be pre-authorized by the custom hardware, or they are being authorized by the CSMS. All token types available in OCPP 2.0.1 can be used for the external authorization. If no CSMS is used, only pre-authorized tokens or tokens of type ”NoAuthorization” can be used. See section G for a detailed description of the mqtt topic.

5.22 Plug & Charge (PnC)

5.22.1 Preconditions

The following preconditions must be met for the vSECC Controller to use PnC functionality:

> The license installed on the vSECC Controller supports PnC (see Section 5.9 on how to install a license).

> PnC functionality is enabled in the configuration (configuration variable ”PncEnabled”, see Section 5.1).

> Usage of the ISO 15118-2 charging standard is enabled (configuration variable ”OfferedChargingStandardsCcs”, see Section 5.1). In addition, ISO 15118-2 is selected as charging standard by the EV.

> TLS is enabled for charging sessions (configuration variable ”TlsEnabled”, see Section 5.1). In addition, TLS is selected as security option by the EV.

> Communication to a CSMS is enabled, the connection to the CSMS is established.

> EV authentication is enabled in the configuration (configuration variable ”AuthCtrlr/Enabled”, see Section 5.1).

> The option ”EMAID” is enabled in the authorization options (configuration variable ”AuthCtrlr/AuthorizationOptions”, see Section 5.1).

> No other authorization process is completed (e.g. via Autocharge or RFID). PnC is offered as payment/authorization option to the EV only if the authorization is still pending. If another authorization option has successfully completed beforehand, only EIM is available and PnC is not advertised to the EV. If another authorization option resulted in a negative response (deauth/blocked), PnC is also not advertised.

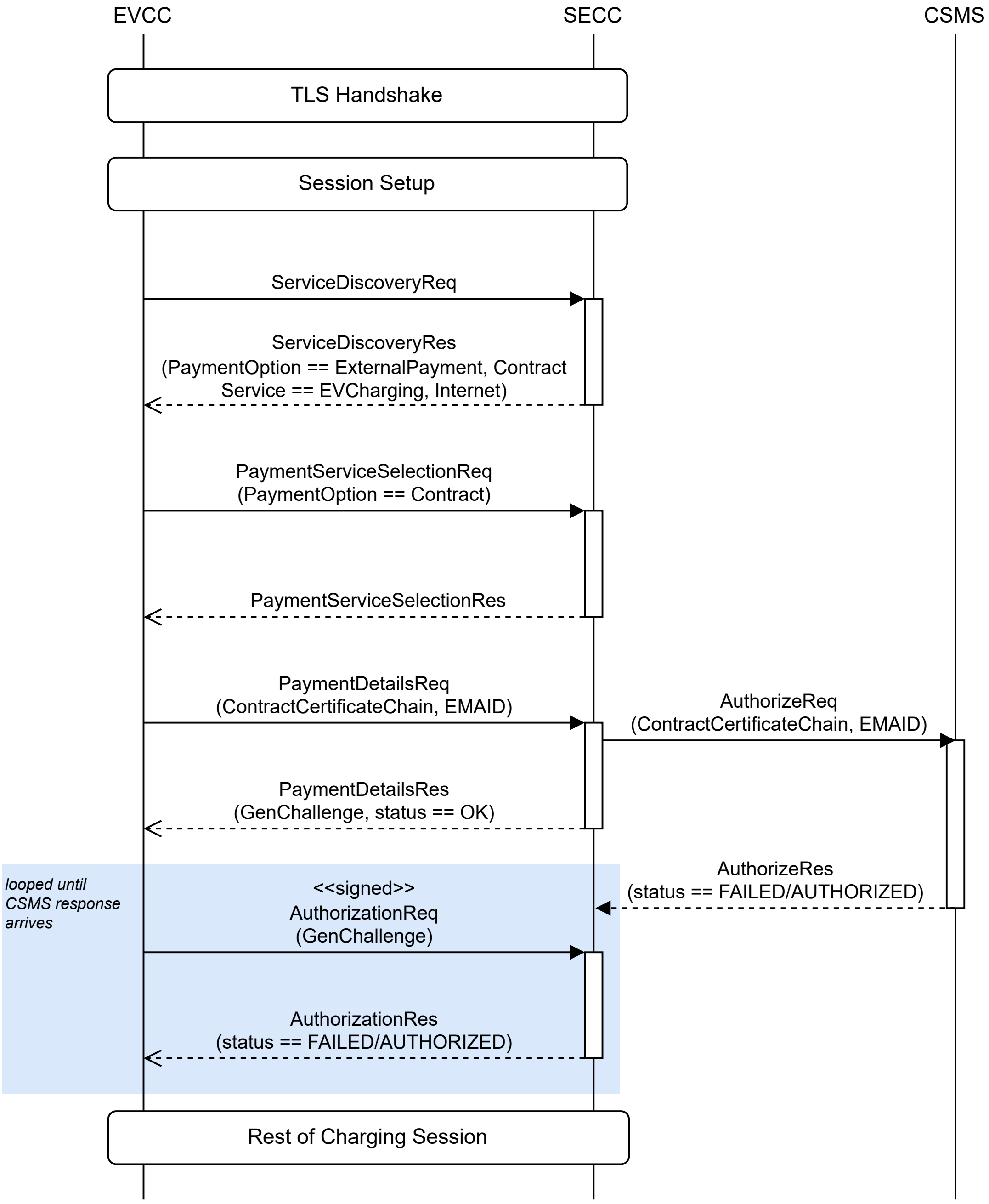
> A signed and valid V2G EVSE leaf certificate with its corresponding certificate chain and the according private key is present on the vSECC Controller, see Section 5.17.4.

In addition, the EV must support ISO 15118-2 Plug & Charge and have the according root certificate installed for verification of the EVSE certificate.
Furthermore, the CSMS must have the ability to verify the contract certificate which is provided by the EV and forwarded by the vSECC Controller.

5.22.2 PnC communication sequence

The good case scenario of charging with authorization via Plug & Charge contains the following steps (some common steps are omitted for simplicity). Refer to diagram 5.22.2 for a visualization.

1. The EV is plugged in, performs the SLAC process and a PLC link is established.
2. The EV sends a `SECCDiscoveryReq` message which indicates support of TLS usage, the vSECC Controller also indicates support of TLS in the response message.
3. A TLS 1.2 connection is established between the EV and the vSECC Controller, the EV checks the EVSE leaf certificate in the process (”TLS handshake”).
4. The EV sends a SupportedAppProtocolRequest which states support of ISO 15118-2 charging communication as preferred choice.
5. The vSECC Controller responds with the confirmation of charging according to ISO 15118-2 (”Session Setup”).
6. The EV queries the EVSE for its available services in the ServiceDiscovery phase. The vSECC Controller responds with PnC (”Contract”) as one of the available payment options.
7. During PaymentServiceSelection the EV selects PnC as payment and thus authorization mode.
8. The EV sends its contract certificate and the corresponding certificate chain in the `PaymentDetailsRequest` message. The vSECC Controller forwards the contract certificate to the CSMS, which verifies the certificate.
9. In the `PaymentDetailsResponse` message the vSECC Controller asks the EV to sign a challenge value (called ”GenChallenge”) as proof that it is the owner of the contract certificate.
10. The EV sends the signed challenge value to the vSECC Controller in the AuthorizationRequest. The vSECC Controller then verifies the signature of the challenge with the public key of the EV it received in the PaymentDetailsRequest.
11. The Authorization messages are repeated until a response from the CSMS arrives. Upon a positive response from the CSMS, the vSECC Controller continues the charging communication by responding with a positive `AuthorizationResponse` and the charging process is started.
12. The charging session is carried out normally.



5.22.3 Error cases

The following events prevent or abort a charging session using authorization via PnC:

The EV is already authorized via other means before the charging session reaches authorization mode selection In this case authorization was already done via external identification means (EIM). Then, authorization via PnC is not offered to the EV but only EIM. This is to prevent unintentional authorization via PnC if the user already chose another method.

The EV does not support TLS In this case authorization via PnC is still offered to the EV. However, the EV does not support and thus not select PnC/Contract as payment option. Instead, the EV selects EIM (External Identification Means). If a positive authorization via EIM is provided, the charging session may continue. Otherwise, the charging is aborted. The vSECC Controller offers EIM in every case, regardless of the PnC settings and preconditions.

The EV selects EIM instead of PnC In this case authorization via PnC is offered to the EV. However, the EV does not select PnC/Contract as payment option. Instead, the EV selects EIM (External Identification Means). If a positive authorization via EIM is provided, the charging session may continue. Otherwise, the charging is aborted. The vSECC Controller offers EIM in every case, regardless of the PnC settings and preconditions.

The EV provides a signed challenge that cannot be verified In this case the vSECC Controller assumes that the EV does not have the private key to the contract certificate it offered. Therefore authorization via PnC is considered to have failed and the vSECC Controller will terminate the charging session immediately. Afterwards, the EV may perform a BCB toggle to reestablish a new session.

The CSMS reports that the contract verification failed In this case authorization via PnC is considered as failed and the vSECC Controller will terminate the charging session. With ISO 15118-2, no other authorization means are carried out after a negative authorization response. The EV may perform a BCB toggle to reestablish a new session.

No connection to the CSMS is established In this case authorization via PnC is not offered to the EV. Authorization with other external identification means is still possible. Note that these other external identification means may have preconditions not described here. See the respective sections, e.g. Section 5.21 for RFID.

5.22.4 Limitations

Currently, the implementation of PnC has the following limitations:

- ISO 15118-20 is not supported.
- Contract certificate installation or update on the EV is not supported. It is not advertised as available service in the ServiceDiscovery phase.
- SalesTariffs according to ISO 15118 are not supported.
- The vSECC Controller does not send energy meter information to the EV nor does it verify the signed response from the EV (MeterInfo record and MeteringReceiptReq/Res handling).

> Offline contract validation: The contract certificate provided by the EV is not validated on the vSECC Controller (offline validation). Instead, it is forwarded to the CSMS (online validation).

5.23 Usage of Payment Terminals

The vSECC Controllers support the usage of so-called Cloud-based Payment Terminals. There is no direct interface between the payment terminal and the vSECC Controller. Instead, the Payment backend and the OCPP backend are interfacing. The concept is shown in the following picture.

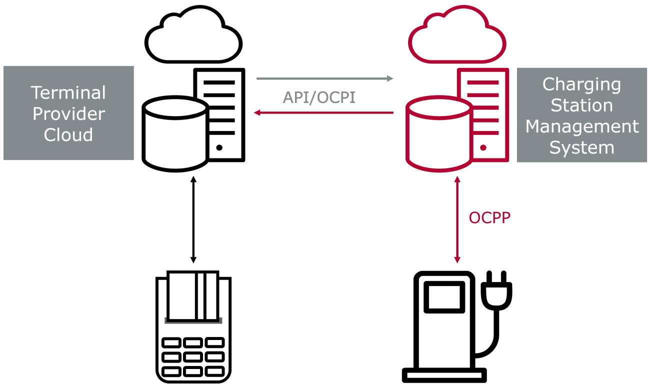


Figure 54: Communication Interface with Payment Terminals

Still, it is important to show the EV driver the tariff and cost of charging e.g. on a display. How this can be achieved is described in the following.

5.23.1 Tariff and Cost

The tariff and cost implementation is based on the OCPP & California Pricing Requirements. A tariff always concerns the whole charging station and is structured like "**1.23 EUR/kWh**", i.e., a **value** followed by **currency** and the unit "**/kWh**". Specific tariffs for individual customers, vehicles, charging times, idle fees, reservation fees or connectors are not supported, yet. Still, these mixed tariffs could be realized (not in the case of Eichrecht), since the CSMS is calculating the final cost and could include such a tariff structure in the calculation. Anyhow, these mixed tariffs would not be displayed to the driver through the vSECC Controller. With OCPP 2.0.1, the charging station tariff can be set via the configuration variable `TariffFallbackMessage` (See chapter 5.7 for details). The configuration value is published on the MQTT bus during start-up of the vSECC Controller and every time it is updated by the CSMS. Two flavors of the same information are published: The raw `TariffFallbackMessage` without any further processing (MQTT Topic *"vsecc/tariff_raw"*) and the tariff in processed form (MQTT topic *"vsecc/tariff"*). This processed form is necessary to be compliant with the restrictions set by the German Eichrecht for ad-hoc payment, since the tariff of a charging session must be part of the data signed by the energy meter.
The vSECC Software uses a Regular Expression (regex) to process/extract the tariff from the full message. The extracted tariff must match the structure mentioned above, with a

dot-separated decimal value with 2 decimal places at most. This way, the charging station can inform the driver with an everyday language message and provide a machine-readable tariff to the energy meter at the same time. The regex may be configured via the `TariffExtractionRegex` configuration variable.
Only 3-letter codes defined by ISO 4217 or currency symbols of the US-Dollar, Euro, Sterling or Japanese Yen are supported by the processing of the `TariffFallbackMessage` value. This limitation is independent from the currencies expected in the configurable regex. Supported currency symbols are replaced with their respective 3-letter code before further use. The raw tariff string is always published to a separate topic, even if the tariff extraction failed and is not published as a result.
With OCPP 1.6, the TariffFallbackMessage is replaced by the configuration key `DefaultPrice`. This unspecified key is part of the OCA's recommendation in *OCPP & California Pricing Requirements*. For the vSECC Software, 1.6 DefaultPrice is simply an alias for 2.0.1 TariffFallbackMessage and therefore behaves identically.

The transaction-specific costs are calculated by the CSMS. In the case of OCPP 2.0.1, they are sent to the charging station via `TransactionEventResponse`s. For OCPP 1.6 it is necessary that the CSMS implements custom data transfer messages according to *OCPP & California Pricing Requirements*. See subsection 5.23.2 for further details. The costs are combined with the currency set for the charging station and then published on the MQTT bus in the topic "*vsecc/connector/evse_id/ocpp/cost*". On the bus, there are no differences between running and total cost.

5.23.2 Data Transfer

The vSECC Software supports custom messages via OCPP's `DataTransfer` functionality inspired by the Open Charge Alliance's proposal OCPP & California Pricing Requirements. For the vendor identifier "org.openchargealliance.costmsg" the messages `FinalCost` and `RunningCost` are supported during OCPP 1.6 operation of the charging station. Only a subset of the proposed message attributes is supported by the vSECC Software: An integer `transactionId` and a decimal number `cost`. The messages can be used to present cost at the charging station.

5.24 MQTT Broker

The vSECC Controller provides an MQTT broker to exchange data with external MQTT clients. This interface provides the possibility to read current charging parameters, control all digital in and digital out connectors (Figure 13) and read analog values like voltage and temperature (Figure 7). For example this could be used to attach a human machine interface (HMI)-controller with a graphical user interface (GUI). All available MQTT topics can be found in Appendix G.

5.24.1 Configuration

The MQTT broker is available after the startup of the device is completed. An external connection to the MQTT broker is only possible with valid credentials. The MQTT user name and password is configurable in the web interface. See Section 5.5 for more information about changing the MQTT user name and password.

> Supported protocol versions: MQTT 5.0 / 3.1.1 / 3.1
> Port: 1883
> Allowed open connections: 50
> Message size limit: 20 MB

The IP address of the MQTT broker is configured with the vSECC Controller's IP configuration in the web interface. One can choose between the connectors ETH1/2 for the MQTT broker. The MQTT broker running on the vSECC Controller will listen on the MQTT standard port 1883.

Caution: A connection to the MQTT interface is not possible without user name and password settings. See Section 5.5 for more information about changing the MQTT user name and password.

5.25 Power Electronics

Please note that to date, some features are only available on the vSECC, and not yet on the vSECC.single.

For each connector of the vSECC Controller there are three configuration options for communicating with a power electronics:

> *Simulation:* For development only! This mode simulates a power electronics internally.
> *Websocket:* Connection via PEP-WS protocol over Ethernet (see Section 2.2.9).
> *CAN:* Connection via PEP-CAN protocol over CAN (see Section 2.2.6).

Some features are only available via PEP-WS:

> OppCharge pantograph control via virtual I/Os

5.25.1 Websocket

Refer to the PEP-WS document provided with the Documentation package for usage instructions.
Multiple connections on a single IP address and port are possible, as long as the endpoint is different, e.g. *http://192.168.1.5:80/PE1* and *http://192.168.1.5:80/PE2*.
The configuration variable `ConfigPollInterval` (see Section 5.7) controls when the configuration is requested from the power electronics and how limit values are communicated

to the EV. When set to `0` (default value), the configuration is only requested once, when the communication to the power electronics is established. When set to a positive value, the configuration is requested regularly, but the values are not updated during a charging session. The last requested configuration right before a charging session is then valid throughout the whole session.

Caution: To avoid hiccups in the EV communication, respond to `request` messages in a timely manner.

