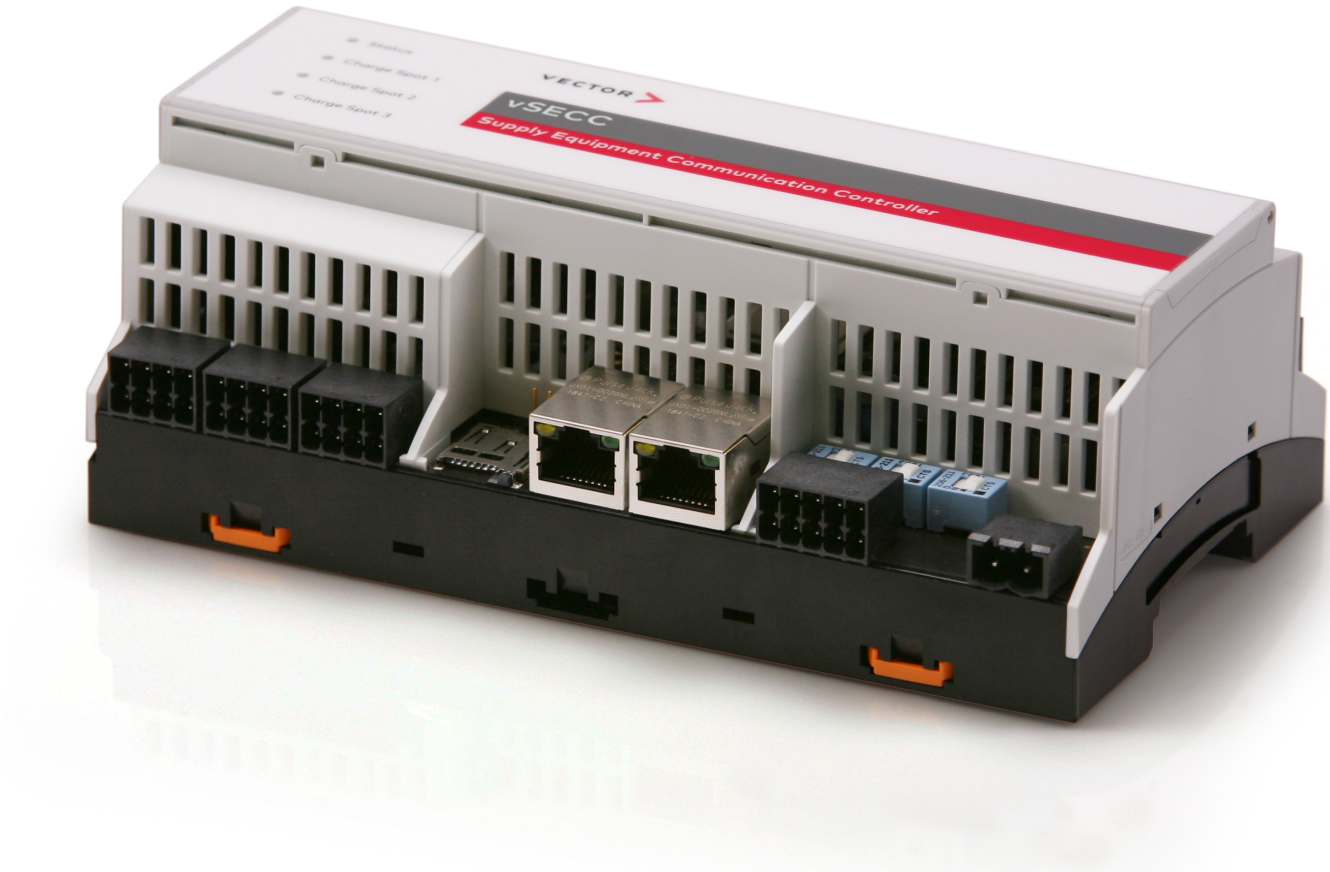
VECTOR



User Manual
vSECC
Supply Equipment Communication Controller

Version 1.2.0

Contents

Version History

Version	Date	Author	Description
v1.0	2020-01-30	Fabian Erat	Initial version
v1.1	2020-04-07	Fabian Erat	Switched template
v1.2	2020-08-21	Rebekka Haisch	Updated documentation for ECU Release 1.2.0
v1.3	2020-10-15	Rebekka Haisch	Included CE Document

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, special emphasis of terms **[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

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 9001:2010. The ISO standard is a globally recognized standard.

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.

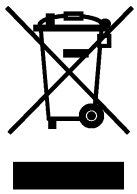
1.1.5 Service, Support and Disposal

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.

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 Controller vSECC is used for communication between the charge controller of the vehicle to be charged and the supply equipment via the charging cable and Type 2 CCS 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 product must always be assembled during operation.
The device may only be used with appropriate connectors. The connectors of the vSECC 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 contains 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 device 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.

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 does not comply with the directive 2014/34/EU and must therefore not be used in explosion critical areas. Installation in mobile equipment or operation 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 functionality and must be assured independently by suitable measures such as insulation monitoring, residual current detection, overload protection and circuit breaker. The vSECC 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 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 at a Glance

The vSECC is a Supply Equipment Communication Controller (SECC) designed to be used in smart DC charging applications. AC charging will follow at a later release. The vSECC is responsible for the communication between an Electric Vehicle (EV), a Charging Station Management System (CSMS) and the power electronics (PE). It is designed for handling up to two CCS Type 2 DC charging points in parallel. In a later release it will be possible to use a CHAdeMO or GB/T connector as the second charging point or CCS Type 1 and AC connectors. All the future options will be available via a pure software update. The large number of practical interfaces makes the vSECC a widely applicable controller for the rapid implementation of intelligent charging stations. A top-level connection scheme is shown in Figure 1.

