



## Charge Module S User Guide

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## 1 Revision

Revision	Release Date	Changes
1	08 March 2021	Initial release
2	08 March 2021	Updated section "Sequence Diagram"
3	17 May 2021	Added section "Abbreviated terms" Updated section "Introduction" Changed section "Sequence Diagram" Added section "Start and Stop Charging" Updated section "Charge Module S CAN-Interface Documentation" Updated section "Error codes" Added section "Charge Module S User Guide Releases"
4	18 May 2021	Changed section "Error codes" Removed section "Charge Module S User Guide Releases"
5	18 May 2021	Corporate Identity
6	22 August 2022	Corporate Identity <u>Updated section "Abbreviated terms"</u> Updated section "Charge Module S CAN-Interface Documentation" Added section "Module Reset" Added section "CAN communication enable/disable" Added section "SLAC Attenuation Threshold" Added section "Customer GPIOs" Updated section "Error Codes" Added section "B-C-B restart"
7	25.October 2022	Updated section "Error Codes" change order of release entries

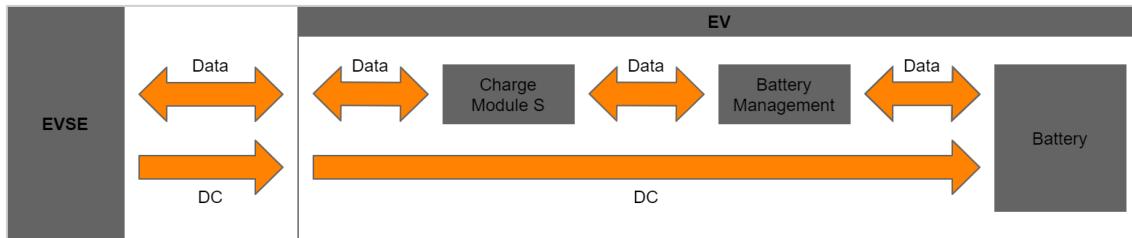
## 2 Abbreviated terms

Most of the abbreviations can be found in the DIN70121 or ISO15118 specification. For convenience they are additionally listed here.

CCS	Combined Charging System
CMS	Charge Module S
CP	Control Pilot
EV	Electric Vehicle
EVCC	Electric Vehicle Communication Controller
EVSE	Electric Vehicle Supply Equipment
PLC	Power Line Communication
SDP	SECC Discovery Protocol
SECC	Supply Equipment Communication Controller
SLAC	Signal Level Attenuation Characterization
SNA	Signal Not Available

### 3 Introduction

Charge Module S add DIN 70121 and ISO 15118 functionality to the EV side. It provides all core functionalities to enable onboard chargers or battery packs the high level communication with a CCS charging station.