5.25.2 CAN

The vSECC Controller is able to control its power electronics via CAN; the vSECC on port CAN2 (see Section 2.2.6), the vSECC.single Board on CAN1 (see Section 3.2.5).
Refer to the PEP-CAN document provided with the Documentation package for usage instructions. Base addresses define the CAN IDs of the messages, e.g. base address 0x300 for the first connector means that its *VehicleStatus* message has CAN ID 0x301. Make sure that the configured base addresses do not cause the CAN IDs to overlap. The baud rate and base addresses of the CAN communication can be configured via Web Interface.
The general charging sequence is identical to the PEP-WS protocol and described in detail in the PEP-WS document. But there are some differences between both protocols which are described in Section 1.4 of the PEP-CAN document.

5.25.3 Simulation

When simulating a power electronics, max values can be configured via the Web Interface:

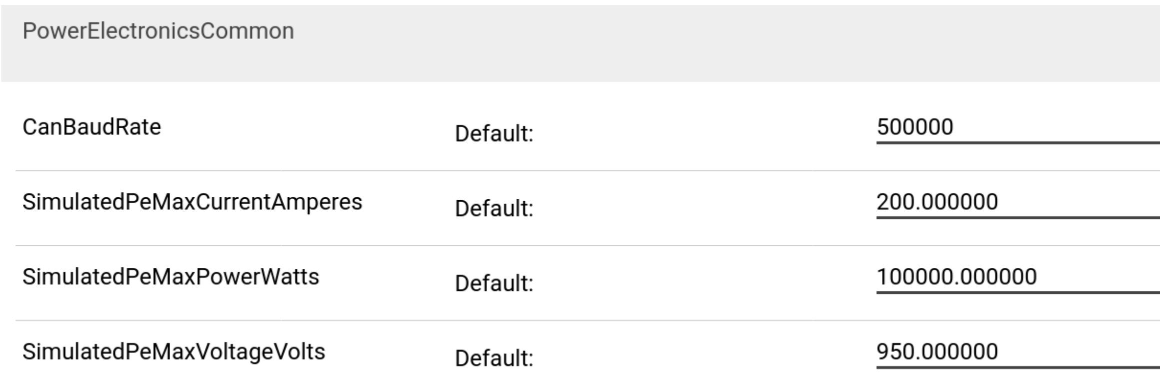


Figure 55: Power Electronics Simulation

5.25.4 PEP Input/Output Identifiers

The vSECC Controllers offer a set of ports which can be controlled over Ethernet via the Power Electronics Protocol (PEP-WS) `getInput` and `setOutput` messages. The ports can also be controlled over CAN using PEP-CAN and its `DigitalOuts1`, `DigitalOuts2`, `DigitalIns`, `AnalogIns1`, `AnalogIns2` and `AnalogIns3` messages.

Refer to the PEP-WS and PEP-CAN documents provided with the Documentation package for usage instructions.

5.25.5 Digital Out

The digital output ports can be set with the PEP-WS `setOutput` message and PEP-CAN `DigitalOuts1` and `DigitalOuts2` messages. Valid values are `0` for logical low, and `1` for logical high.

vSECC The available ports of the vSECC are:

> 15 Digital Out Ports
> 8 Digital In Ports
> 2 Analog In Ports
> 9 Temperature In Ports
> 3 Virtual Out and 1 Virtual In Ports for OppCharge Pantograph Control

Identifier	Connector	Pin
d1	X306	25
d2	X306	24
d3	X306	23
d4	X306	22
d5	X306	21
d6	X306	20
d7	X306	19
d8	X306	18
d9	X306	17
d10	X306	16
d11	X306	15
d12	X306	14
d13	X306	13
d14	X306	12
d15	X306	11

5.25.6 Digital In

The digital inputs ports can be read with the PEP-WS `getInput` message and PEP-CAN `DigitalIns` message. Return values are `0` for logical low, and `1` for logical high.

Identifier	Connector	Pin
d1	X306	9
d2	X306	8 (CONNECTOR 1 START)
d3	X306	7 (CONNECTOR 1 STOP)
d4	X306	6 (PANTO UP)
d5	X306	5 (PANTO DOWN)
d6	X306	4 (PANTO ERR)
d7	X306	3 (CONNECTOR 2 START)
d8	X306	2 (CONNECTOR 2 STOP)

vSECC **Caution:** Inputs d2 – d8 may already be in use when the vSECC is configured for physical stop buttons, CHAdeMO or OppCharge.

5.25.7 Analog In

The ports can be read with the PEP-WS `getInput` message and PEP-CAN `AnalogIns3` message.

vSECC The analog inputs support voltages between 0–10V. Return values are between 0.00 and 10.00 with up to 2 decimal points separated by a dot. The unit is *Volts*.

Identifier	Connector	Pin
a1	X301	2
a2	X301	1

5.25.8 Temperature In

The temperature inputs can be read with the PEP-WS `getInput` message and PEP-CAN `AnalogIns1`, `AnalogIns2` and `AnalogIns3` messages.
There are two ways to access the temperature inputs:

- If you connect a PT1000 temperature sensor, you can read the values in degrees Celsius by using the *tX* identifiers. Computed with $0.29 \cdot R - 295$.
- If you want to use another temperature sensor, you can retrieve the resistance values (in Ohms) by using the *trX* identifiers and use your own conversion function.

Identifier (°C)	Identifier (Ω)	Connector	Pin
t1	tr1	X301	20
t2	tr2	X301	19
t3	tr3	X301	16
t4	tr4	X301	15
t5	tr5	X301	12
t6	tr6	X301	11
t7	tr7	X301	8
t8	tr8	X301	7
t9	tr9	X301	4

vSECC

5.25.9 Virtual In/Outs (vSECC only)

The virtual I/Os can be used to control a pantograph for OppCharge, when the *Pantograph-ControlType* is set to *PeControlled*. Refer to Section 5.16 for more details. The virtual inputs can be read with the PEP-WS `getInput` message, the outputs written with the PEP-WS `setOutput` message.

Make sure to poll the `panto_control` input regularly to get notified when a pantograph movement is requested. Use the `panto_up`, `panto_down` and `panto_error` outputs to notify the vSECC about pantograph state changes.

- `panto_control (input)`: Requested pantograph position, `0` for up, `1` for down
- `panto_up (output)`: Set to `1`, when the pantograph is in its upper endposition
- `panto_down (output)`: Set to `1`, when the pantograph is in its lower endposition
- `panto_error (output)`: Set to `1`, when charging is not allowed (e.g.: vehicle not in position, wind speed limit exceeded, mechanical problems, …)

5.26 Power Electronics Dynamic Limits

There are several ways, how the Power Electronics (PE) is able to communicate limits (voltage, current, power) to the SECC and also the EV.
In general, there are two sorts of limits:

Static limits: Representing the physical limits of the PE. These are communicated to the EV in the ChargeParameterDiscovery message for CCS/Oppcharge. These also apply to CHAdeMO.

Dynamics limits: These represent currently applicable limits of the PE caused by e.g. temperature or environmental constraints. They are communicated to the EV in the CurrentDemand/ChargeLoop for CCS/Oppcharge. These are not applicable to CHAdeMO.

The **static** limits can be set via the `response-configuration` message for PEP-WS (and changed during operation, if a polling interval is configured). For PEP-CAN the limits can be set at any time via the `PECC-Limits` CAN frames.
The **dynamic** limits can be set via the `info-dynamicLimits` message for PEP-WS. This feature is not available when using the PEP-CAN protocol.
If no dynamic limits are configured, static limits are applied. Dynamic limits persist across charging sessions. Once set, they are only reset, when the connection to the PECC is lost. They can not be unset via the `info-dynamicLimits` message, but can be set to the same values as the static limits. Dynamic limits should not be higher than the respective static limits.

5.27 Modbus Gateway

The vSECC Controllers provide a Modbus TCP to RTU gateway. One or multiple Modbus TCP clients (masters) can connect via one of the Ethernet connectors to one or multiple Modbus RTU slaves, they are wired on the RS485 interface (see section 2.2.6). Thus, the vSECC Controllers allow to connect peripherals like an energy meter or isolation monitor to the RS485 interface and make it available to the power electronics or other modules over Modbus TCP. This eliminates the need for a dedicated device in the charging station which was was previously needed to make Modbus RTU slaves available on the Ethernet communication.

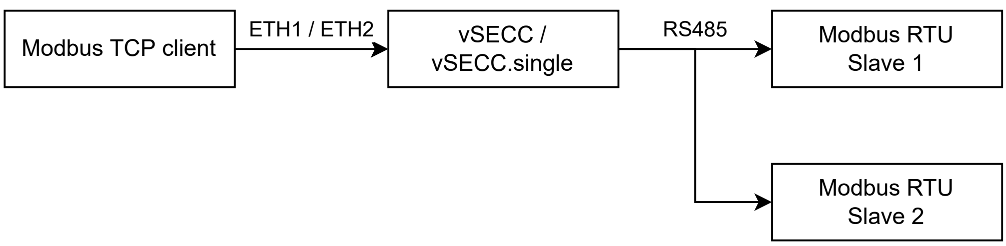


Figure 56: Modbus Gateway Overview

5.27.1 Configuration

Currently, the Modbus TCP to RTU gateway is always active with a fixed configuration on RS485:

> Baudrate: 9600
> Number of data bits: 8
> Number of stop bits: 1
> Parity mode: even

On the TCP side, the IP address of the Modbus is configured with vSECCs IP cofiguration in the Web Interface. One can choose between the connectors ETH1/2 for the Modbus TCP to RTU gateway. The Modbus TCP gateway running on the vSECC Controller will listen on the suggested TCP port 502.

5.28 Energy Meter

The vSECC Controller supports energy meters in order to provide readings to a CSMS. On start and end of an OCPP transaction, signed and unsigned meter readings are sent to the CSMS in the OCPP 1.6 `MeterValues` or OCPP 2.0.1 `TransactionEventRequest` message. For the signed meter readings, OCMF (Open Charge Metering Format) is used. Updates containing unsigned readings are also sent regularly based on the `MeterValueSampleInterval` (OCPP 1.6) / `SampledDataTxUpdatedInterval` (OCPP 2.0.1) set by the CSMS.
A "virtual" energy meter inside the vSECC Software provides a calculated energy value based on the voltage and current values provided by the power electronics. This can be used for a simple estimation of the transferred energy.

At this moment, the vSECC Controllers come along with a direct interface to the LEM DCBM 400/600 energy meters[1]. To provide billing capabilities, a dedicated energy meter per charging connector can be connected via Ethernet. If the two Ethernet ports are already used for e.g. PE and CSMS connection, it is recommended to use an Ethernet Switch.
Another physical energy meter can be used together with the MQTT interface of the vSECC Software. Thus, a custom implementation towards the desired energy meter or an energy meter with a MQTT interface is required.
Energy meters can be configured via the `Connector/EnergyMeterType` variable (see Section 5.7).
The following prerequisites must be met for the energy meter to work:

> The `AuthCtrlr/Enabled` variable must be set to `true`
> The `TxCtrlr/TxStartPoint` and `TxCtrlr/TxStopPoint` variables must be set to `EvConnected` only
> `TxStopPoint` set to `Authorized` is also allowed and can be used, if it can be guaranteed that no deauthorization can happen during charging (e.g. if no RFID reader is connected and the CSMS does not send `RemoteStop` (OCPP 1.6) / `RequestStopTransaction` (OCPP 2.0.1) messages)

> SampledDataCtrlr/Tx{Started|Updated|Ended}Measurands variables must include Energy.Active.Import.Register for the readings to be transmitted to the CSMS at the respective time points

5.28.1 Use of LEM DCBM 400/600

To use the LEM energy meter, its address must be configured via the Connector/EnergyMeterUrl variable with format http://<IP Address>:<Port>, e.g. http://192.168.3.21:80 (HTTPS is currently not supported).
Via the ChargingCommunicationCtrlr/AbortOnEnergyMeterUnavailable configuration variable the behavior is set, what happens if the connection to the meter is broken while charging. If it is enabled, the corresponding connector becomes inoperative until the connection is re-established. Otherwise charging sessions are not aborted and new sessions can be established, but no meter readings are sent to the CSMS.

Caution: Make sure that the time synchronization on the LEM meter is valid, e.g. by configuring NTP on the meter.

Additional steps are required to fulfill the requirements of the German Eichrecht. The virtual energy meter cannot be used for Eichrecht-compliant billing.

5.28.2 Use of MQTT Interface

MQTT can be used to interface any energy meter to the vSECC Controller by providing the glue code between the API of the desired energy meter and the MQTT interface described in this chapter.
A standard message flow of a successful charging session can be found in Annex I. The corresponding MQTT topics can be found in Annex G.
For simplicity, the following description only contains MQTT topics for connector 1, replace the EVSE ID accordingly for connector 2.

Caution: Please note that the vSECC Controller expects certain messages in order to continue in the charging process. These are described with "**must**".

Startup On startup, the vSECC Controller is ready to receive MQTT messages as soon as it publishes ready on the **vsecc/readiness** topic. It keeps the charging connector inoperative by publishing energy_meter_unavailable to **vsecc/connector/1/status/components/report_failure**. Once the energy meter is ready, it **must** publish energy_meter_unavailable to **vsecc/connector/1/status/components/report_resolution** in order to make the connector operative.

Measurement Status The energy meter **must** report its measurement status at startup and then whenever it changes. This is done via the **vsecc/connector/1/em/measurement_status** topic. Possible values are `not_running` and `running`.

Unsigned Readings The energy meter needs to publish unsigned readings at regular intervals, the last published value is sent to the CSMS whenever meter values are transmitted. The values must be sent to the topic **vsecc/connector/1/em/unsigned_reading** with the format `<Timestamp>|<Import reading>|<Export reading>`. The timestamp must be according to RFC3339, readings are in kWh with a dot as decimal separator, import for charging, export for discharging.

Signed Readings Right after the start and end of a charging session, the vSECC Controller requests a signed reading that **must** be answered by the energy meter to ensure a proper flow of information between vSECC Controller, CSMS and energy meter. The request is published by the vSECC Controller in `get_reading_signed` via the **vsecc/connector/1/em/measurement_control** topic. If the energy meter provides signed readings, the response must be in the format `OCMF|<JSON1>|<JSON2>|{"PUBKEY":"<PUBKEY>"}`. If no signed readings are supported, the request must still be answered with `NOT_SUPPORTED`.

Charging Session The vSECC Controller requests the start of an energy meter measurement with `start_measurement` via the **vsecc/connector/1/em/measurement_control** topic. Then it waits until the energy meter **must** report `running` as measurement status. Right after the start of the measurement, a signed reading is requested (which **must** be answered with a signed (i.e. `NOT_SUPPORTED`) reading). If specific information regarding the charging session, transaction, user, etc. is required to start the measurement, e.g. to include in the OCMF-tuple for Eichrecht, see Annex G for more MQTT topics to subscribe to. At the end of the charging session, the vSECC Controller requests the measurement stop with `stop_measurement` via the **vsecc/connector/1/em/measurement_control** topic. Finally, after the charging session has stopped, another signed reading is requested. Please note that further unsigned readings received after the signed reading, are not forwarded to the CSMS anymore.

Error Handling If there are any issues with the energy meter and the charging session should stop, make sure to publish `energy_meter_unavailable` to **vsecc/connector/1/status/components/report_failure**. This will stop the charging session and prevent further sessions until the failure is resolved. If the charging session should continue even if there is an issue with the energy meter, make sure to respond to the commands sent by the vSECC Controller.

5.28.3 Prerequisites for vSECC Controllers to fulfil German Eichrecht

Caution: Vector can provide no guarantee of the completeness of the prerequisites with regards to the charge controller to adhere to the German measurement and calibration law. Please advice a conformity assessment body.

When charging the electric vehicle, the driver or owner should only pay for the amount of energy that was consumed. The basis to ensure that is provided by the German measurement and calibration law. Therefore, when charging stations are built up in Germany and the charging is not for free, they must be compliant with the German ”Eichrecht”.
Today, a certification of the charging station (with a vSECC Controller) by a conformity assessment body can be achieved under the following conditions:

1. **Measuring Capsule**
   The vSECC Controller is not considered part of the so-called ”measuring capsule”, since it only forwards a data structure from the energy meter to the CSMS without modifying it. When the vSECC Controller has started the transaction, the energy meter starts accumulating energy for this transaction (identified with a unique transaction identifier chosen by the energy meter). When the transaction is stopped, the energy meter sends the data readouts in OCMF format in response. The whole data structure is authenticated by a signature mechanism of the energy meter.
   Please refer to the DCBM Operation Manual [1] for further details on this mechanism.
   The vSECC Software then forwards these signed data readouts to the CSMS, which can verify them and use the values e.g. for billing purposes. For more details on the ”Schalt-Mess-Koordination”, please refer to the documentation in Appendix J.
2. **Choice of energy meter**
   Since the vSECC Controller is not allowed to modify any parameters of the energy meter or the data structure of the meter readouts, in order not to be part of the measuring capsule, the energy meter must be chosen with one of the following parameters:
   - **A fixed-value cable compensation**
     The energy meter must be chosen in accordance with the cable resistance. E.g. for a resistance value of 2mΩ, the energy meter with the reference DCBM_N**2**D_x0x0_0000 must be chosen. Other possible variants are DCBM_N**3**D_x0x0_0000 for 4mΩ cable compensation, or DCBM_N**4**D_x0x0_0000 for 6mΩ.
   - **Using 4-wire-measurement**
     Together with a suitable charging cable, the LEM energy meter offers the possibility to use four-wire measurement to measure the energy as close to the EV as possible. Therefore, the energy meter with the reference DCBM_N**1**D_x0x0_0000 must be chosen.