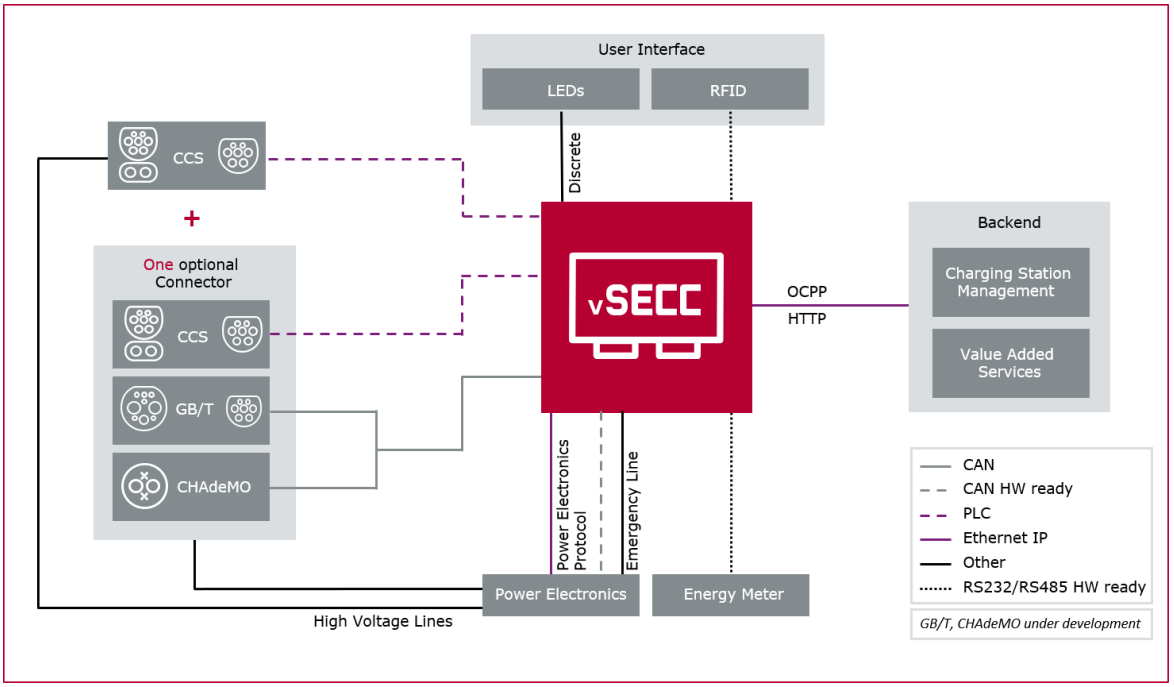


Figure 1: vSECC connection scheme

The communication to the EV is established by Control Pilot (CP) basic signaling (IEC 61851) and Power Line Communication (PLC) for DC charging according to DIN 70121 and ISO 15118. The identification at the charging station is possible with External Identification Means (EIM) and Autocharge. Plug and Charge will be released at a later stage and can optionally be upgraded with a software update. For the communication to the backend e.g. for load management, vSECC requires an Open Charge Point Protocol (OCPP) 2.0.1 compliant CSMS, such as Vector's vCharM. The vSECC is designed to communicate with the power electronics over ethernet using the Power Electronics Protocol (PEP) which is specified by Vector and will be delivered along the controller.
The hardware overview shown in Figure 2 in chapter 2.2 includes all connectors available with the fully populated vSECC. The units provided with this vSECC 1.0 are partly populated, so some connectors may be missing or are rendered useless because the corresponding circuits are not in place. With the current version of the vSECC, the following connectors can be used:

- X300: Charge Connector (currently not populated)
- X301: Analog Inputs (e.g. Temperature Sensors)
- X302: CCS Charging Connector 2
- X303: CCS Charging Connector 1
- X304: Safety Outputs
- X305: Serial Communication (RS232, RS485, 2x CAN, currently not populated)
- X306: Digital In-/Outputs
- X307: Power Supply
- ETH1: RJ45 Ethernet Connector 1
- ETH2: RJ45 Ethernet Connector 2

The connectors are described more in detail in chapter 2.2.

1.4 vSECC Features

1.4.1 CCS Type 2 DC charging

- IEC 61851 Control Pilot for basic communication
- DIN 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 (sent via OCPP interface)
- No authentication and no payment details
- Realization of ChargingSchedules in charging station as PowerMaxLimit set
- IEC Control Pilot is only used for setting up High Level Communication

1.4.2 Hardware IEC CP/PP supervision

- 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

1.4.3 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

1.4.4 Firmware Update

- Firmware updates according to OCPP 2.0.1 use case L02
- Supported download methods: HTTP/HTTPS
- Secure firmware images (accepts only signed updates)

1.4.5 Logfile Upload

- Logfile upload according to OCPP 2.0.1 use case N01
- Supported upload methods: HTTP/HTTPS
- vSECC notifies the CSMS of the current upload status

1.4.6 CSMS connectivity (OCPP)

- Supported CSMS protocols: OCPP 2.0.1
- Websocket based connection according to OCPP 2.0.1: Part 4 – JSON 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
- It is possible to update the charging station password (OCPP 2.0.1 use case A01)
- 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)
- Is it possible to authorize a driver using a start button and ISO 15118 External Identification Means (EIM) (OCPP 2.0.1 use cases C02 and C08)
- 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 – E01, E04, E06, E08 – 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)
- It is possible to send transaction related meter values (OCPP 2.0.1 use case J02)
- It is possible to perform General Smart Charging (OCPP 2.0.1 use cases K01 – K02, K06 – K07)
- 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 protocol
- It is possible to support vendor-specific OCPP messages (OCPP 2.0.1 use cases P01 – P02)
- Any non-supported messages are rejected

1.4.7 Power electronic control via Vector PEP

- Connection to power electronic via physical ethernet
- Communication based on websocket connection with JSON data exchange
- Usage of Vector’s PEP 1.2

1.4.8 AutoCharge for identification of vehicles

> Pre-stage to Plug and 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 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

1.4.9 Webbased Device Configuration

> The vSECC can be configured via a local web frontend
> The vSECC runs a HTTP server that allows accessing the web based configuration via ethernet interfaces and a normal web browser

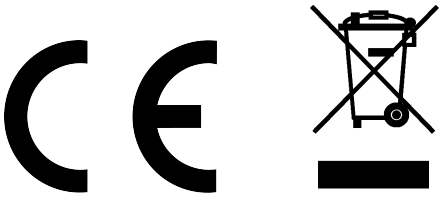
1.5 Scope of Delivery

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 informations are listed.

CE



FCC

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.

KC

R-R-VeC-vSECC

Company Name:	Vector Informatik GmbH
Product Name:	Supply Equipment Communication Controller
Model Name:	vSECC
Manufacturer:	Vector Informatik GmbH
Country of Manufacture:	Germany
Date of Manufacture:	11-2020

1.6.1 Europe

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)

CE

The manufacturer

Vector Informatik GmbH
Ingersheimer Straße 24
70499 Stuttgart

herewith declares that the following product
vSECC Supply Equipment Communication Controller (Art. Nr. 20006)
complies with the essential requirements of the above directives, when used for its intended purpose. The sole responsibility for issuing this Declaration of Conformity is with Vector.

The following harmonized standards have been applied:

IEC 61851-21-2:2018 *Electric vehicle conductive charging system – Part 21-2: Electric vehicle requirements for conductive connection to an AC/DC supply – EMC requirements for off-board electric vehicle charging systems*

IEC 61000-4 *Electromagnetic compatibility (EMC), specifically the parts*
IEC 61000-4-2 : 2008, IEC 61000-4-3 : 2006 + AMD1: 2007 + AMD2: 2010, IEC 61000-4-4 : 2012, IEC 61000-4-5 : 2014 + AMD1: 2017, IEC 61000-4-6 : 2013, IEC 61000-4-8 : 2009, IEC 61000-4-11 : 2004 + AMD1: 2017

Place: Stuttgart
Date: 2020-09-30

Managing Director Dr. Thomas Beck

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Handelsregister Stuttgart HRB 17317

Geschäftsführer:
Dr. Thomas Beck
Thomas Riegraf

1.6.2 Korea

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

Director General of National Radio Research Agency

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

2 Installation Guide

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

Figure 2 shows the vSECC from above. Each connector is described in detail below.

Figure 2: vSECC connector overview

2.2.1 X300 - CHAdeMO, GB/T

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

Figure 3: vSECC connector: X300

This connector 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 4: vSECC connector: X301

This connector is used for both analog input signals and external temperature sensors. See section 3.7.3 and 3.7.4 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 5: vSECC connector: X302

This connector is used for CCS Charging at charging port 2. Only DC-charging is supported yet which requires the following pins:

> 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.

> Pin 6, PP2: Proximity Pin. 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

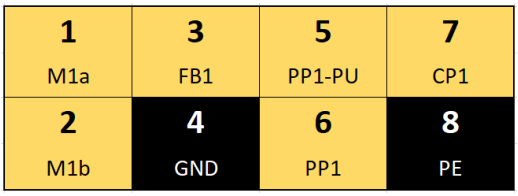

Figure 6: vSECC connector: X303

This connector is used for CCS Charging at charging port 1. Only DC-charging is supported yet which requires the following pins:

> 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.
> Pin 6, PP1: Proximity Pin. 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 7: 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 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)
- 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.