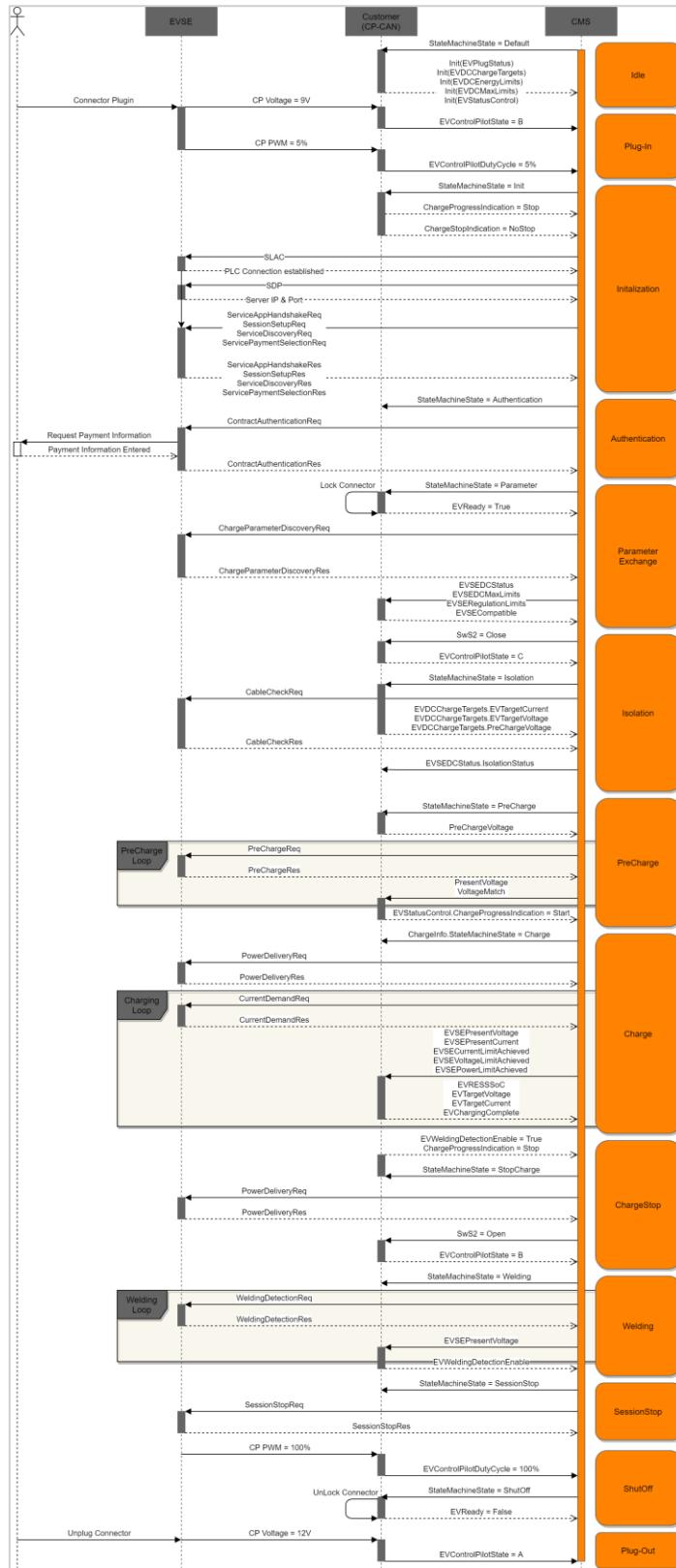


The Module is equipped with a QCA7005 and a powerful Cortex M4 running a state-of-the-art Real Time Operating System with our complete software stack included.

Charge Module S is shipped with pre-flashed firmware including the bootloader.