For more information on the certification requirements, please take a look at the Application Note ”Building charging stations compliant to German Measurement and Calibration Law with the vSECC Controllers” on vector.com/vsecc/documentation.

[1] https://www.lem.com/en/file/10314/download

6 Service Guide

In this chapter you will find the following information:

6.1 Reset Factory Defaults

The vSECC, vSECC.single Board and vSECC.single are equipped with a reset button, see Section 2.3.1 (vSECC), Section 3.3 (vSECC.single Board) and Section 4.3 (vSECC.single) for its exact location.

To reset the device to the factory settings perform the following actions:

1. Power off the device (remove power plug)
2. Press and hold the reset button
3. Power on the device
4. Keep on holding the button until
   - vSECC: All 4 LEDs on the housing blink 4 times
   - vSECC.single (Board): The LED blinks red 4 times
5. Release the button

After the reset, the LEDs behave as follows:

- vSECC: All 4 LEDs remain solid red
- vSECC.single (Board): The LED remains solid orange (red and green both active)

Then, please wait until the System LED is solid green. Now, your vSECC Controller is fully operational with the factory settings in place.

Caution: Pressing the reset button deletes all custom configuration data permanently, including certificates and timezone settings. If possible, make a backup prior to the reset.

6.2 Firmware Update

The process how to update the firmware is described in detail in chapter 5.8.

6.3 Status LEDs

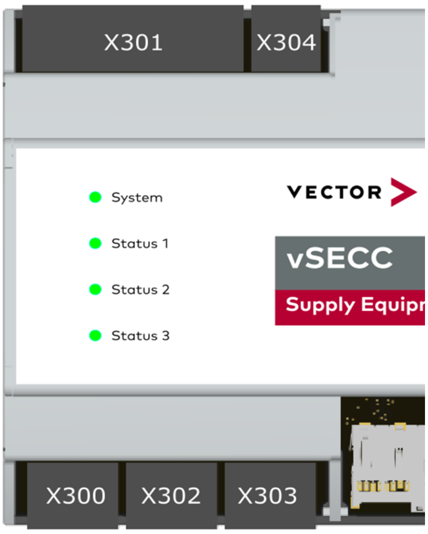


Figure 57: vSECC

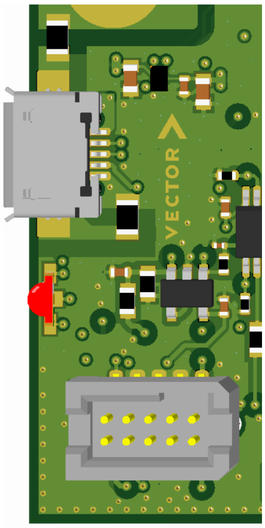


Figure 58: vSECC.single Board

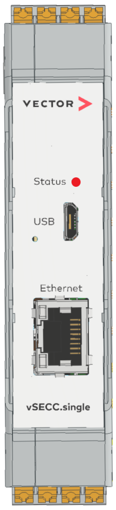


Figure 59: vSECC.single

The vSECC, vSECC.single Board and vSECC.single are equipped with a System LED that indicates the status of the controller. The vSECC has three additional LEDs representing the status of the respective charging port. Each LED has multiple possible states, as described in detail below.

System LED

This LED shows the overall system status of the vSECC Controller:

- Off: No power is provided.
- Orange, flashing: Currently not used.
- Orange, continuously: Early boot phase.
- Green, flashing: Late boot phase.
- Green, continuously: Initialization is complete and the vSECC Controller is now running.
- Red, flashing: Indicates the special events reboot and factory reset.
- Red, continuously: The vSECC Controller is in maintenance mode.

Please note that the **vSECC**'s System LED may briefly flash green when power is first connected. This should be ignored.

Caution: While the vSECC.single Board indicates the end of the boot process, it may take a few seconds until the controller is fully operational and starts communication with the power electronics, EV or the CSMS.

Charging Port LEDs (vSECC only)

Three Status LEDs as shown in Figure 57 indicate the current state of the respective charging port. The LED `Status 1` corresponds to connector X303 (CCS 1), `Status 2` corresponds to connector X302 (CCS 2), and `Status 3` corresponds to connector X300 (CHAdeMO):

> Off: Connector works, but currently no EV is connected.

> Green, flashing: The connected EV is currently charging.

> Green, lit continuously: An EV is connected.

> Red, flashing: Currently not used.

> Red, continuously: The connector is inoperative. This may be due to a setting in the CSMS or an internal error.

7 Technical Data vSECC

In this chapter you will find the following information:

7.1 General

Parameter	Min.	Typ.	Max.	Unit
Supply voltage V_{in}	18	24	30	V
Power consumption at 24 V				
> Idle, communication to back end and power electronics active		7		W
> Charging CCS on two spots, communication to back end and power electronics active		7		W
> Charging CCS and CHAdeMO simultaneously, communication to back end and power electronics active		36		W
> 5 digital ouputs at max load, communication to back end and power electronics active		30		W
> All digital ouputs at max load, CHD_SEQ at max load, CHD_LATCH at 25 Ω, CPU at 100 % load		107		W
Current draw during boot-up			1.5	A
Temperature range	-40		70	°C
Dimensions (length x width x depth)	161.6 x 89.7 x 60.7			mm
Total weight	approx. 276			g
IP protection class	20			

7.2 Digital Inputs

6 general purpose digital inputs + 2 inputs used for CHAdeMO start/stop buttons (IEC 61131-2 Type 1 & 3 compatible, active high):

Parameter	Min.	Typ.	Max.	Unit
Input voltage		24		V
Switching thresholds				
> High to Low		4.4		V
> Low to High		6.0		V
Current draw per input	2.1		2.6	mA

7.3 Digital Outputs

16 general purpose digital outputs (active high):

Parameter	Min.	Typ.	Max.	Unit
Output voltage (High)		V_{in} - 1	V_{in}	V
Output current per channel			200	mA
Total output current all channels			3.2	A
Each output is overcurrent and short-circuit protected				

7.4 Analog Inputs

2 general purpose analog inputs:

Parameter	Min.	Typ.	Max.	Unit
Input voltage	0		10	V
Resolution	12			bit

The analog inputs are not calibrated on every single device and therefore not usable for high-precision measurements.

7.5 Temperature Inputs

9 temperature sensor inputs, optimized for usage with PT-1000 temperature sensors:

Parameter	Min.	Typ.	Max.	Unit
Driven output current		400		μA
Resolution	16			bit

The temperature inputs are not calibrated on every single device and therefore not usable for high-precision measurements.

7.6 Safety Outputs

3 isolated relays (normally opened):

Parameter	Min.	Typ.	Max.	Unit
Rated current			100	mA
Switching voltage (DC)			30	V
Delay time		3.6	5	ms

7.7 Serial Communication

7.7.1 CAN1 (CHAdeMO)

CAN port with switchable bus termination:

Parameter	Min.	Typ.	Max.	Unit
Baudrate		500		kbit/s

7.7.2 CAN2 (Power Electronics)

CAN port with switchable bus termination:

Parameter	Min.	Typ.	Max.	Unit
Baudrate		500		kbit/s

7.7.3 RS485 (Modbus TCP to RTU gateway)

Configuration parameter:

Parameter	Min.	Typ.	Max.	Unit
Baudrate		9600		kbit/s
Number of data bits		8		
Number of stop bits		1		
Parity mode		even		

7.8 CCS Connectors

7.8.1 Full Bridge Out

Output voltage switchable via software (overcurrent and short-circuit protected):

Parameter	Min.	Typ.	Max.	Unit
> 24 V mode selected		V_{in}- 1.7	V_{in}	V
> 12 V mode selected	10	12	14	V
Output current for 2 seconds			2	A

7.8.2 Full Bridge Feedback

Parameter	Min.	Typ.	Max.	Unit
Output resistance	0		15	Ω
> Connector locked		11		$k\Omega$
> Connector unlocked		1		$k\Omega$

7.8.3 Control Pilot

2 control pilot pins (designed according to IEC 61851):

Parameter	Min.	Typ.	Max.	Unit
Output voltage				
> On state		12		V
> Off state		-12		V
Frequency	0.98	1	1.02	kHz
Duty cycle accuracy	+/- 5			μs

7.9 CHAdeMO Sequence Circuit

Sequence circuit signals (designed in accordance with CHAdeMO v0.9.1 and v1.2.0 ED2):

Parameter	Min.	Typ.	Max.	Unit
Charge sequence signal 1				
> On state voltage	11.65	12	12.35	V
> Driven continuous output current			2	A
Charge sequence signal 2				
> Open drain output				

> Maximum input voltage > Maximum continuous input current			0.35 2	V A
Connector proximity detection > Pull-down resistor		200		Ω
Vehicle charge permission > Pull-up resistor > External leakage current		1	 2	kΩ mA
Latch Out > On state voltage > Output Current	11.65	12	12.35 500	V mA
Latch In > Input Current	200		500	mA

8 Technical Data vSECC.single Board

In this chapter you will find the following information:

8.1 General

Parameter	Min.	Typ.	Max.	Unit
Supply voltage V_{in}	11	12	13	V
Power consumption at 12 V		5		W
Temperature range	-40		70	°C
PCB Dimensions (further details in mechanical drawing)	94.10 x 58.00			mm
Total weight	approx. 48			g

8.2 Digital IO's

10 software-programmable general purpose digital IO's with VCC_LOGIC power supply output for opto-couplers and level shifters:

8.2.1 Digital Inputs

Parameter	Min.	Typ.	Max.	Unit
Input voltage		3.3	3.6	V
Switching thresholds > High to Low > Low to High	 2.0		 0.8	 V V
Current draw per input	-8		8	μA

8.2.2 Digital Outputs

Parameter	Min.	Typ.	Max.	Unit
Output voltage (High)		3.2		V
Output voltage (Low)		0.1		V
Output current per channel			3	mA
Each output short-circuit (to GND) protected				

8.2.3 VCC_LOGIC Power Supply

Parameter	Min.	Typ.	Max.	Unit
Output Voltage	3.27		3.55	V
Output Current			30	mA

8.3 Analog Inputs

4 general purpose analog inputs:

Parameter	Min.	Typ.	Max.	Unit
Input voltage	0		5	V
Resolution	12			bit
VCC_ADC can be used as reference voltage.				

8.4 Temperature Inputs

2 temperature sensor inputs, optimized for usage with PT-1000 temperature sensors, supervised by safety output:

Parameter	Min.	Typ.	Max.	Unit
Measurement current	970	1000	1030	μA
Measurement range	815		1600	Ω
Resolution	12			bit

8.5 Safety Output

One digital output. Supervision of CP, PP and temperature sensors always active. Output is **OFF** when energy transfer is not allowed (CP State in states A/B/F/E and/or temperature inputs not in range). Output is **ON** when energy transfer is allowed (CP state in states C/D and temperature inputs in range).

Caution: In order to deactivate supervision of PP (e.g. when using CCS Type 2 Connector), connect PP_PU (X301.2) with PP (X301.1) and add a Resistor of 142 Ω between PP and GND (X301.4-6).

Caution: You can not use a pull-up on this output.

Parameter	Min.	Typ.	Max.	Unit
Max. output current			10	mA
Output voltage (active)	3.14	3.3		V
Delay time (CP loss, PP loss)		3.6	5	ms
Upper treshold temperature input (resistance) > Equivalent temperature	1333 86.3		1359 93.1	Ω °C
Lower threshold temperature input (resistance) > Equivalent temperature	802 -50.3		816 -46.7	Ω °C

8.6 Serial Communication

8.6.1 CAN1 (Power Electronics)

CAN port with fixed bus termination.

Caution: Please use a baudrate of maximum 250 kBaud currently. Using 125 kBaud is adviced.

8.6.2 RS485 (Modbus TCP to RTU gateway)

Configuration parameter:

Parameter	Min.	Typ.	Max.	Unit
Baudrate Number of data bits Number of stop bits Parity mode		9600 8 1 even		kbit/s

8.7 CCS Connector Control Pilot

1 control pilot pin (designed according to IEC 61851):

Parameter	Min.	Typ.	Max.	Unit
Output voltage > On state > Off state		 12 -12		 V V
Frequency	0.98	1	1.02	kHz

Duty cycle accuracy	+/- 5	μs

9 Technical Data vSECC.single

In this chapter you will find the following information:

9.1 General

Parameter	Min.	Typ.	Max.	Unit
Supply voltage V_{in}	11	12	13	V
Power consumption at 12 V		5		W
Operating temperature	-40		50	°C
Storage temperature	-40		70	°C
PCB Dimensions (further details in mechanical drawing)	114.50 x 99.00			mm
Total weight	approx. 140			g

9.2 Digital IO's

9.2.1 SAF_FB (Safety Feedback)

The SAF_FB (Safety Feedback) is defined as input signal at connector X301.1. This signal is connected with the vSECC.single Board's digital input DIO5 through the Samtec connector:

Parameter	Min.	Typ.	Max.	Unit
Input voltage		3.3	V_{in}	V
Switching threshold		1.57		V
Current draw		3.3		mA

Caution: The digital input (SAF_FB) is populated with a pull up resistor to 3.3V. When the connector X301.1 is not connected, the voltage of the digital input is pulled up to the level of 3.3V. In this case the digital input DIO5 shows a high value. When the connector X301.1 is connected to GND, the digital input DIO5 goes to a low value.

9.2.2 DIN1, DIN2 (Digital Input 1 & 2), DIN_FB (Digital Input Feedback)

DIN1 (Digital Input 1), DIN2 (Digital Input 2) and DIN_FB (Digital Input Feedback) are defined as input signals. They are connected with the vSECC.single Board's DIOs through the Samtec connector as follows:

> DIN1 (X301.2) is connected to digital input DIO6
> DIN2 (X301.3) is connected to digital input DIO7
> DIN_FB (X301.4) is connected to digital input DIO9

Parameter	Min.	Typ.	Max.	Unit
Input voltage		5	V_{in}	V

Switching threshold		1.57		V
Current draw		0.51		mA

Caution: The digital inputs (DIN1, DIN2 and DIN_FB) are populated with a pull up resistor to 5V. When the connector is not connected, the voltage of each digital input is pulled up to the level of 5V. In this case the digital input shows a high value. When the connector is connected to GND, the digital input goes to a low value.

9.2.3 HB1_OUT (Half Bridge Output 1), HB2_OUT (Half Bridge Output 2)

HB1_OUT (Half Bridge Output 1) and HB2_OUT (Half Bridge Output 2) are defined as output signals. They are connected with the vSECC.single Board's DIOs through the Samtec connector as follows:

> HB1_OUT (X303.3) is configured via digital output DIO1
> HB2_OUT (X303.4) is configured via digital output DIO4

Parameter	**Min.**	**Typ.**	**Max.**	**Unit**
Output voltage (High)		V_{in} - 0.75	V_{in}	V
Switching (Delay time)				
> High to Low		1		μs
> Low to High		1		μs
Rated current per channel		1		A
Each output is short-circuit proof				

9.2.4 HS_OUT (High Side Switch Output)

HS_OUT (High Side Switch Output) is defined as output signal at connector X304.1. This signal is connected with the vSECC.single Board's digital output DIO10 through the Samtec connector:

Parameter	**Min.**	**Typ.**	**Max.**	**Unit**
Output voltage (High)		V_{in} - 0.5	V_{in}	V
Switching (Delay time)				
> High to Low	39	94	235	μs
> Low to High	39	94	235	μs
Rated current per channel		2		A
Each output is short-circuit proof				

9.3 Temperature Inputs

Two temperature sensor inputs, optimized for usage with PT-1000 temperature sensors, supervised by safety output:

Parameter	Min.	Typ.	Max.	Unit
Measurement current	970	1000	1030	μA
Measurement range	815		1600	Ω
Resolution	12			bit

9.4 Safety Output

Two outputs are available for Safety Output: OUT_SAF_HS (Output Safety High Side; X303.1) and OUT_SAF_LS (Output Safety Low Side; X303.2). The supervision of CP, PP and temperature sensors is always active. The output is **OFF** when energy transfer is not allowed (CP State in states A/B/F/E and/or temperature inputs not in range). The output is **ON** when energy transfer is allowed (CP state in states C/D and temperature inputs in range).