Safety Outputs: Loss Detection, Control Pilot 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 (EV) which sets a specific Control Pilot (CP) state. Four state categories exist: Ax, Bx, Cx and Dx. Energy transfer is allowed only in state categories Cx and Dx.
In order to enforce this, vSECC provides a logical output called *CP supervision*. This output controls the power electronics’ ability to energize its outlet. Conceptually, a logical AND conjunction exists in the power electronics between power electronics communication controller (PECC) control input and CP supervision: The power electronics is able to close its contactors if and only if the CP supervision allows it, i.e., the CP state category is Cx or Dx. See Figure 2.2.5 for an illustration of this principle.

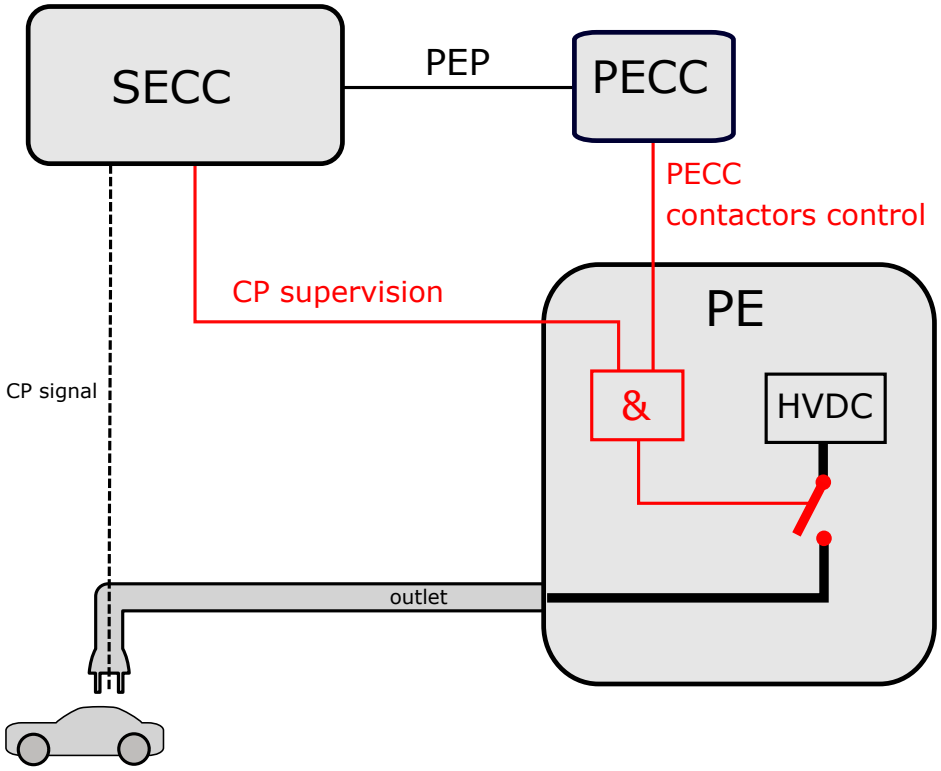

Figure 8: vSECC safety output

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

2.2.6 X305 - CAN

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 9: vSECC connector: X305

This connector will be used for planned features coming with future software releases.

2.2.7 X306 - Digital In and Digital Out Connectors

1 REL1b	3 DIN7	5 DIN5	7 DIN3	9 DIN1	11 OUT15	13 OUT13	15 OUT11	17 OUT9	19 OUT7	21 OUT5	23 OUT3	25 OUT1
2 DIN8	4 DIN6	6 DIN4	8 DIN2	10 OUT16	12 OUT14	14 OUT12	16 OUT10	18 OUT8	20 OUT6	22 OUT4	24 OUT2	26 REL1a

Figure 10: vSECC connector: X306

This connector is used for both digital input and digital output signals. See section 3.7.2 and 3.7.1 for details and a mapping of PEP-identifiers to connector pins.

> Pin 1 (REL1b) outputs 24V.

> Pin 26 (REL1a) is the ground pin (GND).

2.2.8 X307 - Power Supply Connector

1 Sup GND	2 Sup 24V

Figure 11: vSECC connector: X307

This connector is used for the supply voltage of 24 V. The current drawn is below 200 mA, so providing at least 200 mA should be sufficient.

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 (Backend)

This connector is used to connect network entities such as a Charging Station Management System (CSMS/Backend) or the Power Electronics Communication Controller (PECC) to the vSECC.

2.2.10 ETH2 - Ethernet 2

This connector is used 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

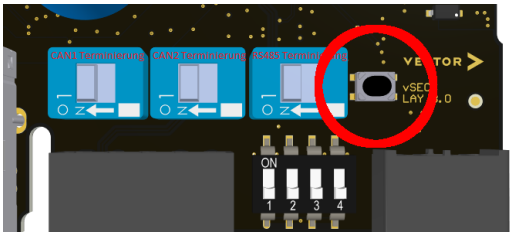

Figure 12: vSECC reset button in the lower right corner (top view)

This button is used to reset the configuration to the factory defaults. See Section 4.1 for details.

The vSECC version 1.2 does not support this functionality.

2.3.2 DIP Switches

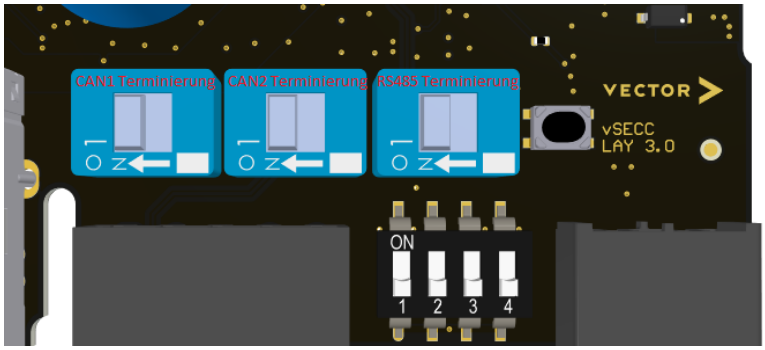

Figure 13: vSECC connector: DIP Switches

In the lower right corner, right above connextor X305 and X307, DIP switches allow the configuration of some vSECC functionality. 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 could be deactivated for some of the functions. If a function supervision has been deactivated, it is not considered for the result provided at the respective safety output.
Proximity Pin inputs are not always necessary. Hence, their supervision could be deactivated.
A supervision is deactivated by flipping the respective switch to the ”ON” position (upwards).

- 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 backend URI. Please use the Web-UI or an already connected CSMS to configure the vSECC (see Section 3.1). 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. Connect the ETH1 ethernet port to an ethernet network providing DHCP. This allows the configuration of the vSECC via the Web-UI.
5. Connect the X307 power supply connnector. Take care of the correct polarity. Ensure that 24 V and at least 200 mA are provided.

The vSECC starts up as soon as the power supply is connected. The System LED (see Section 4.3) blinks green as long as the startup 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.
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 1, 2, 3 and 4 to the ”ON” position. This disables the PP1, PP2, CC1 AC and CC1 DC loss detection. Note that the Proximity Pin (PP) is not yet supported, but will be in a future release.
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. See Section 3.7 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 200 mA are provided.