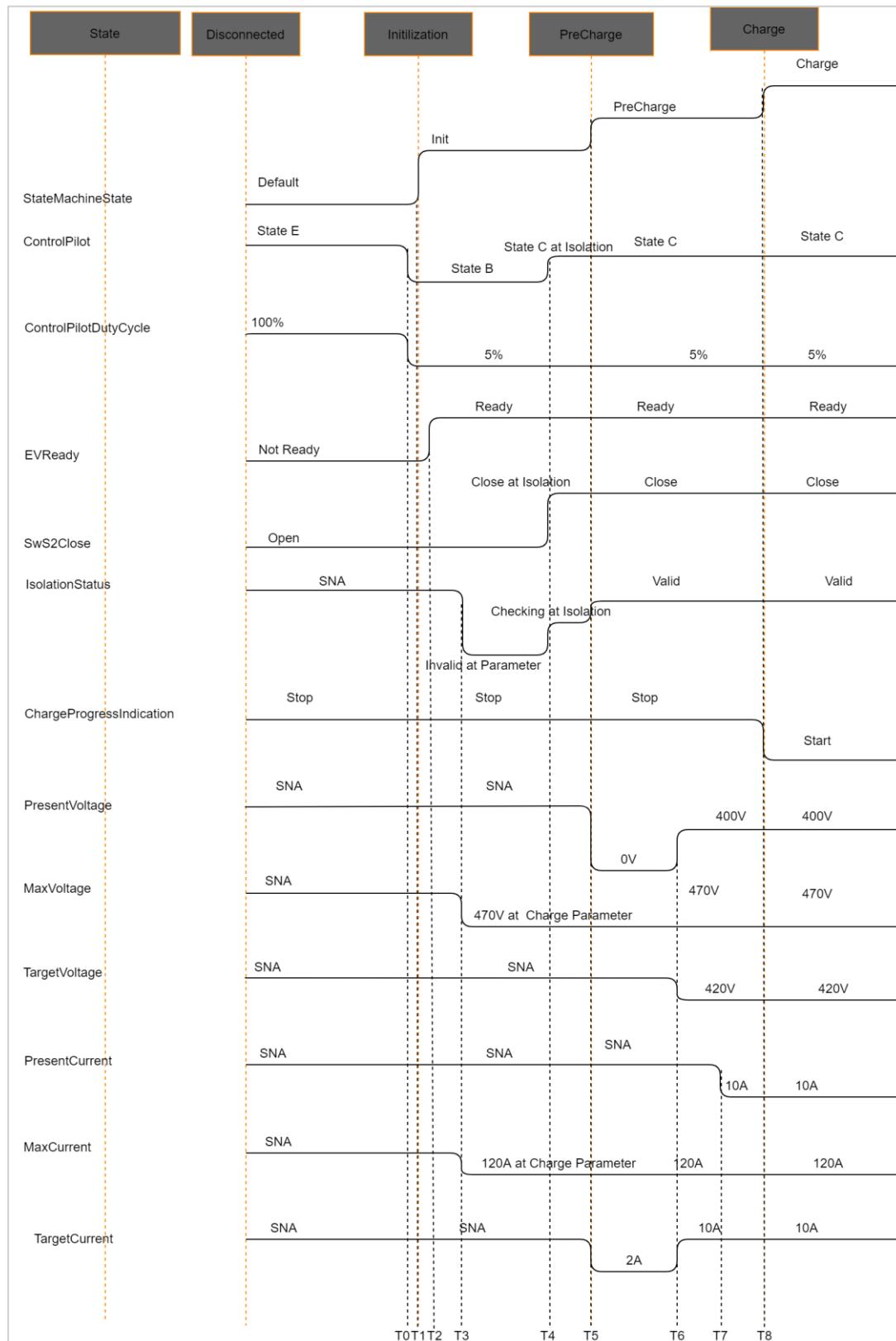
## 4 Sequence Diagram

The sequence diagram below shows the individual states that can occur during a charging process.