Parameters of OUT_SAF_HS (Output Safety High Side):

Parameter	Min.	Typ.	Max.	Unit
Output voltage (High)		V_{in} - 0.5	V_{in}	V
Switching (Delay time)				
> High to Low	39	94	235	μs
> Low to High	39	94	235	μs
Rated current per channel		2		A
Each output is short-circuit proof				

Parameters of OUT_SAF_LS (Output Safety Low Side):

Parameter	Min.	Typ.	Max.	Unit
Output voltage (High)			0.35	V
Switching (Delay time)				
> High to Low	12	38	76	μs
> Low to High	20	65	130	μs
Rated current per channel		2		A
Each output is short-circuit proof				

Caution: In order to deactivate supervision of PP (e.g. when using CCS Type 2 Connector), connect PP_PU (X302.3) with PP (X302.2) and add a Resistor of 142 Ω between PP (X302.2) and PE (X302.4).

Parameter	Min.	Typ.	Max.	Unit
Delay time (CP loss, PP loss)		3.6	5	ms
Upper treshold temperature input (resistance)	1333		1359	Ω
> Equivalent temperature	86.3		93.1	°C
Lower threshold temperature input (resistance)	802		816	Ω
> Equivalent temperature	-50.3		-46.7	°C

9.5 Serial Communication

9.5.1 CAN1 (Power Electronics)

CAN port with fixed bus termination.

Caution: Please use a baudrate of maximum 250 kBaud currently. Using 125 kBaud is adviced.

9.5.2 RS485 (Modbus TCP to RTU gateway)

Configuration parameter:

Parameter	Min.	Typ.	Max.	Unit
Baudrate		9600		kbit/s
Number of data bits		8		
Number of stop bits		1		
Parity mode		even		

9.6 CCS Connector Control Pilot

One control pilot pin (designed according to IEC 61851):

Parameter	Min.	Typ.	Max.	Unit
Output voltage				
> On state		12		V
> Off state		-12		V
Frequency	0.98	1	1.02	kHz
Duty cycle accuracy	+/- 5			μs

A Conformity Declarations

A.1 vSECC

VECTOR

EC Declaration of Conformity

according to directive 2014/30/EU (EMC)
according to directive 2011/65/EU (RoHS)
according to directive 2012/19/EU (WEEE)

The manufacturer

Vector Informatik GmbH

Ingersheimer Straße 24

70499 Stuttgart

herewith declares that the following product
vSECC Supply Equipment Communication Controller (Art. No. 20006)

complies with the essential requirements of the above directives, when used for its intended purpose. This declaration also comprises the delegated directive (EU) 2015/863.
The sole responsibility for issuing this Declaration of Conformity is with Vector.

Following harmonized standards have been applied:

EN 61000-6-2:2005 + AC: 2005	Generic standards – Immunity standard for industrial environments
EN 61000-6-3:2007 + A1:2011 + AC:2012	Generic standards - Emission standard for residential, commercial and light-industrial environments
EN 61000-3-2:2014	Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)
EN 61000-3-3:2013	Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low voltage supply systems, for equipment with rated current <16 A per phase and not subject to conditional connection
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Place: Stuttgart

Date: 2020-09-30

Sign. Thomas Beck

Managing Director Dr. Thomas Beck

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Handelsregister Stuttgart HRB 17317

Managing Directors:
Dr. Thomas Beck
Dr. Stefan Krauß
Thomas Riegraf

TCB **GRANT OF EQUIPMENT AUTHORIZATION** **TCB**

Certification

Issued Under the Authority of the

Federal Communications Commission

By:

ACB, Inc.
6731 Whittier Avenue Suite C110
McLean, VA 22101

Date of Grant: 02/16/2021

Application Dated: 02/11/2021

Vector Informatik GmbH
Ingersheimer Str. 24
Stuttgart, 70499
Germany

Attention: Thomas Beck

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: 2AXYRVSECC
Name of Grantee: Vector Informatik GmbH
Equipment Class: **Part 15 Class B Digital Device**
Notes: **Communication Controller for Charging Stations**

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15B	-			

CSA GROUP™

Certificate of Compliance

Certificate: 80136659 **Master Contract:** 302522

Project: 80136659 **Date Issued:** 2022-10-12

Issued To: **Vector Informatik GmbH**
Ingersheimer Str. 24
Stuttgart, Baden-Württemberg, 70499
Germany

Attention: Rebekka Jentzsch

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Issued by: Markus Hackl
Markus Hackl

PRODUCTS
CLASS - C386266 - INFORMATION TECHNOLOGY EQUIPMENT (CSA 62368-1)
CLASS - C386296 - INFORMATION TECHNOLOGY EQUIPMENT (ANSI/UL 62368-1) - Certified to US Standards

Communication Controller for Charging Stations, model vSECC, build-in unit, Class III
Ratings:
18 – 30 Vdc / 5 A

DQD 507 Rev. 2019-04-30 Page 1

2C68-73D3-11B0-CA74

방송통신기자재등의 적합등록 필증

Registration of Broadcasting and Communication Equipments

상호 또는 성명 Trade Name or Registrant	주식회사 벡터코리아아이티
기자재명칭(제품명칭) Equipment Name	Supply Equipment Communication Controller
기본모델명 Basic Model Number	vSECC
파생모델명 Series Model Number	
등록번호 Registration No.	R-R-VeC-vSECC
제조자/제조(조립)국가 Manufacturer/Country of Origin	Vector Informatik GmbH / 독일
등록연월일 Date of Registration	2020-10-14
기타 Others	

위 기자재는 「전파법」 제58조의2 제3항에 따라 등록되었음을 증명합니다.
It is verified that foregoing equipment has been registered under the Clause 3, Article 58-2 of Radio Waves Act.

2020년(Year) 10월(Month) 14일(Day)

국립전파연구원장 국립전파연구원장인

Director General of National Radio Research Agency

※ 적합등록 방송통신기자재는 반드시 **"적합성평가표시"** 를 부착하여 유통하여야 합니다.
위반시 과태료 처분 및 등록이 취소될 수 있습니다.

मानक : पथप्रदर्शक :

भारतीय मानक ब्यूरो

(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)

BUREAU OF INDIAN STANDARDS

(Ministry of Consumer Affairs, Food & Public Distribution, Govt. of India)

मानक भवन, 9 बहादुर शाह जफ़र मार्ग, नई दिल्ली – 110002
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi – 110002
दूरभाष / Phone: +91-11-23230856/2323010131/23233375/23239402
ई–मेल / E-mail: registration@bis.gov.in
वेबसाईट / Website: https://bis.gov.in/, https://www.crsbis.in/BIS/

Our Ref: Registration/CRS 2021-4099/R-41194808 Date:23-06-2021

Subject : Licence Document

MANUFACTURING UNIT :	Vector Informatik Gmbh INGERSHEIMER STR.24 D 70499 STUTTGART, GERMANY BADEN WURTTEMBERG,Germany-70499 Thomas.Riegraf@vector.com 4971180670108	

Dear Sir,

1.With reference to your Application, we are pleased to inform you that it has been decided to grant you licence as per details given below :

Product Category :	Automatic Data Processing Machine
Product Name :	Controller Appliance (ADPM)
IS NO :	IS 13252(PART 1):2010/ IEC 60950-1 : 2005
Brand (As Declared by Manufacturer) :	vector
Model :	[Brand -> vector, Models -> vSECC]
Factory Address :	INGERSHEIMER STR.24 D 70499 STUTTGART, GERMANY BADEN WURTTEMBERG,Germany-70499

2. The Licence is being granted for your unit located at the address and for the brand and models mentioned at serial no 1 above.

3. The number assigned to this Licence is **R-41194808** which has been made operative from **23-06-2021** and is valid upto **22-06-2023** . The Licence Number should invariably be referred to in your future correspondence.

4. The rights and privileges under the licence shall not be exercised by any other factory / organization at any other location. This licence is not transferable. In the event of shifting of the manufacturing machinery from the registered premises to some other place use of the Licence Number shall be stopped and BIS shall be informed.

5. The licensee shall comply with the provisions of the Act, rules and regulations framed thereunder and as amended from time to time.

6. The licensee shall follow the guidelines for the use of Standard Mark and labeling requirements as per Annex-I.

7. The licensee shall not use the licence in any manner which contravenes the provisions of Act, rules and regulations framed thereunder and as amended from time to time.

8. Upon expiry of validity, stoppage or suspension or cancellation of licence, you shall discontinue forthwith the self declaration of conformity to the relevant Indian Standard(s) and withdraw all promotional and advertising matter which contains any reference thereto.

9. As per your declaration, **Shripad Kanni, Local Productline Manager, VECTOR INFORMATIK INDIA PRIVATE LIMITED(Address- 5th Floor, Office No. 11 to 14, Tara Height,, Old Pune Mumbai Road, Wakdewadi, Pune, Maharashtra, 411003,NA)** is your authorized Indian representative. Any intended change in the name of the Indian representative ought to be brought to our notice immediately along with requisite fees and document.

10. For renewal of licence, the licensee shall have to apply to BIS three months in advance before expiration of the licence and application form for renewal is available on BIS website

11. The licence is not transferable. Kindly acknowledge receipt of this letter.

Thanking you,

Yours faithfully,
(Peeyush Prakash)
Sc. C
Telfax : +91-11-23230856
E-mail: registration@bis.gov.in

Note: This is a system generated letter. Hence signature is not required.
To verify authentication of letter, kindly scan the QR code on this letter.

A.2 vSECC.single

VECTOR

EU Declaration of Conformity

according to directive 2014/30/EU (EMC)
according to directive 2011/65/EU (RoHS)
according to directive 2012/19/EU (WEEE)

CE

The manufacturer

Vector Informatik GmbH

Ingersheimer Straße 24

70499 Stuttgart

herewith declares that the following product
vSECC.single Supply Equipment Communication Controller (Art. No. 20011)

complies with the essential requirements of the above directives, when used for its intended purpose. This declaration also comprises the delegated directive (EU) 2015/863.
The sole responsibility for issuing this Declaration of Conformity is with Vector.

Following harmonized standards have been applied:

EN 61000-6-2:2005 + AC: 2005	Generic standards – Immunity standard for industrial environments
EN 61000-6-3:2007 + A1:2011 + AC:2012	Generic standards - Emission standard for residential, commercial and light-industrial environments
EN 61000-3-2:2014	Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)
EN 61000-3-3:2013	Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low voltage supply systems, for equipment with rated current <16 A per phase and not subject to conditional connection
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Place: Stuttgart

Date: 2023-05-05

Sign. Thomas Beck

Managing Director Dr. Thomas Beck

Vector Informatik GmbH
Ingersheimer Str. 24
70499 Stuttgart · Deutschland
Tel.: +49 711 80670-0
Fax: +49 711 80670-111
www.vector.com

BW Bank Stuttgart
IBAN: DE20 6005 0101 0002 2245 85 BIC: SOLADEST600

Deutsche Bank Stuttgart
IBAN: DE87 6007 0070 0161 4080 00 BIC: DEUTDESSXXX

Handelsregister Stuttgart HRB 17317

Managing Directors:
Dr. Thomas Beck
Dr. Stefan Krauß
Thomas Riegraf

UKCA Declaration of Conformity

In accordance with UK Government Guidance
The Electromagnetic Compatibility Regulations 2016: 2016 No 1091 (EMC)
The Restriction of the Use of Hazardous Substances
in Electrical and Electronic Equipment Regulations 2012: 2012 No 3032 (RoHS)

The manufacturer

Vector Informatik GmbH

Ingersheimer Straße 24

70499 Stuttgart, Germany

herewith declares that the following product
vSECC.single Supply Equipment Communication Controller (Art. No. 20011)

complies with the essential requirements of the above-mentioned relevant UK Statutory Instruments and their amendments, when used for its intended purpose.
The sole responsibility for issuing this Declaration of Conformity is with Vector.

The following standards have been applied:

EN 61000-6-2:2005 / AC:2005	Generic standards – Immunity standard for industrial environments
EN 61000-6-3:2007 / A1:2011 / AC:2012	Generic standards – Emission standard for residential, commercial and light-industrial environments
EN 61000-3-2:2014	Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)
EN 61000-3-3:2013	Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low voltage supply systems, for equipment with rated current <16 A per phase and not subject to conditional connection
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Dr. Thomas Beck
Dr. Stefan Krauß
Thomas Riegraf

VECTOR

FCC-Self-Declaration of Conformity

Supplier's Declaration of Conformity

47 CFR § 2.1077 Compliance Information

Unique Identifier: Art. No. 20011 - vSECC.single

Vector North America Inc.

39500 Orchard Hill Place, Suite 500
Novi, Michigan
48375
Phone: +1 248-449-9290; email: sales@us.vector.com

FCC Compliance Statement (products subject to Part 15)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Place: Stuttgart
Date: 2023-05-05

Sign. Thomas Beck
Managing Director Dr. Thomas Beck

Place: Novi, Michigan
Date: 2023-05-05

Sign. Tony Mascolo
Local Managing Director Tony Mascolo

Vector Informatik GmbH
Ingersheimer Str. 24
70499 Stuttgart · Deutschland
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BW Bank Stuttgart
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IBAN: DE87 6007 0070 0161 4080 00 BIC: DEUTDESSXXX
Handelsregister Stuttgart HRB 17317

Managing Directors:
Dr. Thomas Beck
Dr. Stefan Krauß
Thomas Riegraf

CSA GROUP™

Certificate of Compliance

Certificate:	80149809	**Master Contract:**	302522
Project:	80149809	**Date Issued:**	2023-03-21

Issued To: **Vector Informatik GmbH**
Ingersheimer Str. 24
Stuttgart, Baden-Württemberg, 70499
Germany

Attention: Anna Marilena Hesse

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Issued by: Markus Hackl
Markus Hackl

C US

PRODUCTS
CLASS - C386266 - INFORMATION TECHNOLOGY EQUIPMENT (CSA 62368-1)
CLASS - C386296 - INFORMATION TECHNOLOGY EQUIPMENT (ANSI/UL 62368-1) - Certified to US Standards

Communication controller, model vSECC.single, Class III equipment, built in equipment, Ratings 11 Vdc to 13 Vdc.

DQD 507 Rev. 2019-04-30 Page 1

6A81-3D74-1299-368C

방송통신기자재등의 적합등록 필증

Registration of Broadcasting and Communication Equipments

상호 또는 성명 Trade Name or Registrant	**주식회사 벡터코리아아이티**
기자재명칭(제품명칭) Equipment Name	**Supply Equipment Communication Controller**
기기부호/추가 기기부호 Equipment code /Additional Equipment code	**IMI61**
기본모델명 Basic Model Number	**vSECC.single**
파생모델명 Series Model Number	
등록번호 Registration No.	**R-R-VeC-vSECCsingle**
제조자/제조국가 Manufacturer/Country of Origin	**Vector Informatik GmbH/독일**
등록연월일 Date of Registration	**2023-05-14**
기타 Others	

위 기자재는 「전파법」 제58조의2 제3항에 따라 등록되었음을 증명합니다.
It is verified that foregoing equipment has been registered under the Clause 3, Article 58-2 of Radio Waves Act.

2023년(Year) 05월(Month) 15일(Day)

국립전파연구원장 국립전파연구원장인

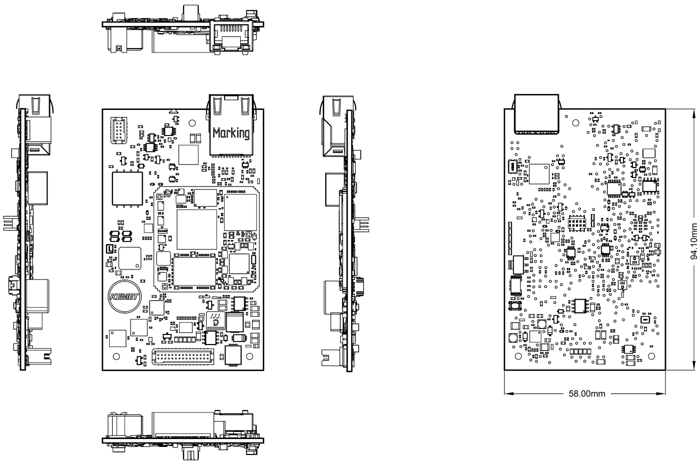
Director General of National Radio Research Agency

※ 적합등록 방송통신기자재는 반드시 **"적합성평가표시"** 를 부착하여 유통하여야 합니다.
위반시 과태료 처분 및 등록이 취소될 수 있습니다.