After the vSECC has started up, set the correct power electronics URI for both connectors using the Web-UI 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-UI (see Section 3.1.1) to set the correct backend 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 200 mA are provided.

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

3 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, install the Root CAs, download log files and update the firmware.

3.1 Configuring the vSECC

The vSECC 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.

3.1.1 Web Interface Configuration

To connect to the configuration web interface, open a web browser and enter the vSECC's IP address (e.g. http://192.168.3.11). This will take you to the landing page as shown in Figure 14. 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 15.

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

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

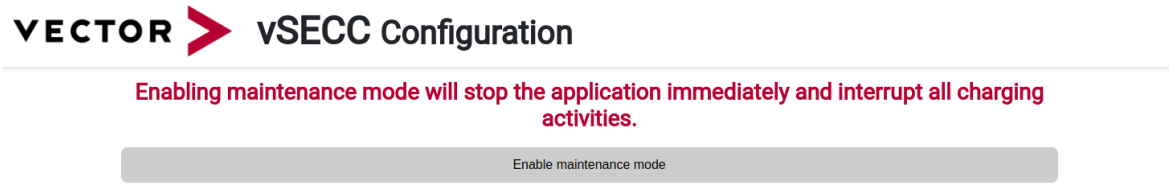

Figure 14: Maintenance Mode Off

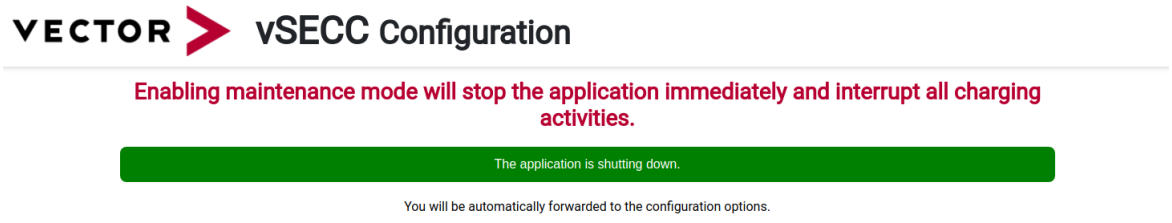

Figure 15: Waiting for Shutdown

After the application has shut down, you will enter the maintenance mode as shown in Figure 16.
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 application. This will take you back to the view shown in Figure 14. Pushing [Reboot vSECC] causes a reboot of the whole system.

Rebooting the system may take up to two minutes.

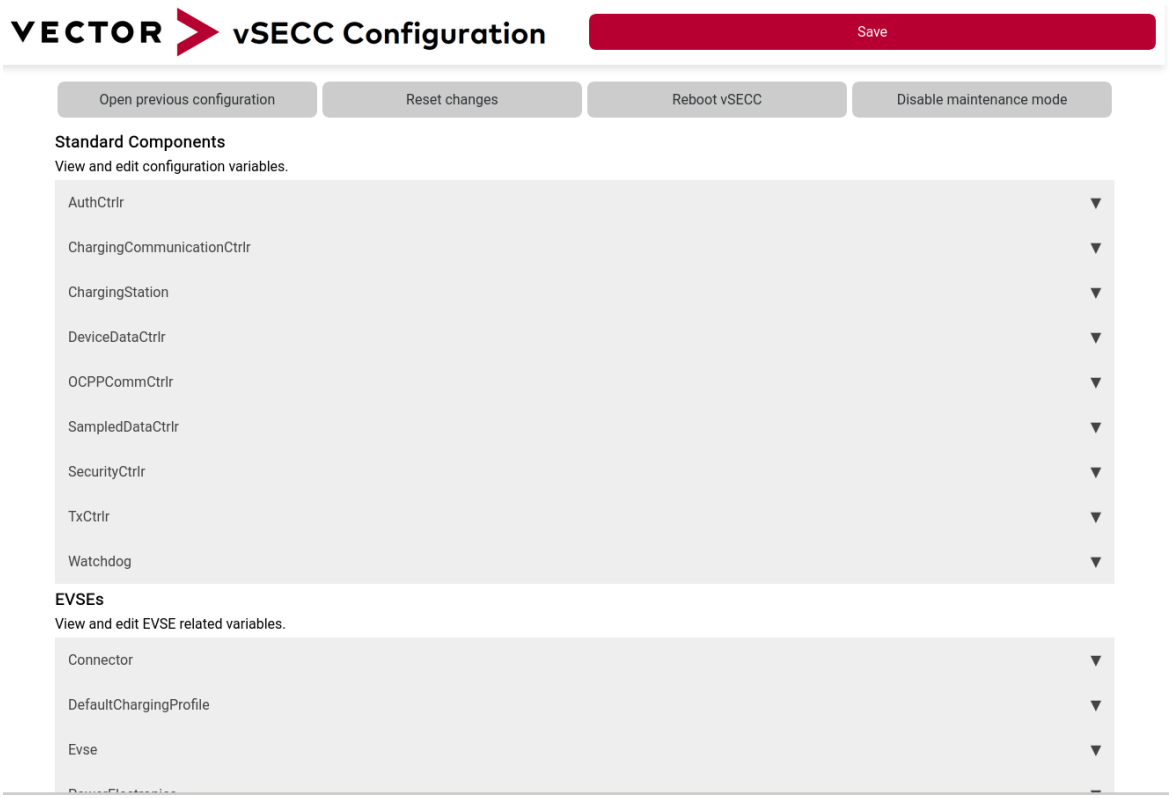

Figure 16: Maintenance Mode On

Use the [Save] button in the upper right corner to save your changes to the configuration. Pushing the [Open previous configuration] button will load the previous configuration into the current view, allowing you to easily compare settings between firmware updates. You can press the [Save] button to apply the displayed previous configuration. To reset the configuration to factory defaults, press [Reset changes]. Be aware that resetting to factory defaults will permanently overwrite all custom changes made before. Other than the described buttons, the view also contains four more sections:

- Standard Components
- EVSEs
- Log Files
- Certificate upload

The ”Standard Components” section contains configuration variables which apply to the entire vSECC application, such as the address of the CSMS. Chapter 3.5 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. The ”Certificate upload” section allows installing additional Root-CAs on the vSECC.

3.1.2 OCPP Configuration

As an alternative to the web interface, the vSECC can also be configured by using a CSMS. To initially connect to a CSMS, you must specify the CSMS's URI in the vSECC's configuration using the web interface. The corresponding variable is called ”BaseUri” and can be found inside the ”ChargingStation” section as seen in Figure 17.

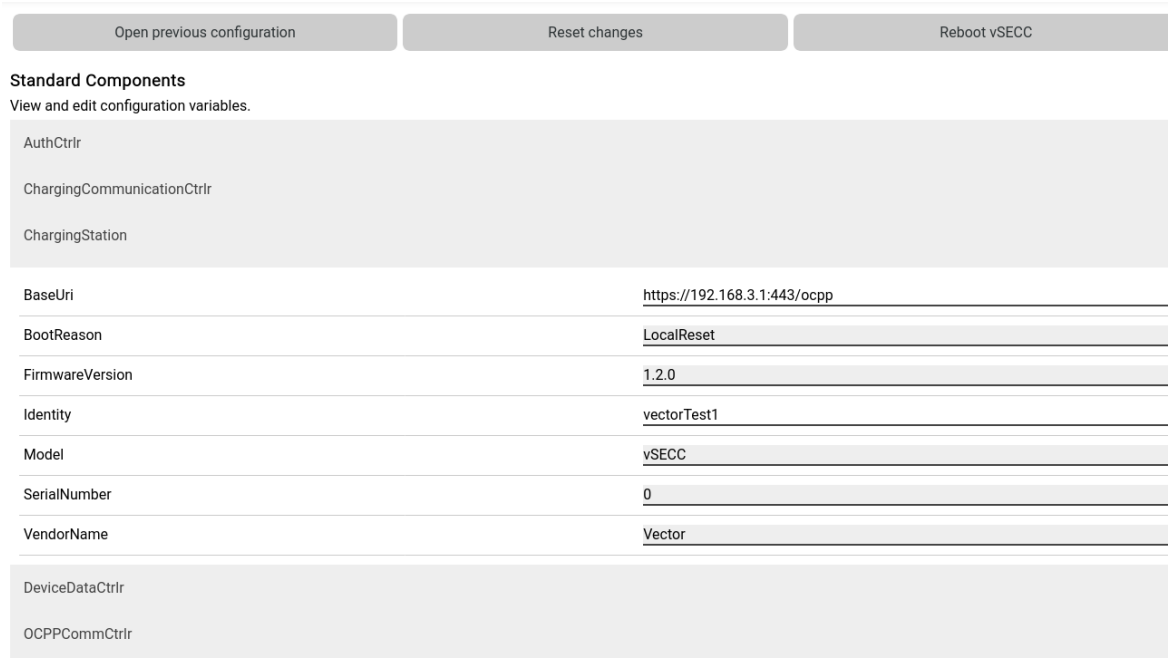

Figure 17: Variable ”BaseUri”

The vSECC uses the OCPP messages ”SetVariables”, ”GetVariables” and ”GetBaseReport” for configuration data exchange with the CSMS. For further information about the structure and usage of those messages, please refer to the OCPP 2.0.1 Part 2 - Specification document.

Inside Vector's CSMS solution vCharM for example, the vSECC's variables are presented as shown in Figure 18. The information about the available variables is gathered automatically when the vSECC establishes its connection. Changes to any variables are sent to the vSECC, where they are validated and then applied to its configuration.

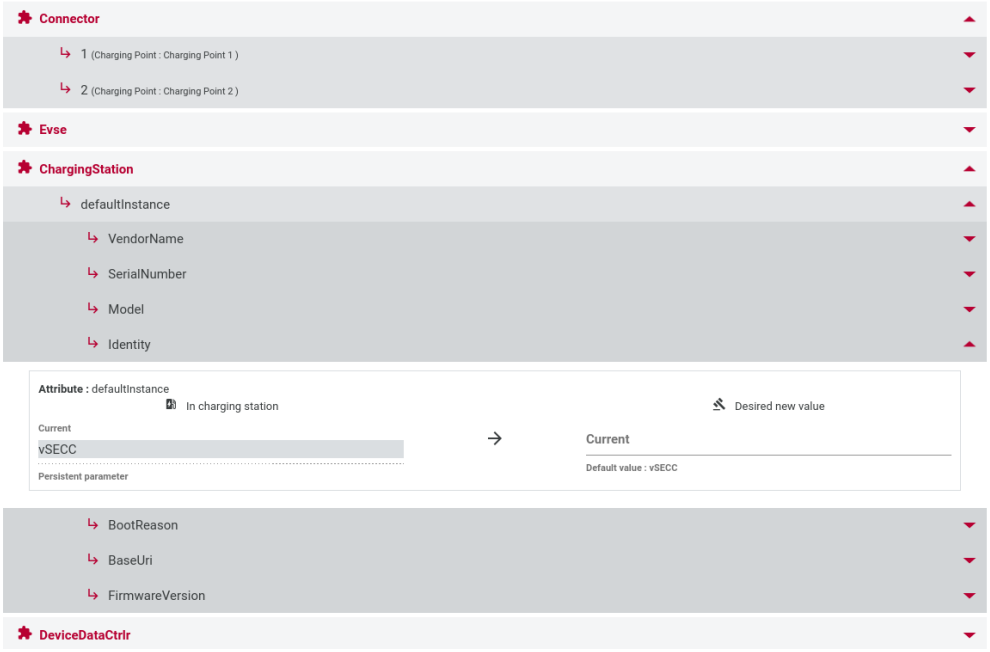

Figure 18: vCharM Charging Station Configuration

3.2 Installing Root Certificate Authorities (CAs)

When connecting to a CSMS using a secured TLS connection, the vSECC uses its installed root certificate authorities (Root-CAs) for verifying the server's certificate chain. The vSECC 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 into maintenance mode as desribed in chapter 3.1.1. Head over to the ”Certificate upload” section as seen in Figure 19. Then press the [Browse...] button to select a certificate you would like to install. Pressing the [Upload] button finishes the installation of the certificate. The changes take effect after the next reboot of the system.

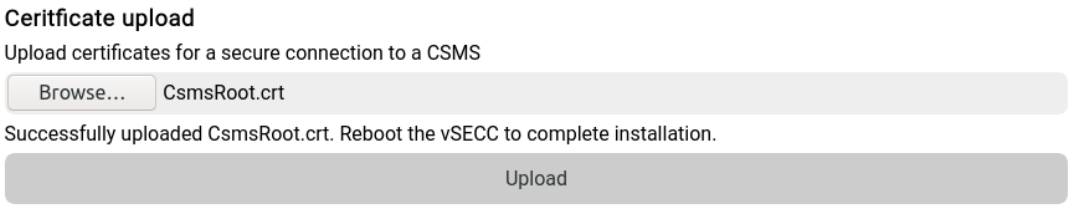

Figure 19: Installing Root-CAs

Installing a Root-CA via OCPP uses the ”InstallCertificate” messages. The vSECC 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 OCPP 2.0.1 Part 2 - Specification document.

3.3 Downloading Log Files

To assist technical support, the vSECC application's log files can be downloaded from the vSECC either by using the web interface or via OCPP.
To download log files using the web interface, put the vSECC into maintenance mode as described in chapter 3.1.1. Head over to the "Log Files" section shown in Figure 20. Then press the [Download] button to download the log files.

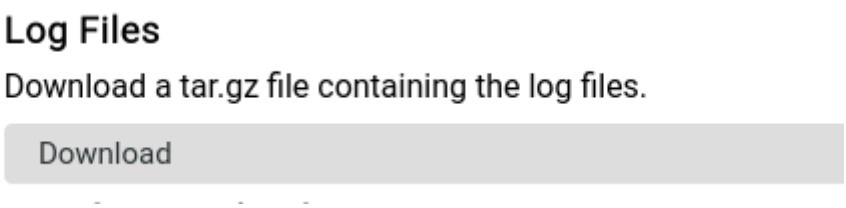

Figure 20: Downloading Log Files

Downloading log files via OCPP uses the "GetLog" messages. The vSECC will compress its log files into an archive and upload it to the URI specified by the CSMS. For further information about the structure and usage of those messages, please refer to the OCPP 2.0.1 Part 2 - Specification document. 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 21 and 22.