원본

B vSECC.single Board Mechanical Drawing

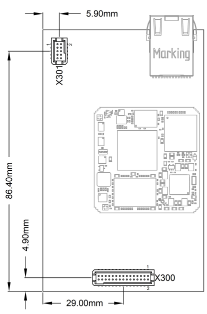
Mechanical Dimensions



VECTOR

Layout: **vsecc-single v1.0.0**
Designer: virced
File: vsecc-single_MEC.PCBDwf
Unit: **metric**
General Tolerances: **ISO 2768 mK**
Modified: 2021-04-23

Connector Interface



X300 pinout

pin number	signal name	pin number	signal name
1	VCC_SUP	2	VCC_SUP
3	GND	4	GND
5	VCC_LOGIC	6	DIO1
7	DIO2	8	DIO3
9	DIO4	10	DIO5
11	DIO6	12	DIO7
13	DIO8	14	DIO9
15	DIO10	16	VCC_ADC
17	GND_ADC	18	AIN1
19	AIN2	20	AIN3
21	AIN4	22	SAFETY_OUT
23	CAN1_HIGH	24	RS485_A
25	CAN1_LOW	26	RS485_B
27	RS232_RXD_TTL	28	CAN2_HIGH
29	RS232_TXD_TTL	30	CAN2_LOW

X301 pinout

pin number	signal name	pin number	signal name
1	PP	2	CP
3	PP_PU	4	GND
5	GND	6	GND
7	GND_TEMP	8	GND_TEMP
9	AIN_TEMP_2	10	AIN_TEMP_1

Mating Connectors:

X300: SAMTEC SFM-115-02-L-D-A
X301: SAMTEC SFM-105-02-L-D-A

mated height: 9.91mm

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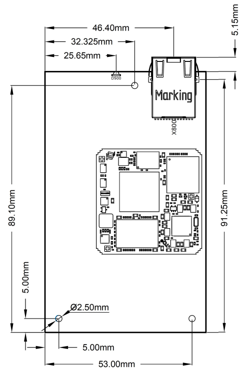
VECTOR

Layout: **vsecc-single v1.0.0**
Designer: virced
File: vsecc-single_MEC.PCBDwf
Unit: **metric**
General Tolerances: **ISO 2768 mK**
Modified: 2021-04-23

Baseboard / Housing Interface



Partinformation

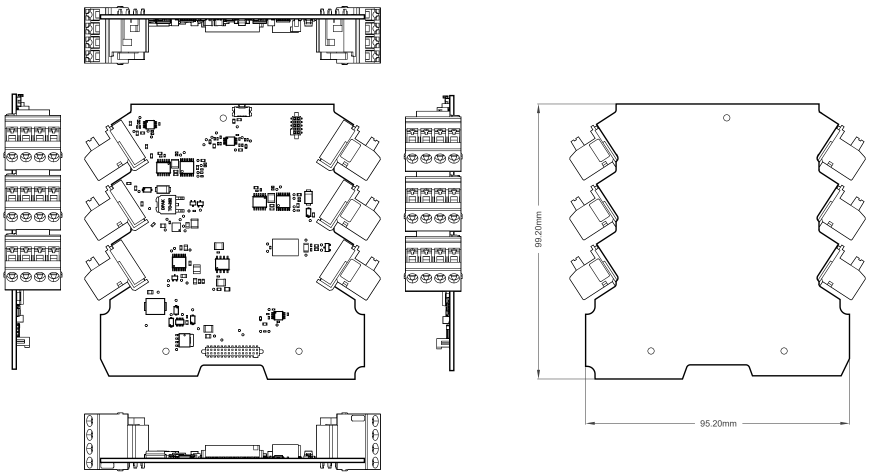
Designator	Manufacturer	Partnumber
D500	WUERTH ELEKTRONIK	155124RV73200
X800	WUERTH ELEKTRONIK	7498111120AR

VECTOR

Layout: vsecc-single v1.0.0			
Designer: virced		Unit: metric	General Tolerances: ISO 2768 mK
File: vsecc-single_MEC.PCBDwf		Modified: 2021-04-23	

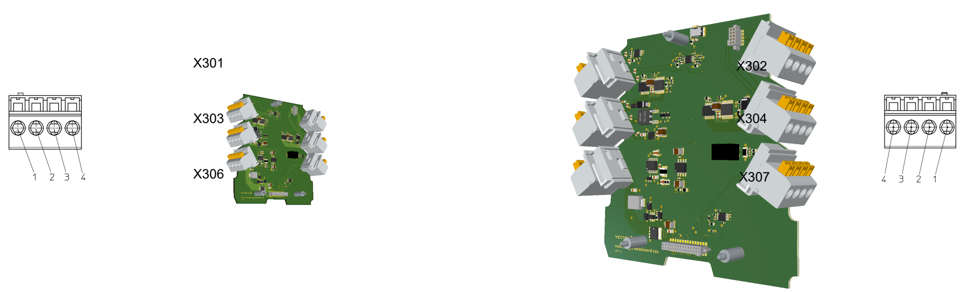
C vSECC.single Mechanical Drawing

Mechanical Dimensions



VECTOR
Layout: baseb.-css v1.2.1
Designer: virmed
Unit: metric
General Tolerances: ISO 2768 mK
File: vsecc-single-baseboard-ccs.PCBDwf
Modified: 2022-12-06

Pinout



X301

Pin	Function
1	SAF_FB
2	DIN1
3	DIN2
4	DIN_FB

X303

Pin	Function
1	OUT_SAF_HS
2	OUT_SAF_LS
3	HB1_OUT
4	HB2_OUT

X306

Pin	Function
1	RS232_TXD
2	RS232_RXD
3	GND_SUPPLY
4	VCC_SUPPLY

X302

Pin	Function
1	CP
2	PP
3	PP_PU
4	PE

X304

Pin	Function
1	AIN_TEMP1
2	AIN_TEMP2
3	GND_AIN
4	HS_OUT

X307

Pin	Function
1	RS485_B
2	RS485_A
3	CAN_H
4	CAN_L

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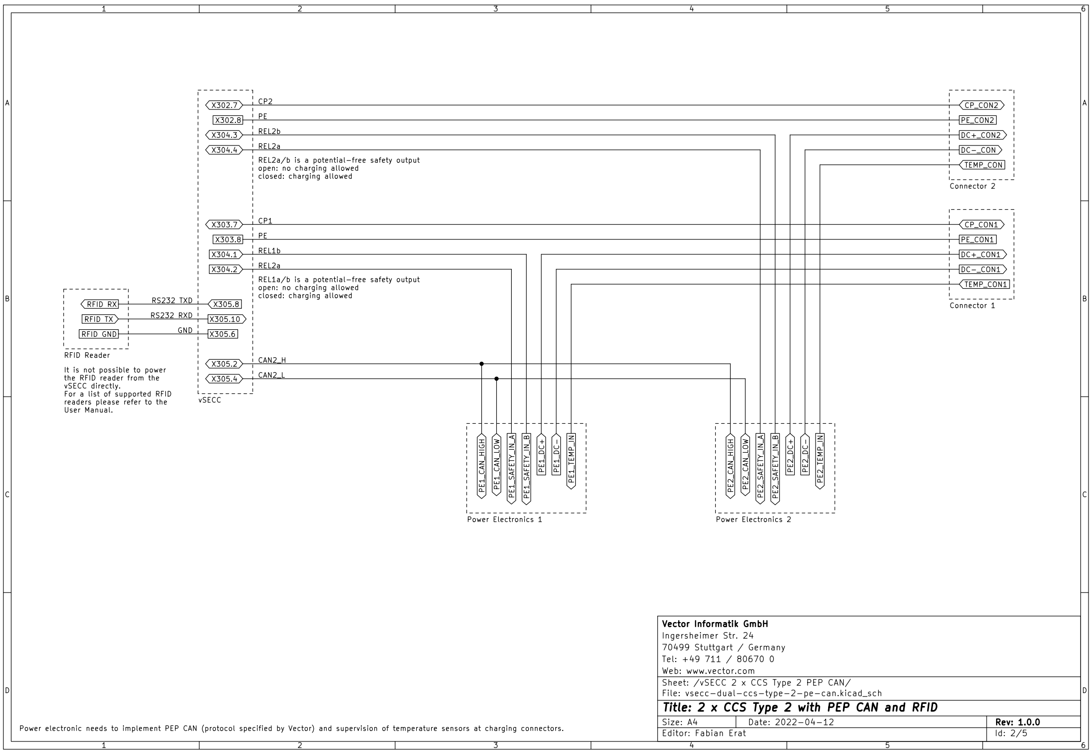
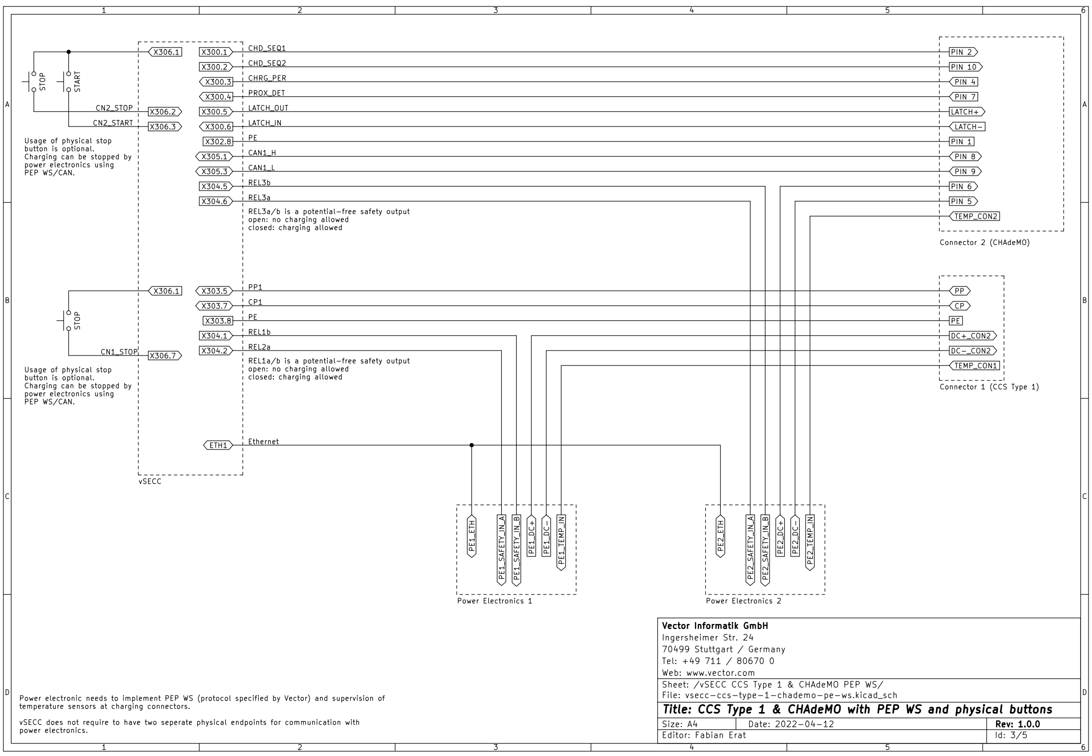
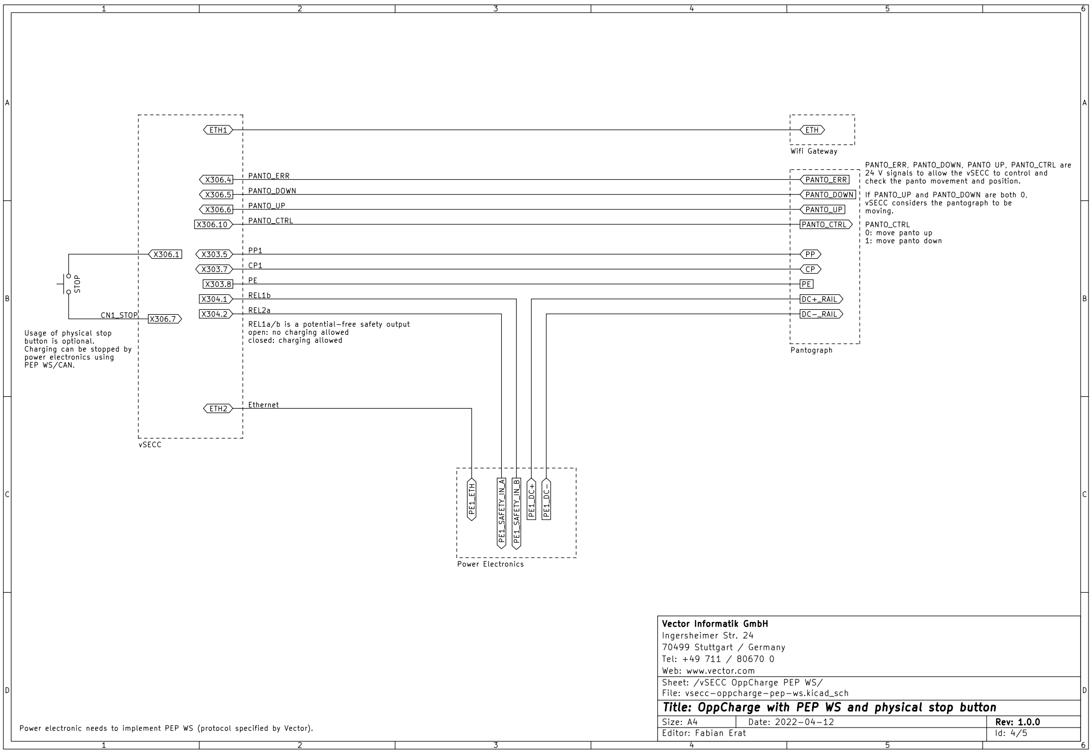
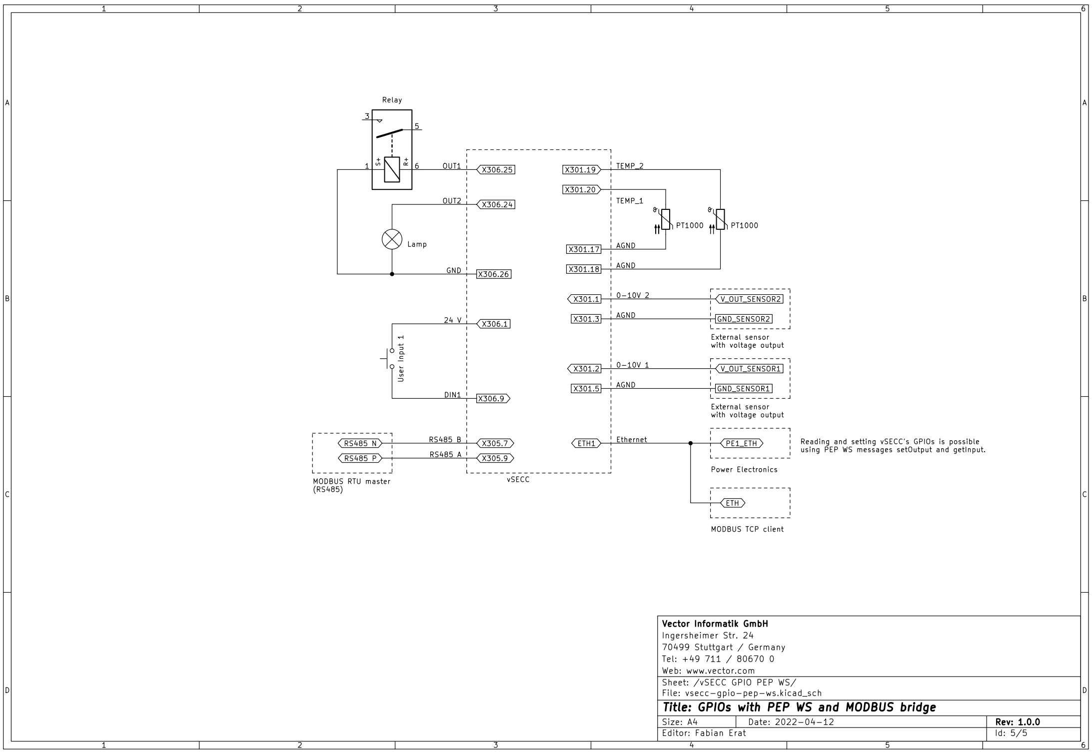
VECTOR
Layout: baseb.-css v1.2.1
Designer: virmed
Unit: metric
General Tolerances: ISO 2768 mK
File: vsecc-single-baseboard-ccs.PCBDwf
Modified: 2022-12-06

D vSECC Example Wiring Diagrams



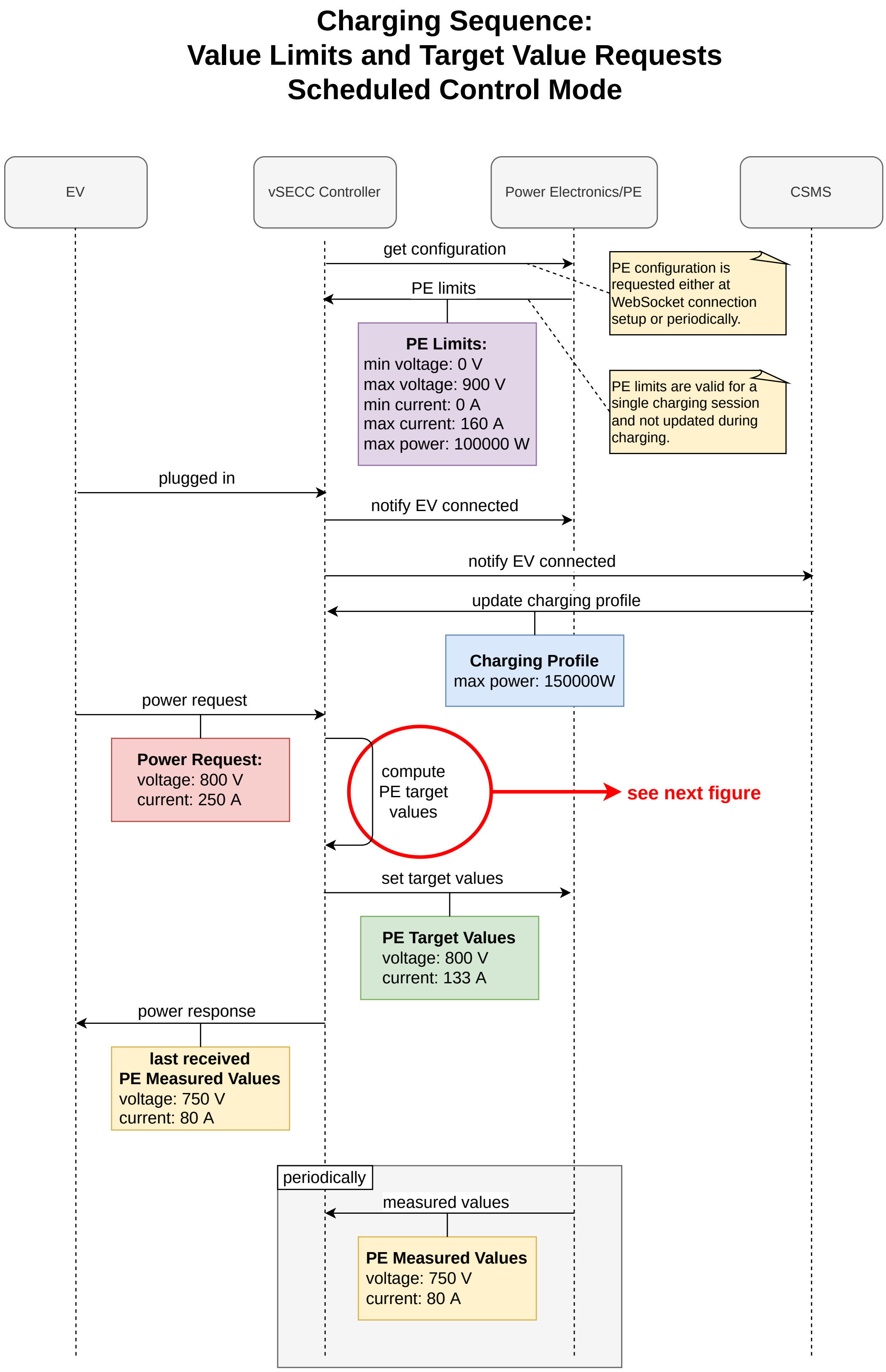



ETH1
ETH
Wifi Gateway
PANTO_ERR, PANTO_DOWN, PANTO UP, PANTO_CTRL are 24 V signals to allow the vSECC to control and check the panto movement and position.
If PANTO_UP and PANTO_DOWN are both 0, vSECC considers the pantograph to be moving.
PANTO_CTRL
0: move panto up
1: move panto down
X306.4 PANTO_ERR
X306.5 PANTO_DOWN
X306.6 PANTO_UP
X306.10 PANTO_CTRL
X306.1
X303.5 PP1
X303.7 CP1
X303.8 PE
X304.1 REL1b
X304.2 REL2a
CN1_STOP X306.7
STOP
PP
CP
PE
DC+_RAIL
DC-_RAIL
Pantograph
Usage of physical stop button is optional. Charging can be stopped by power electronics using PEP WS/CAN.
REL1a/b is a potential-free safety output
open: no charging allowed
closed: charging allowed
ETH2 Ethernet
vSECC
PE1_ETH
PE1_SAFETY_IN_A
PE1_SAFETY_IN_B
PE1_DC+
PE1_DC-
Power Electronics
Vector Informatik GmbH
Ingersheimer Str. 24
70499 Stuttgart / Germany
Tel: +49 711 / 80670 0
Web: www.vector.com
Sheet: /vSECC OppCharge PEP WS/
File: vsecc-oppcharge-pep-ws.kicad_sch
Title: OppCharge with PEP WS and physical stop button
Size: A4 Date: 2022-04-12 Rev: 1.0.0
Editor: Fabian Erat Id: 4/5
Power electronic needs to implement PEP WS (protocol specified by Vector).


Relay
OUT1 X306.25
OUT2 X306.24
Lamp
GND X306.26
24 V X306.1
User Input 1
DIN1 X306.9
RS485 N
RS485 P
RS485 B X305.7
RS485 A X305.9
MODBUS RTU master (RS485)
vSECC
X301.19 TEMP_2
X301.20 TEMP_1
PT1000
PT1000
X301.17 AGND
X301.18 AGND
X301.1 0-10V 2
X301.3 AGND
V_OUT_SENSOR2
GND_SENSOR2
External sensor with voltage output
X301.2 0-10V 1
X301.5 AGND
V_OUT_SENSOR1
GND_SENSOR1
External sensor with voltage output
ETH1 Ethernet
PE1_ETH
Power Electronics
Reading and setting vSECC's GPIOs is possible using PEP WS messages setOutput and getInput.
ETH
MODBUS TCP client
Vector Informatik GmbH
Ingersheimer Str. 24
70499 Stuttgart / Germany
Tel: +49 711 / 80670 0
Web: www.vector.com
Sheet: /vSECC GPIO PEP WS/
File: vsecc-gpio-pep-ws.kicad_sch
Title: GPIOs with PEP WS and MODBUS bridge
Size: A4 Date: 2022-04-12 Rev: 1.0.0
Editor: Fabian Erat Id: 5/5

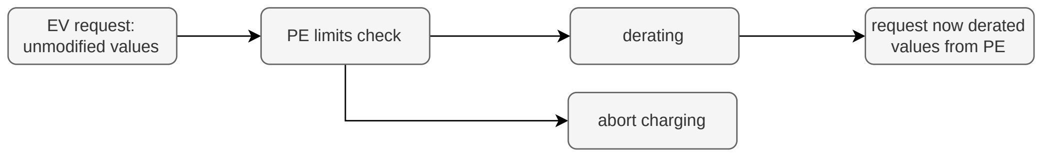
E Limits and Schedules

E.1 Limits and Schedules: Communication Sequence

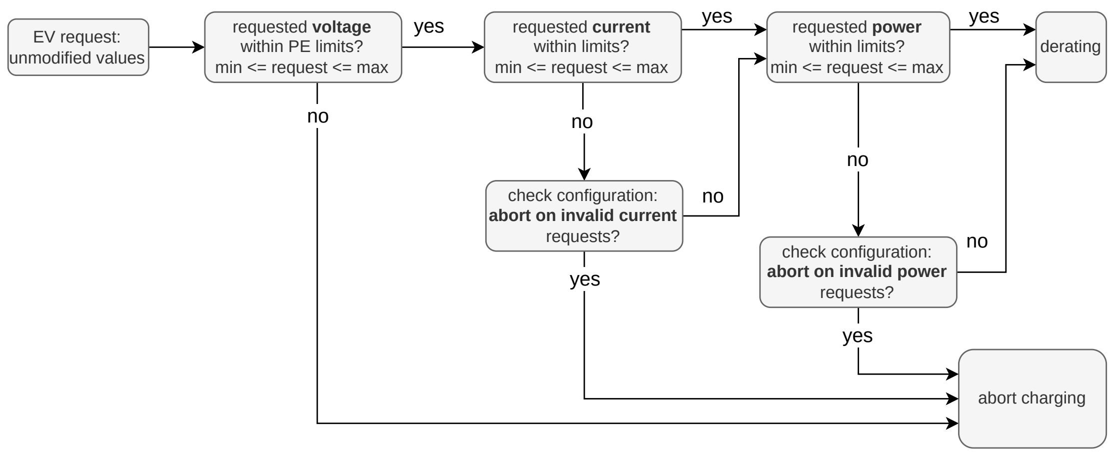


E.2 Limits and Schedules: Limits Checks and Derating

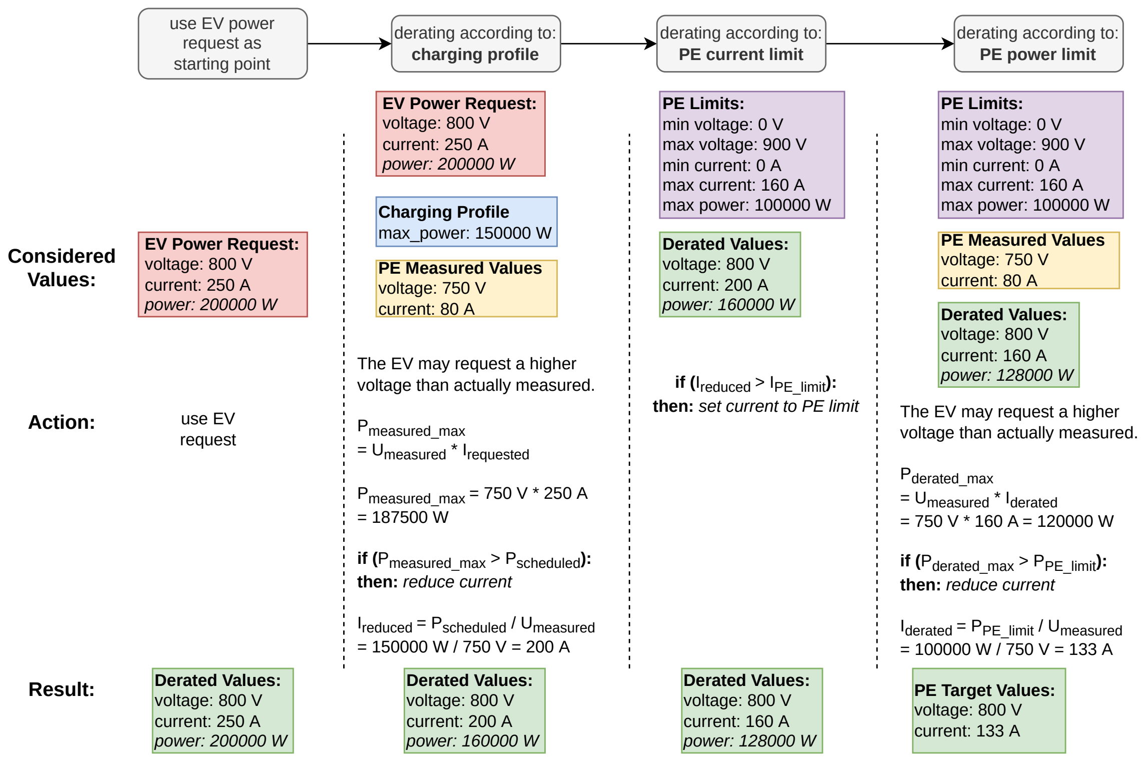
Compute Target Values Scheduled Control Mode: Overview



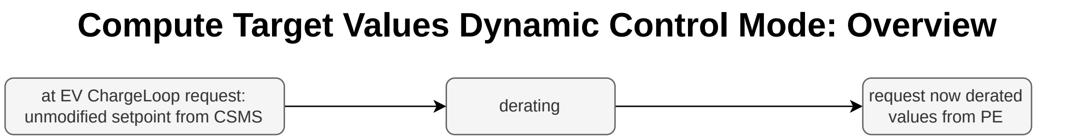
Compute Target Values Scheduled Control Mode: PE Limits Check

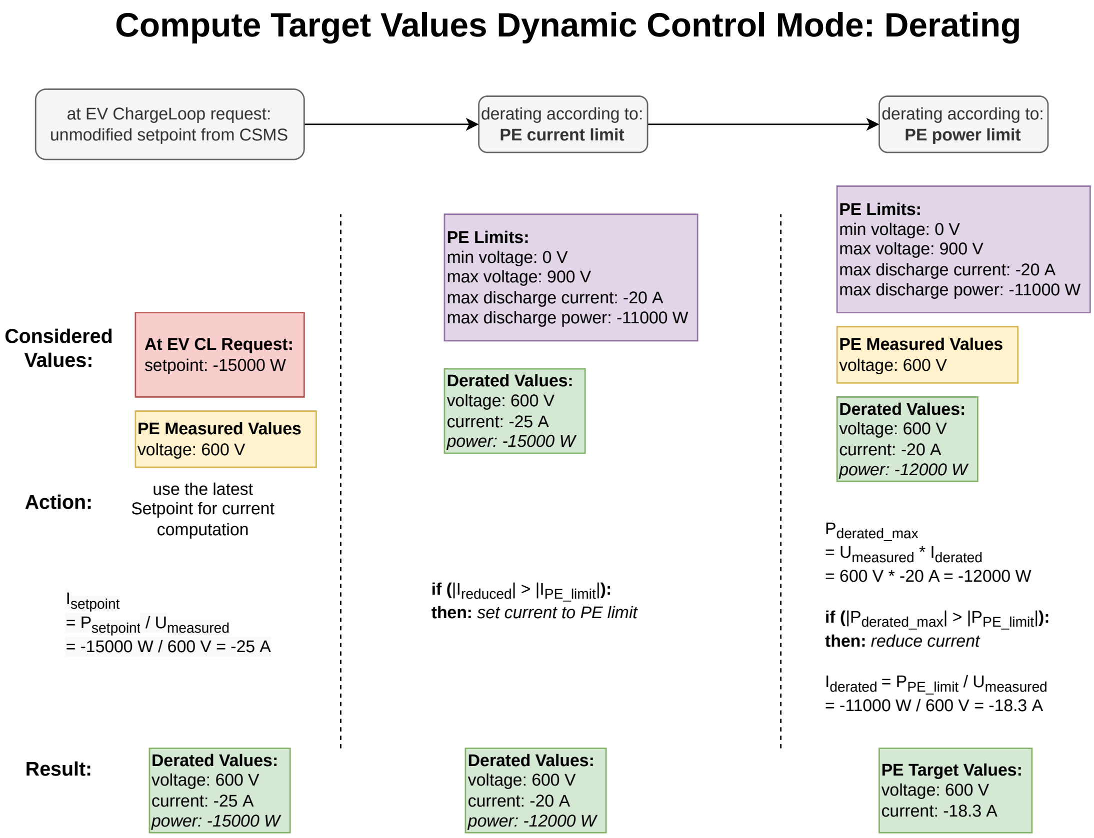


Compute Target Values Scheduled Control Mode: Derating



E.3 Limits and BPT Dynamic Control Mode: Limits Checks and Derating





F Restarting a Charging Session

Neither DIN SPEC 70121 nor ISO 15118-2 define a way for the EVSE to reinitialize a charging session after a previous one has already been completed, i.e., [V2G-DC-107], [V2G-DC-116], [V2G2-508] or [V2G2-728] happened.