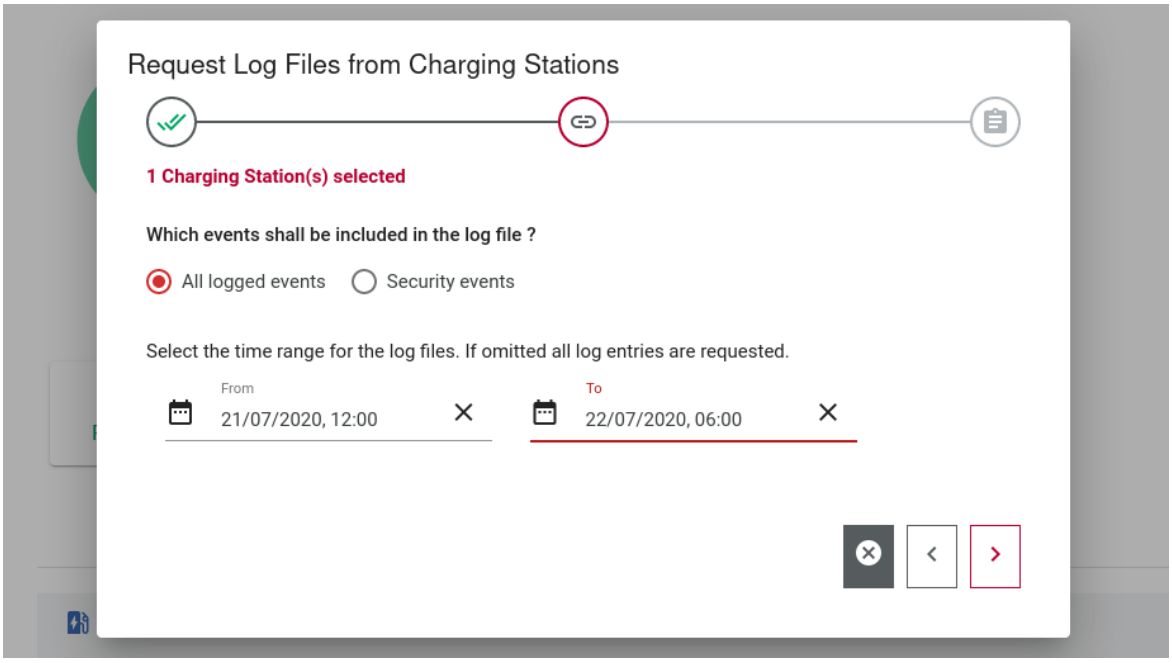

Figure 21: vCharM Requesting Log Files

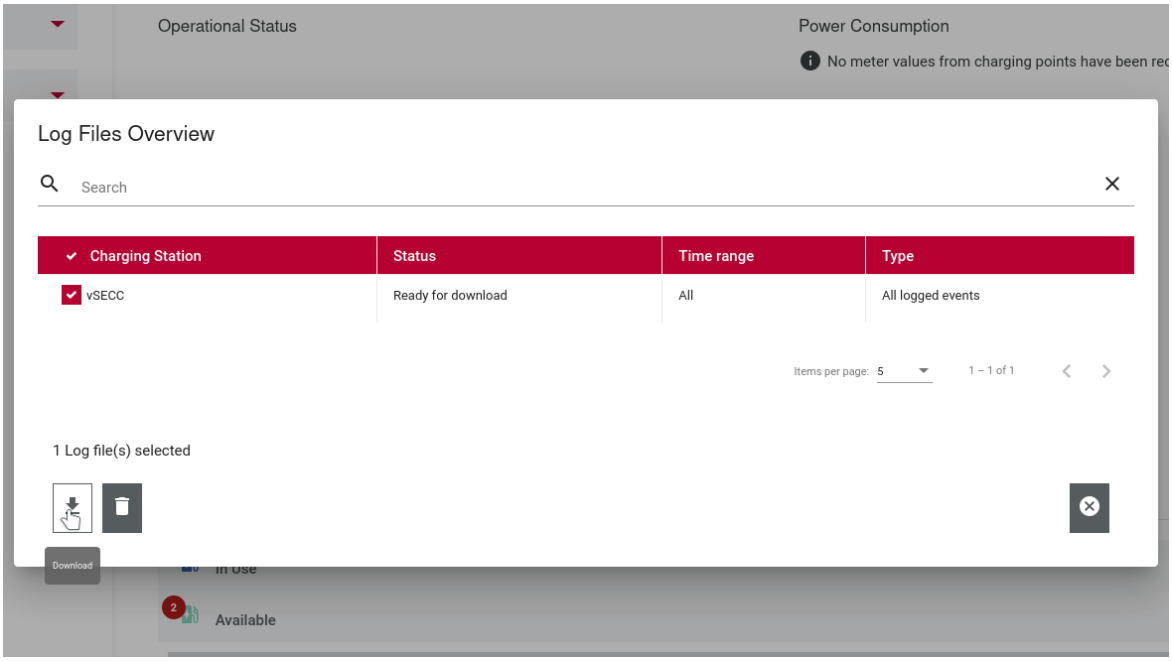

Figure 22: vCharM Downloading Log Files

3.4 Firmware Update

Updating the vSECC's firmware via OCPP utilizes the "UpdateFirmware" messages. The vSECC will download the firmware from the URI specified inside the CSMS's 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 OCPP 2.0.1 Part 2 - Specification document.
Inside vCharM, a firmware update can be requested via the "Update Firmware" dialog as seen in Figure 23. 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, which initiates the update process.