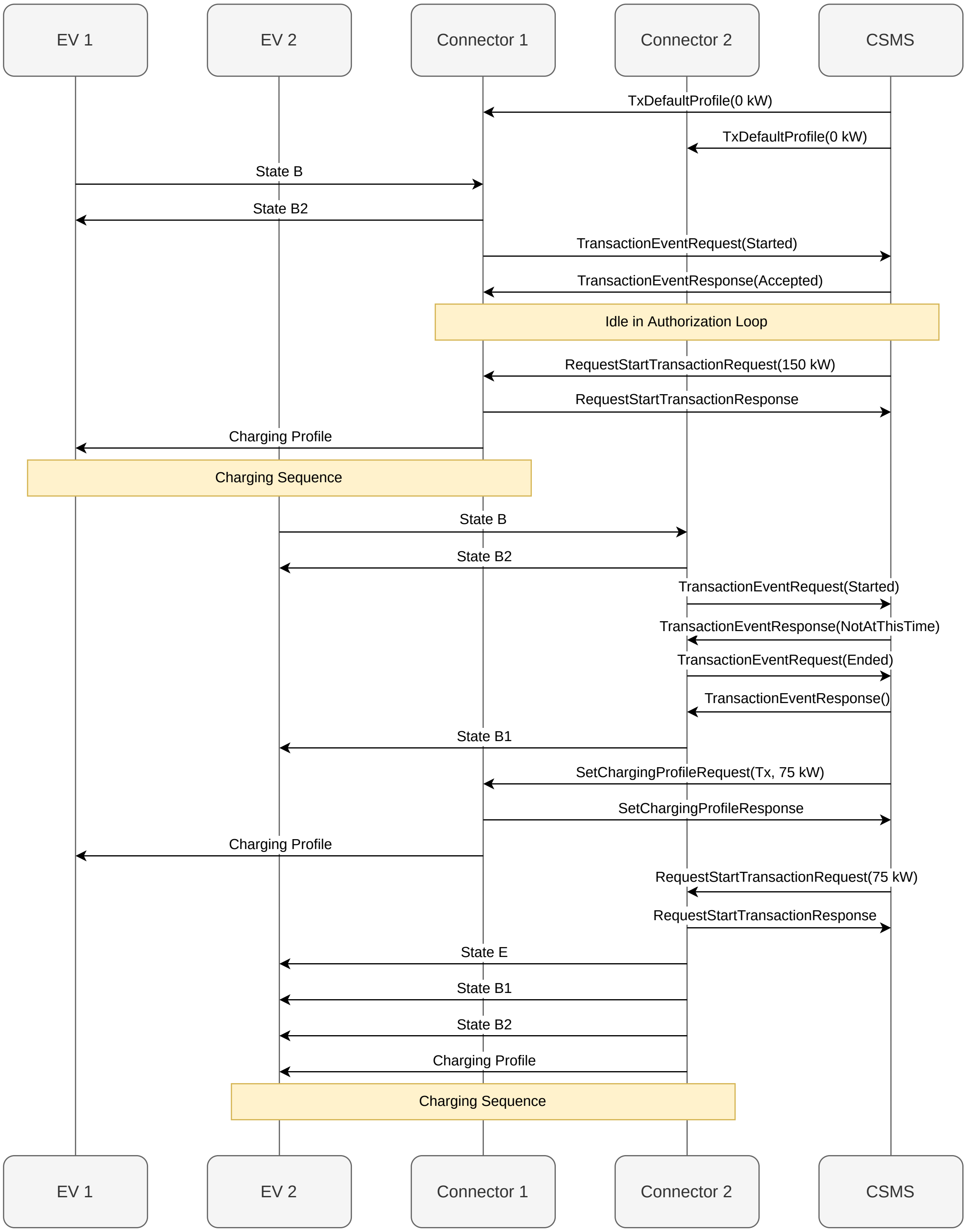
This severely restricts the flexibility, especially for DIN sessions. E.g., when implementing a charging pause or the OCPP *TransactionEventRequest(NotAtThisTime)* and its counterpart for waking up the EV.

Nevertheless, the vSECC Controller supports a way to achieve exactly this for most vehicles: By purposefully applying Control Pilot (CP) state E while the EV remains plugged in, the vehicle is signalled either a *plug-out* event (if it does not monitor the Proximity Pin) or a severe error condition. By reverting the CP state back to X1 (i.e., state B as long as the EV is still plugged in), the vSECC Controller signals the EV a *plug-in* event or the resolution of the error condition. Most EVs then try to (re)initialize a charging session.

Please see the subsequent sequence diagrams for an illustration of the following use-case: The TxDefaultProfiles for both connector 1 and 2 are set to 0 kW. The maximum available power is currently 150 kW. EV 1 connects and could charge with the whole 150 kW. While EV 1 is charging, EV 2 plugs in and the CSMS notifies the vSECC Controller that charging is currently not possible at connector 2 (*TransactionEventResponse(NotAtThisTime)*). EV 2 thus terminates its charging session and becomes idle. Then, after some time, the power served to EV 1 is reduced by half. Hence, more power is available and connector 2 is notified that the power limit is now 75 kW and an (OCPP) transaction should start. This results in the vSECC Controller executing a *BEB-Toggle* by applying CP state E, X1 and X2 (B1 and B2) which in turn signals the EV that a new charging session should start.

This scenario describes two EVs charging in parallel. A sequential charging could be achieved similarly, by first stopping session 1 (e.g., tiggered by the EV because the battery is fully charged) and then notifying the vSECC Controller about the newly available power at connector 2.

F.1 Sequence Diagram: Restarting a Charging Session



G MQTT gateway: Description of imports and exports

G.1 Exports

G.1.1 EVCCID

content	The EVCCID (vehicle identification string) the charging station received from the EV.
format	A string representing the EVCCID
topic	vsecc/connector/{evse_id}/ev/evccid
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.2 Measurement Control

content	The action to be executed by the energy meter.
format	One of ”stop_measurement”, ”start_measurement”, ”get_reading_signed”.
topic	vsecc/connector/{evse_id}/em/measurement_control
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.3 Measured Voltage

content	The voltage measured by the power electronics, given in volts.
format	A string representing the number, formatted as double with 6 decimal places, e.g., ”653.524559”.
topic	vsecc/connector/{evse_id}/pe/measured_voltage
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.4 Measured Current

content	The current measured by the power electronics, given in amperes.
format	A string representing the number, formatted as double with 6 decimal places, e.g., ”11.524559”.
topic	vsecc/connector/{evse_id}/pe/measured_current
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.5 Transaction ID

content	The OCPP transaction ID for current charging session.
format	The transaction ID, e.g., ”12af8962-dfbe-41ea-8038-b2eaf4754c7c”. Empty string if value is cleared or invalid.
topic	vsecc/connector/{evse_id}/ocpp/transaction_id
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.6 Authorization State

content	The authorization state for the given connector, identified by the evse_id. If unauthorized, an EV may connect but is not allowed to charge.
format	One of ”deauthorized” (EV not authorized), ”authorized” (charging authorized), ”pending” (authorization not completed, yet).
topic	vsecc/connector/{evse_id}/status/charging_authorization_state
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.7 EV Authorization Token

content	The authorization token that corresponds to the authorization status (published previously) for the given connector, identified by the evse_id.
format	The authorization token as string. Empty string if value is cleared or invalid.
topic	vsecc/connector/{evse_id}/ocpp/ev_authorization_token
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.8 Display Message Raw

content	Messages received over OCPP via SetDisplayMessageRequest.
format	Raw string representation of the OCPP payload.
topic	vsecc/display_message_raw

G.1.9 Tariff ID

content	If available: The tariff ID of the selected charging profile.
format	A string representing the tariff ID as number, formatted as integer, e.g., ”0”.
topic	vsecc/connector/{evse_id}/ev/tariff_id
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.10 EVSE ID String

content	Each charging point has a unique ID which must not be confused with the OCPP evse_id. This ID varies between used charging protocols and must be set by the charging point operator. In case of DIN 70121 charging, this ID is specified in DIN SPEC 91286. ISO 15118-2 charging specifies the ID format in Section H.2
format	The EVSEID as string, e.g., ”49*564543*01” (DIN) or ”DE*VEC*EOEC*S01” (ISO) or ”chademo” (CHAdeMO, no ’real’ ID is available with this charging protocol).
topic	vsecc/connector/{evse_id}/status/evse_id_string
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.11 Transferred Energy

content	If available: The transferred energy so far for the current OCPP Transaction. Is only available if the energy meter is NOT disabled (i.e. virtual or real). Values are computed from unsigned readings.
format	A string representing a meter reading, formatted as double with 6 decimal places, e.g., ”11.524559”. The unit is kWh.
topic	vsecc/connector/{evse_id}/em/transferred_energy
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.12 EV Error Code (EvErrorCode)

content	If available: The most recent EvErrorCode the vSECC got from the EV. Applies to ISO-2 and DIN only. The actual strings may be subject to change in the future.
format	The raw string given by the lib.CCS, e.g., ”VSECCLIB_DC_EVERROR_CODE_TYPE_NO_ERROR”. Published only if the error code has changed.
topic	vsecc/connector/{evse_id}/ev/ev_error_code
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.13 Control Pilot (CP) State

content	If available: The most recent CP state of the respective connector. The actual strings may be subject to change in the future.
format	One of ”state_a”, ”state_b”, ”state_c”, ”state_d”, ”state_e”, ”state_f”, ”state_invalid”. Published only if the CP state has changed.
topic	vsecc/connector/{evse_id}/ev/cp_state
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.14 State of Charge (SoC)

content	If available: The current battery state of charge (SoC) of the EV.
format	A string representing a percentage, formatted as integer, e.g., ”43”.
topic	vsecc/connector/{evse_id}/ev/soc
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.15 Time To Full SoC

content	If available: The remaining time until the currently charging EV has reached its full state of charge (SoC).
format	A string representing the time in seconds, formatted as integer, e.g., ”534”.
topic	vsecc/connector/{evse_id}/ev/time_to_full_soc
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.16 Charging Session State

content	The standard-specific state the charging process is currently in. The actual strings may be subject to change in the future.
format	A string representing the state, e.g. ”ChargeParameterDiscovery”.
topic	vsecc/connector/{evse_id}/status/charging_session_state
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.17 Charging Standard

content	The charging standard used in the currently running charging session. It is published at the beginning of a charging session.
format	One of ”iso15118_2”, iso15118_20, din70121 , ”chademo”, ”oppcharge”.
topic	vsecc/connector/{evse_id}/status/charging_standard
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.18 OCPP Connection Status

content	The connection status to the CSMS of the vSECC. Published on change.
format	One of ”disconnected”, ”connecting”, ”connected, ”error_on_write”, ”error_on_connection”, ”error_on_handshake”, ”error_on_read”.
topic	vsecc/ocpp_connection_status

G.1.19 Digital Out

content	Set the specified digital out port.
format	”1” for logical high, ”0” for logical low.
topic	vsecc/io/d_out/{d_out_id}/value
topic_parameter	**d_out_id**: The digital out port to be set.

G.1.20 Active Failures

content	Summary of the active failures across all components of the specified EVSE.
format	CSV list of strings, e.g.: [”Failure1”,”Failure2”]. Empty list if no failure exists: []
topic	vsecc/connector/{evse_id}/status/components/active_failures
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.21 Availability

content	Availability of the specified EVSE
format	”operative” if the EVSE is available, ”inoperative” otherwise.
topic	vsecc/connector/{evse_id}/status/availability
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.22 Component Failure

content	Active failure of a component
format	Descriptive string of the failure state, e.g. ”pe_inoperative”.
topic	vsecc/connector/{evse_id}/status/components/report_failure
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.23 Component Failure Resolution

content	Resolved failure of a component
format	Descriptive string of the resolved failure state, e.g. ”pe_inoperative”.
topic	vsecc/connector/{evse_id}/status/components/report_resolution
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.1.24 Readiness

content	Status of the vSECC initialization. Is published right after boot-up when the vSECC is ready to process MQTT messages. Is published just before shutdown when the vSECC is not able to process MQTT messages anymore.
format	Either ”ready” after the initialization or ”shutdown” just before the shutdown is executed.
topic	vsecc/readiness

G.1.25 Firmware Version

content	The firmware version the vSECC is currently running. Is published once at startup.
format	A string representing the firmware version, e.g. ”2.8.1”.
topic	vsecc/firmware_version

G.1.26 Tariff Raw

content	The tariff as it has been set by the CSMS in the ’TariffFallbackMessage’ device model variable.
format	The string contained in the ’TariffFallbackMessage’ device model variable.
topic	vsecc/tariff_raw

G.1.27 Tariff

content	Tariff value extracted from the ’TariffFallbackMessage’ device model variable. Published only if extraction succeeded.
format	A string with the following format: ”<value> <currency>/kWh”, e.g. ”0.42 EUR/kWh”. Per default, <value> is a decimal value with a dot as decimal separator and two decimal places. <currency> is a 3 character currency code from ISO 4217. Depending on the configured regular expression, the actual format may differ.
topic	vsecc/tariff

G.1.28 Cost

content	Last received cost value from the CSMS for the selected connector. Continuously updated during a transaction. For additional info on the transaction subscribe to the topic vsecc/connector/evse_id/ocpp/transaction_id.
format	A string with the following format: ”<value> <currency>”, e.g. ”32.42 EUR”. <value> is a decimal value with a dot as decimal separator and two decimal places. <currency> is the 3 character currency code set in the ’Currency’ device model variable.
topic	vsecc/connector/{evse_id}/ocpp/cost

G.2 Imports

G.2.1 Measurement Status

content	The current measurement status of and reported by the energy meter.
format	Either ”running” or ”not_running”.
topic	vsecc/connector/{evse_id}/em/measurement_status
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.2.2 Signed Reading

content	A signed reading reported by the energy meter, e.g. after a control command ”get_reading_signed”.
format	An OCMF-like string with the following format: OCMF|<JSON1>|<JSON2>|”PUBKEY”:”<PUBKEY>” XOR the string ”NOT_SUPPORTED”.
topic	vsecc/connector/{evse_id}/em/signed_reading
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.2.3 Unsigned Reading

content	An unsigned reading reported by the energy meter. Unsigned readings are published in an interval of 10s.
format	A string with the following format, timestamp is given as explained in RFC3339: <Timestamp>|<Import reading>|<Export reading>
topic	vsecc/connector/{evse_id}/em/unsigned_reading
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.2.4 Energy Meter Log Entry

content	Log entries from the energy meter.
format	One log entry per MQTT message.
topic	vsecc/connector/{evse_id}/em/log
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.2.5 Digital In

content	The value of the digital IN port.
format	”1” for logical high, ”0” for logical low.
topic	vsecc/io/d_in/{d_in_id}/value
topic_parameter	**d_in_id**: The ID of the digital in port.

G.2.6 Analog In

content	The value of the analog IN port, unit is Volts (V).
format	Float value as string, e.g. ”1.253”.
topic	vsecc/io/a_in/{a_in_id}/value
topic_parameter	**a_in_id**: The IT of the analog in port.

G.2.7 Temperature In

content	The value of the temperature IN port, unit is Degrees Celsius (°C).
format	Float value as string, e.g. ”25.3”.
topic	vsecc/io/t_in/{t_in_id}/temperature
topic_parameter	**t_in_id**: The ID of the temperature IN port.

G.2.8 Temperature In Resistance

content	The resistance value of the temperature IN, unit is Ohms.
format	Integer value as string, e.g. ”3483”.
topic	vsecc/io/t_in/{t_in_id}/resistance
topic_parameter	**t_in_id**: The id of the temperature in port.

G.2.9 Component Failure

content	Signals that a failure state is active. EVSE will become unavailable. Must be resolved using the report_resolution topic to clear the failure.
format	Descriptive string of the failure state, e.g. ”display_connection_loss”. Must match the string of the report_resolution topic on clearing the failure.
topic	vsecc/connector/{evse_id}/status/components/report_failure
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.2.10 Component Failure Resolution

content	Signals that a failure state has been resolved. EVSE will become available once all failures have been cleared.
format	Descriptive string of the failure state, e.g. ”display_connection_loss”. Must match the string of the report_failure topic that caused the failure.
topic	vsecc/connector/{evse_id}/status/components/report_resolution
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.2.11 Reinit EV to start charging

content	Content is not used.
format	Content should be null.
topic	vsecc/connector/{evse_id}/preview/start_charging_reinit_ev
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

G.2.12 External authorization

content	Authorization token, token type, and token pre-authorization status
format	Content should be a JSON struct containing the ”idToken” (string), ”type” (string), and ”preauthorized” (boolean) fields. Preauthorized tokens are immediately considered authorized and will not trigger an AuthorizeRequest. The maximum length of the idToken is limited by the active OCPP version. For allowed values of ”type”, see IdTokenEnumType in OCPP 2.0.1.
topic	vsecc/connector/{evse_id}/preview/external_authorization
topic_parameter	**evse_id**: The evse_id the message corresponds to, e.g., ”1”.

H vSECC.single Input/Output MQTT Topics

The vSECC.single features I/O ports which are accessible through the MQTT bus. The following table depicts the mapping between port labels printed on the side of the vSECC.single housing, the vSECC.single Board's Samtec Connector Pins and signals, and the corresponding and alternative MQTT topics.

Please note: The connector description *X301* is ambiguous. A distinction must be made between the vSECC.single's connector and the vSECC.single Board's connector, both carry the same designation (X301). Refer to the following figures as well as Section 4 and 3. In the table below, the connectors located on the vSECC.single are called *Phoenix* Connectors. The connectors on the vSECC.single Board, however, are called *Samtec* Connectors.