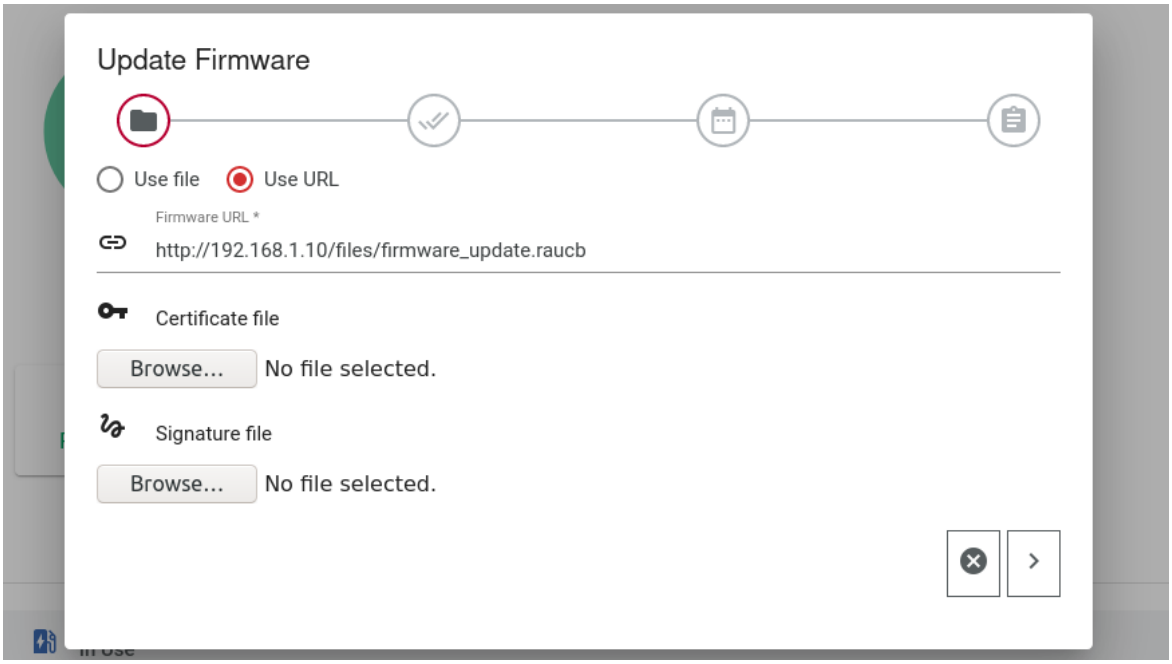

Figure 23: vCharM Firmware Update

3.5 Configuration Variable Reference

Component/Variable	Description
ChargingStation/ BaseUri	The URI of the CSMS to connect to using OCPP over WebSocket. **Default:** https://192.168.3.1:443/ocpp
ChargingStation/ Identity	The OCPP charging station ID which identifies a charging station at the CSMS. Each vSECC represents one charging station. **Default:** vectorTest1
DefaultChargingProfile/ SchedulePeriodLimits	When no charging profile is provided by the CSMS, this value limits the charging power. The unit is determined by the DefaultChargingProfile/Unit variable. **Default:** 500000
OCPPCommCtrlr/ BackendComActivated	It is possible to operate the vSECC 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. **Default:** true
SecurityCtrlr/ BasicAuthPassword	Password used for HTTP Basic Authentication when connecting to the CSMS. **Default:** ””
SecurityCtrlr/ 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. **Default:** ””
AuthCtrlr/ Enabled	If set to true, this variable causes the vSECC to send an AuthorizeRequest to the CSMS before every charging transaction to authorize the charging process. If the charging process cannot be authorized, no charging will take place. If set to false, the vSECC will not send any authorization messages. **Default:** false

Connector/ DinChargingMode	If the EV requested charging according to DIN 70121, this variable defines which EnergyTransferType is supported by the vSECC. Possible values are: DC_extended: DC charging using the extended pins of an IEC 62196-3 Configuration EE or Configuration FF connector. DC_core: DC charging using the core pins of an IEC 62196-3 Configuration CC connector (corresponding to an IEC 62196-2 Type 1 connector) or of an IEC 62196-3 Configuration DD connector (corresponding to an IEC 62196-2 Type 2 connector). **Default:** DC_extended
Charging-CommunicationCtrlr/ AbortOnInvalidRequest-Current	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. Note: If the requested voltage could not be supplied, the charging session is aborted. **Default:** true
Charging-CommunicationCtrlr/ AbortOnInvalidRequest-Power	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 to be within the power electronics' limits. Note: If the requested voltage could not be supplied, the charging session is aborted. **Default:** true
PowerElectronics/ Type	If set to "Simulation", the vSECC communicates with an internal power electronics simulation. If set to "Websocket", the vSECC will communicate with a PEP compliant websocket server through its ethernet interface. **Default:** Simulation

PowerElectronics/ Uri	The URI to communicate with the power electronics. If the ”Type” variable is set to ”Simulation”, the default value is sufficient. When using real power electronics, the URI must be set to the websocket server’s address. **Default:** http://localhost:8080/PowerElectronics

3.6 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 unit corresponds to one charging station. This relationship is based on a unique charging station OCPP ID for each charging station. Figure 24 shows the edit menu of the charging station "vSECC" which consists of two EVSEs with one connector each.

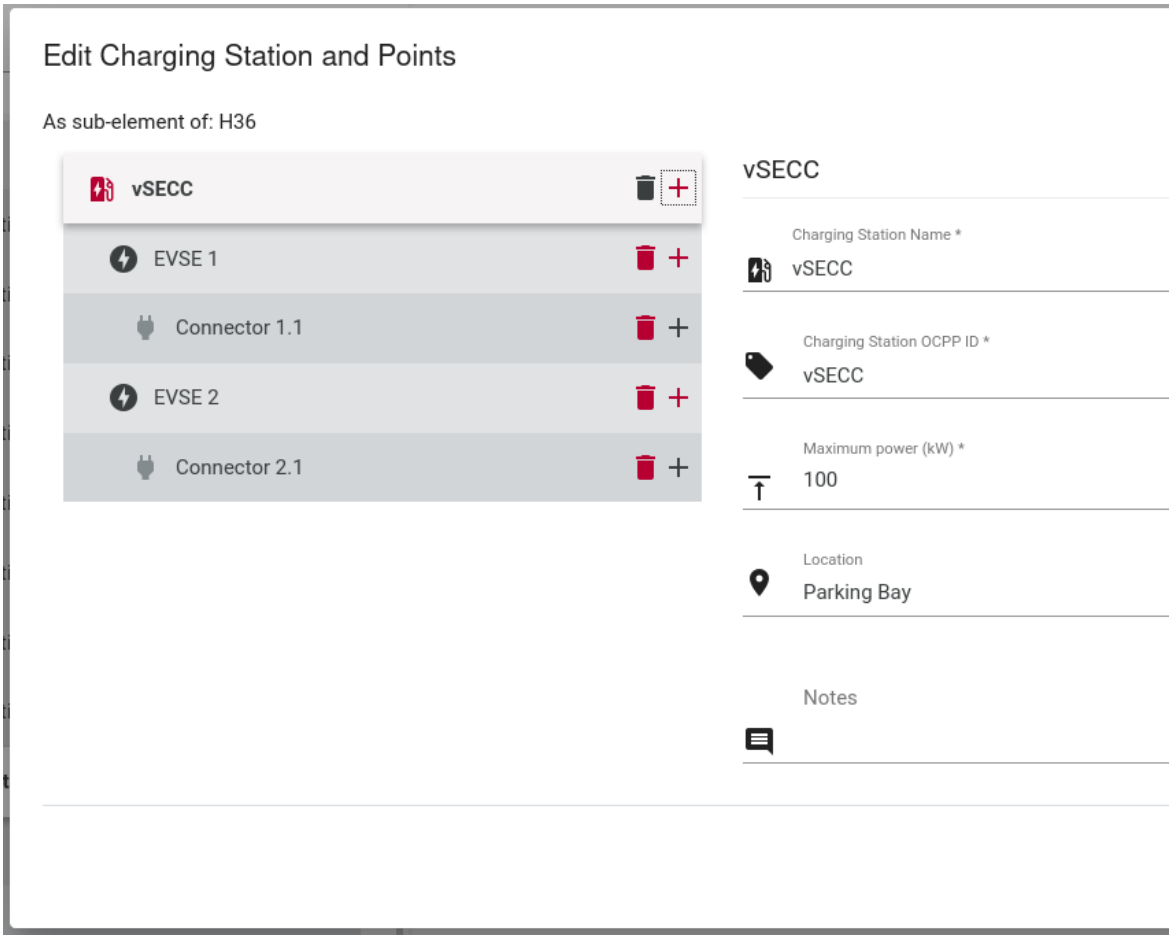

Figure 24: vCharM Charging Station Editing

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 25.

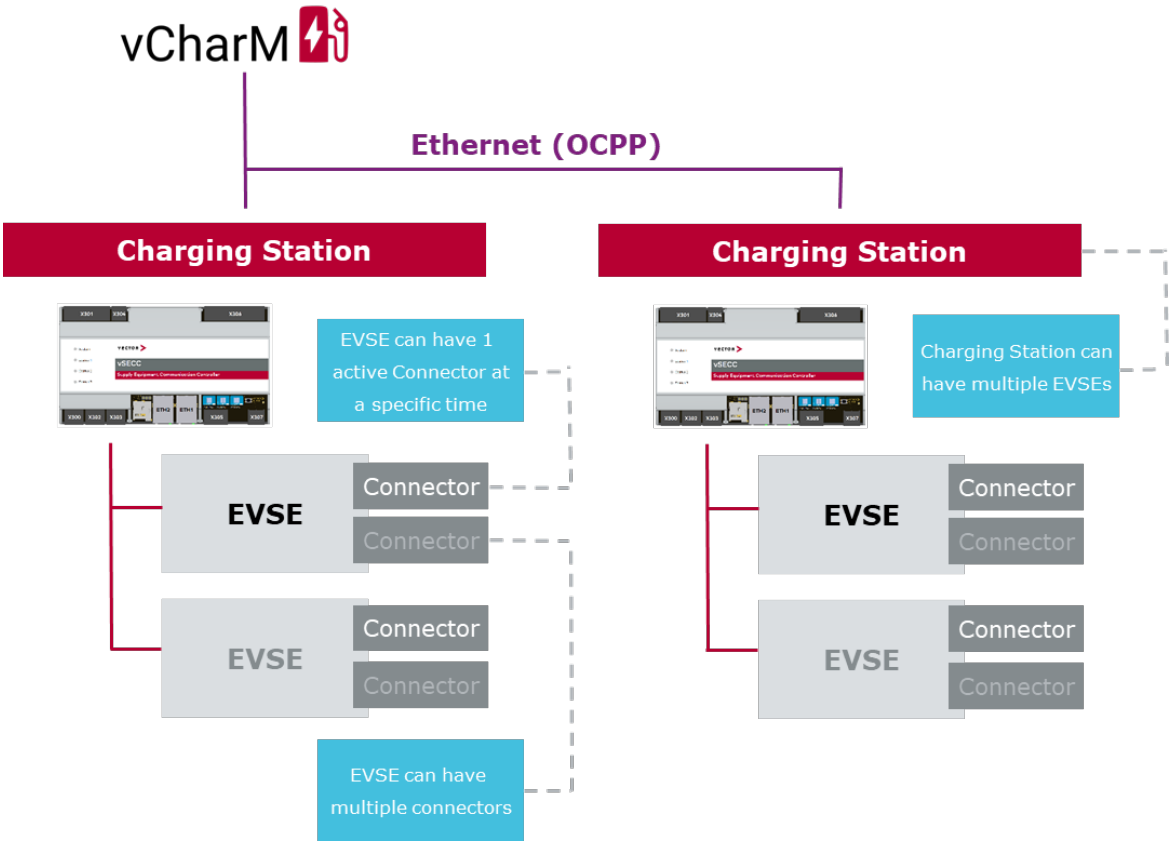

Figure 25: Overview according to OCPP 2.0: Part 1

3.7 Power Electronics Protocol Input/Output Identifiers

The vSECC hardware offers the following ports, which can be controlled over ethernet via the Power Electronics Protocol (PEP) *getInput* and *setOutput* messages:

- 16 Digital Out Ports
- 8 Digital In Ports
- 2 Analog In Ports
- 9 Temperature In Ports

Refer to the PEP document provided with the vSECC documentation package for usage instructions.

3.7.1 Digital Out

The digital output ports can be set with the *setOutput* message. Valid values are *0* for logical low, and *1* for logical high.

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
d16	X306	10

3.7.2 Digital In

The digital inputs ports can be read with the *getInput* message. Return values are *0* for logical low, and *1* for logical high.

Identifier	Connector	Pin
d1	X306	9
d2	X306	8
d3	X306	7
d4	X306	6
d5	X306	5
d6	X306	4
d7	X306	3
d8	X306	2

3.7.3 Analog In

The analog inputs support voltages between 0-10V. The ports can be read with the *getInput* message.
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

3.7.4 Temperature In

The temperature inputs can be read with the *getInput* message.
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

4 Service Guide

In this chapter you will find the following information:

4.1 Reset Factory Defaults

The vSECC is equipped with a reset button, see Section 2.3.1 for its exact location. Pressing this button for at least 5 seconds restores the factory configuration settings.

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

The vSECC version 1.2 does not support this functionality.

4.2 Firmware Update

The process how to update the firmware is described in detail in chapter 3.4.

4.3 Status LEDs

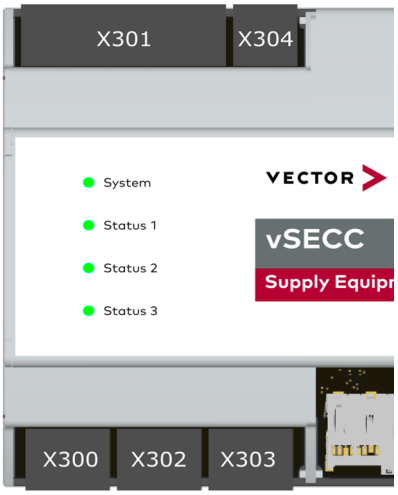

Figure 26: vSECC status LEDs on the top view.

The vSECC is equipped with four LEDs that indicate its current status. Each LED has one of four states, as described in detail below.

System LED

This LED shows the overall system status of the vSECC:

- Off: The vSECC is not running. This may be due to a lack of supplied power.
- Green, flashing: The vSECC is starting up. This may take several seconds. If finished, the LED turns green continuously.
- Green, lit continuously: The vSECC has finished initialization and is now running.
- Red, flashing: *Currently not used.*
- Red, continuously: *Currently not used.*

Charging Port LEDs

Three Status LEDs indicate the current status of the respective charging port.

- 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.

5 Technical Data

In this chapter you will find the following information:

5.1 General

Parameter	Min.	Typ.	Max.	Unit
Supply voltage V_{in}	18	24	30	V
Power consumption at 24 V (charging on one spot, communication to backend and power electronics active)		4.8		W
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			

5.2 Digital Inputs

Parameter	Min.	Typ.	Max.	Unit
8 general purpose digital inputs (IEC 61131-2 Type 1 & 3 compatible)				
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

5.3 Digital Outputs

Parameter	Min.	Typ.	Max.	Unit
16 general purpose digital outputs				
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				

5.4 Analog Inputs

Parameter	Min.	Typ.	Max.	Unit
2 general purpose analog inputs				
Input voltage	0		10	V
Resolution	12			bit

5.5 Temperature Inputs

Parameter	Min.	Typ.	Max.	Unit
9 temperature sensor inputs, optimized for usage with PT-1000 temperature sensors				
Driven output current		400		μA
Resolution	24			bit

5.6 Safety Outputs

Parameter	Min.	Typ.	Max.	Unit
3 isolated relays (normally opened)				
Rated current			100	mA
Switching voltage (DC)			30	V

5.7 CCS Connectors

5.7.1 Full Bridge Out

Parameter	Min.	Typ.	Max.	Unit
Output voltage switchable via software				
> 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
Overcurrent and short-circuit protected				

5.7.2 Full Bridge Feedback

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

5.7.3 Control Pilot

Parameter	Min.	Typ.	Max.	Unit
2 control pilot pins, designed according to IEC 61851				
Output voltage				
> On state		12		V
> Off state		-12		V
Frequency	0.98	1	1.02	kHz
Duty cycle accuracy	+/- 5			μs

A 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 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.

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 unit 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.

B 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
HVDC	High Voltage Direct Current
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
SECC	Supply Equipment Charge Controller
TLS	Transport Layer Security
UI	User Interface
URI	Uniform Resource Identifier
VAS	Value Added Service

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