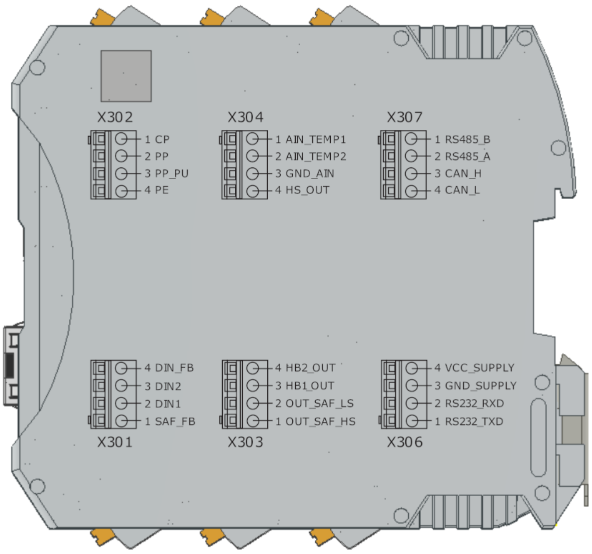


Figure 60: vSECC.single pinout printed on the side of the housing

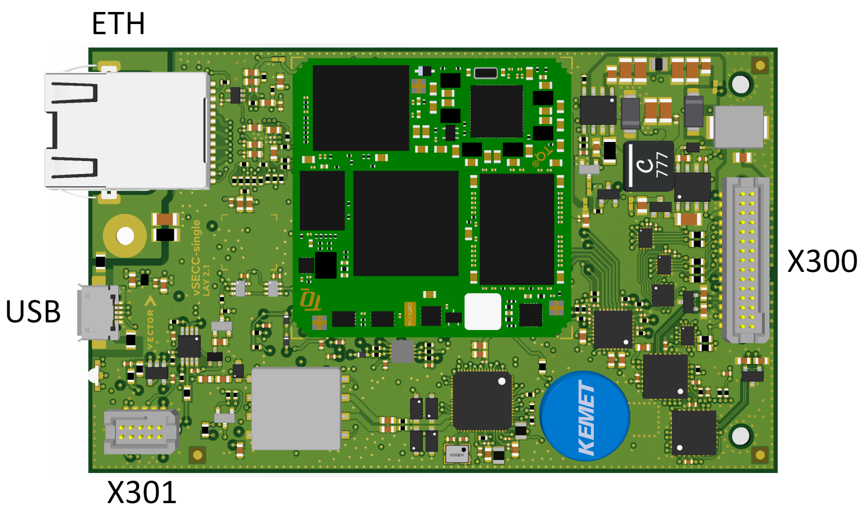
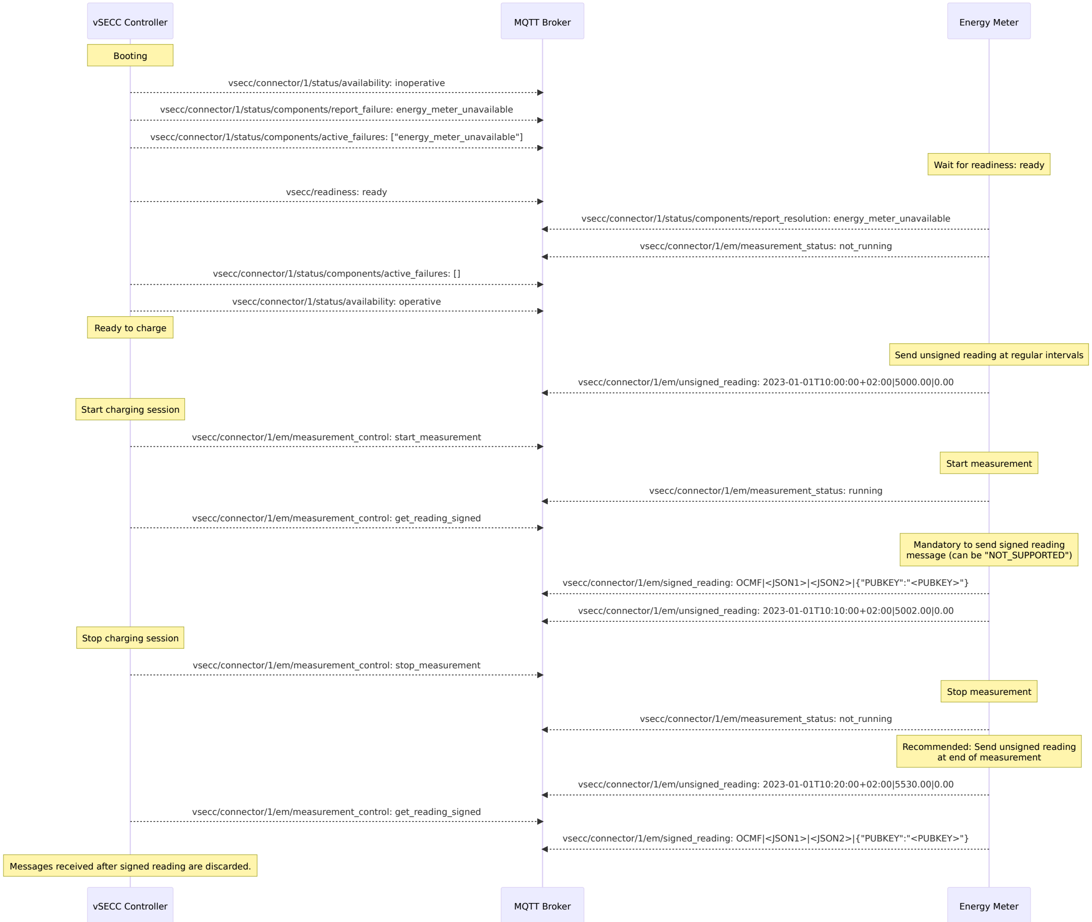


Figure 61: vSECC.single Board top view with designation of interfaces

Phoenix Connector	Phoenix X30x Pin	Housing Label	Samtec X300 Pin	Samtec X301 Pin	Signal Name	MQTT Topics
X301	1	SAF_FB	10		DIO5	vsecc/io/d_in/SAF_FB_IN/value vsecc/io/d_in/5/value
	2	DIN1	11		DIO6	vsecc/io/d_in/DIN1/value vsecc/io/d_in/6/value
	3	DIN2	12		DIO7	vsecc/io/d_in/DIN2/value vsecc/io/d_in/7/value
	4	DIN_FB	14		DIO9	vsecc/io/d_in/DIN_FB/value vsecc/io/d_in/9/value
X303	3	HB1_OUT	6		DIO1	vsecc/io/d_out/HB1_OUT/value vsecc/io/d_out/1/value
	4	HB2_OUT	9		DIO4	vsecc/io/d_out/HB2_OUT/value vsecc/io/d_out/4/value
X304	1	AIN_TEMP1		10	AIN_TEMP_1	vsecc/io/t_in/1/value vsecc/io/t_in/1/temperature
	2	AIN_TEMP2		9	AIN_TEMP_2	vsecc/io/a_in/2/value vsecc/io/t_in/2/temperature
	4	HS_OUT	15		DIO10	vsecc/io/d_out/HS_OUT/value vsecc/io/d_out/10/value

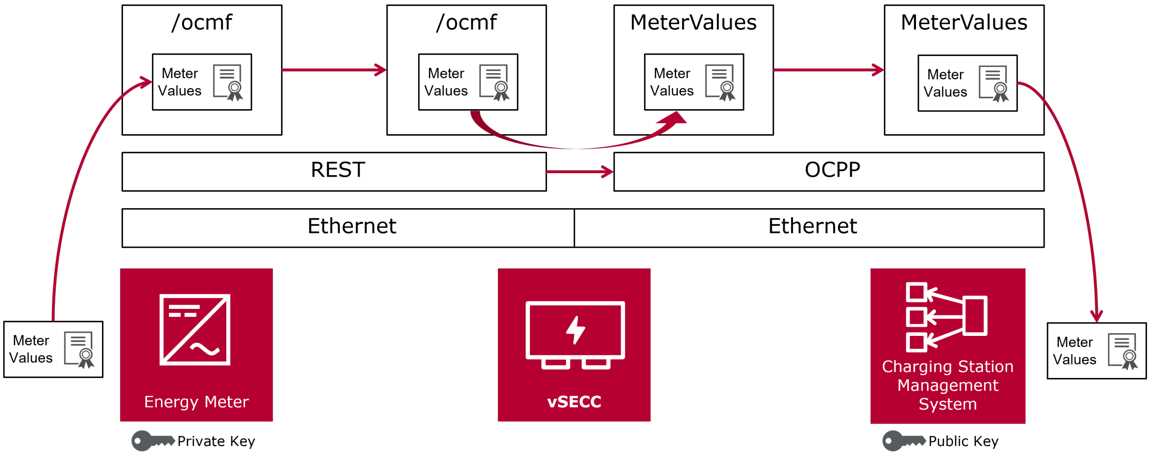
I MQTT Energy Meter Sequence



J Documentation for Eichrecht certification

J.1 Communication between the vSECC and the measuring capsule (”Schalt-Mess-Koordination”)

As the vSECC is not part of the measuring capsule, it interfaces to the energy meter via TCP/IP connection and a REST interface of the LEM energy meter. The back end connection is via OCPP.



A charging sequence compliant to Eichrecht is described in the following sequence diagram:

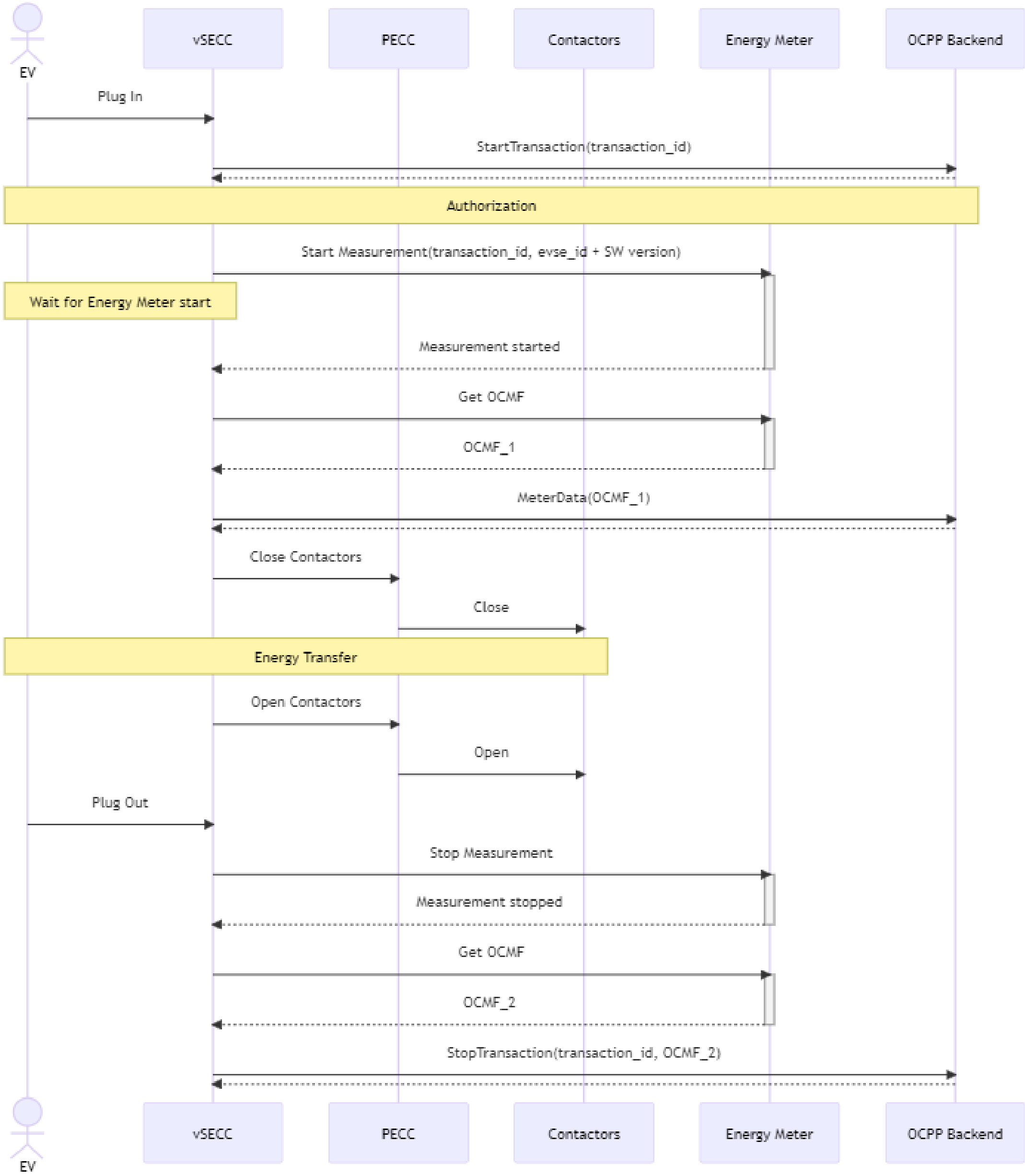


Figure 62: Schalt-Mess-Koordination

In case the OCPP connection is lost during a transaction, the OCMF readings are stored in the vSECC and retransmitted after the connection is restored.
The pagination counter of the LEM meter is part of the legal fields and increments after each read. A signed OCMF reading is requested at the start and end of each transaction.

J.2 Identification of the charge controller software

The vSECC Firmware version is sent to the Energy Meter in the ”evseId” field as part of the start command, as specified in the LEM document ”HOW to FULFILL OCMF FIELDS from 28/11/2022”. An example for a start command: `{"evseId":"49*564543*01, v2.7.5", "transactionId":"e5c8eafe-af51-4790-83e1-cfdd69d64ebd", "clientId": "020000000001", "tariffId":0, "cableId":0, "userData":""}`

K Glossary

Autocharge Procedure to authenticate and to authorize a vehicle automatically at a charging station. The EVCC ID of the vehicle is used as identifier. The Combined Charging System (CCS) standard is required, since the EVCC ID is exchanged via V2G communication (DIN SPEC 70121 or ISO 15118). The recommended integration with OCPP is described in the Whitepaper “WhitePaper Identification of Electric Vehicles in Charging Station Management System via OCPP” published by Vector, which can be found in the Downloads Section.

Certificate Authority In cryptography, a certificate authority (CA) is an entity that issues digital certificates. A CA acts as a trusted third party, which is trusted both by the subject (owner) of the certificate and by the party relying upon the certificate. A CA is required e.g. for TLS and PnC Certificates.

Charging Station The term charging station describes a physical system where an EV can be charged. Each vSECC Controller corresponds to one charging station.

CHAdeMO is a DC charging standard for electric vehicles. It enables seamless communication between the car and the charger via CAN communication. Since the standard was developed in Japan, it is applied mainly by Japanese and North-American car manufacturers.

Combined Charging System is an open, universal and international charging system for electric vehicles based on international standards. The CCS combines single-phase with fast 3-phase AC charging using alternating current of maximum of 43 kW. It also provides very fast high-power DC charging within a single system. The CCS system includes the connector, the managing of control functions and the charging communication between electric vehicle and infrastructure over Powerline Communication.

Connector The term connector describes an electrical outlet on a charging station. It is connected to a single EVSE. An EVSE can have multiple connectors attached to it, e.g. one CCS and one CHAdeMO compliant outlet. However, an EVSE will always use only one of its connectors exclusively.

Control Pilot See chapter 2.2.5 for more information.

External Identification Means Any external means that enable the user to identify, authenticate and authorize his contract or the EV for a charging session at the charging station, e.g. an RFID card.

Electric Vehicle Supply Equipment is defined by its ability to deliver energy to one EV at a time. A charging station can be connected to one or more EVSEs.

GB/T The Guobiao standard 27930 for AC and DC charging was developed for charging of Chinese EVs. As CHAdeMO, the communication takes place via CAN.

High Level Communication is specified in the ISO 15118 series as a bi-directional digital communication using protocols, messages and physical and data link layers.

Load Leveling enables the prevention of overloading the charging infrastructure by calculating the maximum power that is distributed from the charging stations to the vehicles.

Plug and Charge Identification mode where the customer just has to plug his electric vehicle into the EVSE and all aspects of authentication, authorization, load control and billing are automatically taken care of with no further intervention from the customer.

Smart Charging The term smart charging is used for charging systems of electric or hybrid vehicles according to ISO 15118, DIN SPEC 70121, SAE J2847/2. The communication between vehicle and charging station is realized in two ways:
1) As powerline communication via the control pilot pin in the form of a PWM signal and a digital signal for HomePlug-GreenPhy standard.
2) Wireless in case of inductive charging.

Value Added Services allow additional information, which is not directly needed for the pure charging of the EV, to be exchanged via separate communication channels such as HTTP, HTTPS, FTP. The to-date most prevalent VAS is the Preconditioning of buses, which is standardized by VDV261.

L Abbreviations

AC	Alternating Current
CA	Certificate Authority
CCS	Combined Charging System
CP	Control Pilot
CSMS	Charging Station Management System
DC	Direct Current
ECU	Electronic Control Unit
EIM	External Identification Means
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
GUI	Graphical User Interface
HVDC	High Voltage Direct Current
HMI	Human Machine Interface
OCPP	Open Charge Point Protocol
PE	Protective Earth
PE(P)	Power Electronics (Protocol)
PECC	Power Electronics Communication Controller
PLC	Power Line Communication
PnC	Plug and Charge
PP	Proximity Pin
SECC	Supply Equipment Charge Controller
TLS	Transport Layer Security
UI	User Interface
URI	Uniform Resource Identifier
VAS	Value Added Service

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