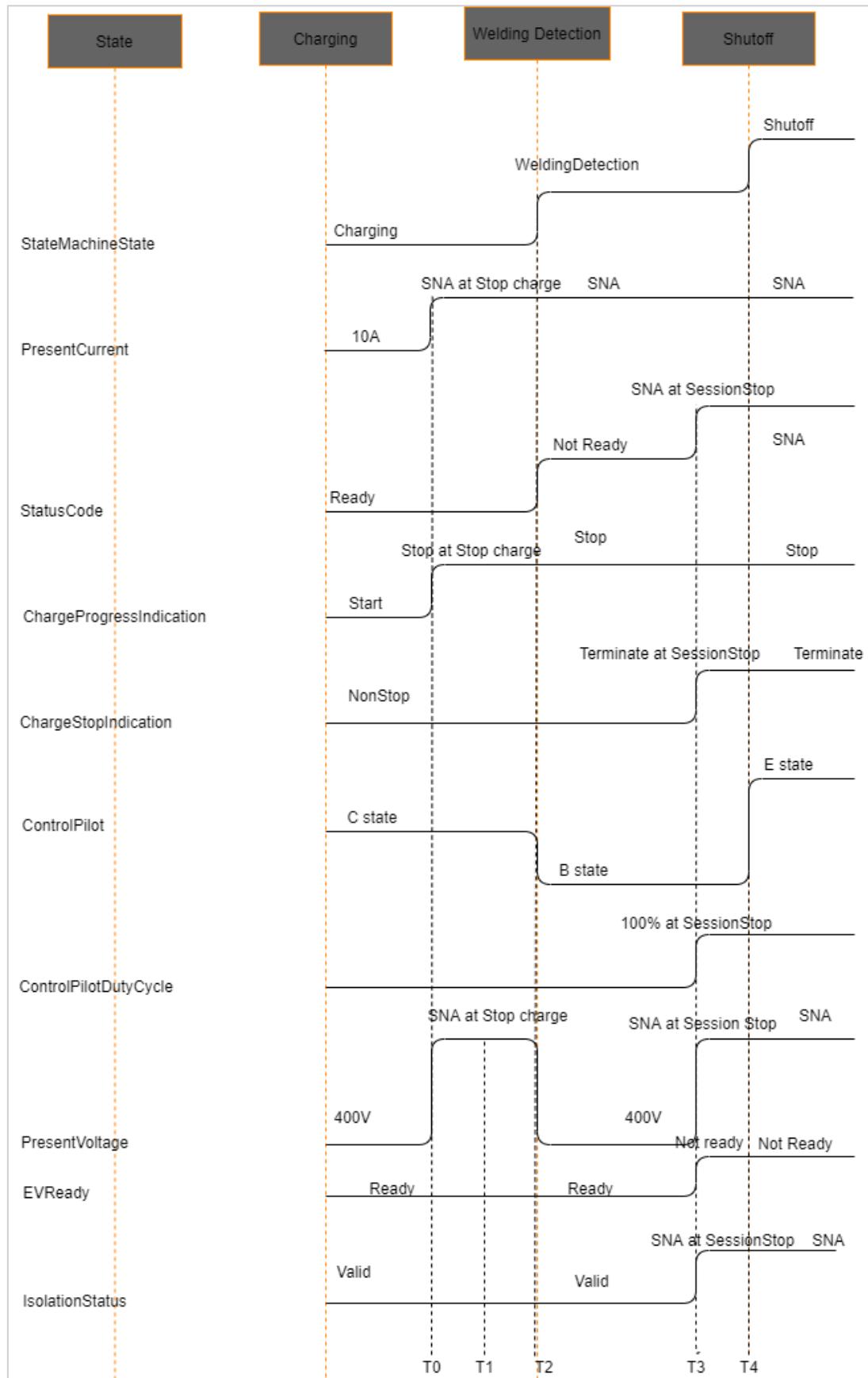
## 5 Start and Stop Charging

### 5.1 Start Charging



Time Slot	Description
T0	The control pilot state changes from state E to state B once the charging connector is plugged into the vehicle inlet and the pilot duty cycle changes from 100% to 5%.
T1	The state machine changes to "Init" state after the vehicle connection is stable.
T2	The signal EVReady should be set to "True" in between "Init" and "Isolation" state when the following conditions are satisfied: <ul style="list-style-type: none"> <li>• HV battery is ready.</li> <li>• The charging connector is locked.</li> <li>• Parking brake is engaged.</li> </ul>
T3	"Parameter" state has been reached. The high level communication is established and several charging parameters are exchanged. <ul style="list-style-type: none"> <li>• The Isolation monitoring changes from "SNA" to "invalid".</li> <li>• The max voltage and max currents values are updated to the correct values from "SNA".</li> </ul>
T4	With the "Isolation" state, the SwS2 switch is going to be closed and the control pilot changes to state C.
T5	The state machine changes to "PreCharge" and the isolation changes to "Valid". The present voltage and target current values are updated in the "PreCharge" state. The TargetCurrent is fixed at 2A in the "PreCharge" state.
T6,T7	The PresentVoltage, PresentCurrent, TargetVoltage and TargetCurrent are set in the "PreCharge" state.
T8	The ChargeProgressIndication changes to "Start" and the actual charging begins. The state machine changes to "Charging" state.

## 5.2 Stop Charging



Time Slot	Description
T0	Before the charging stops the EV reduces the present current.
T1	During "StopCharge" phase the EVSE does not transmit a valid PresentVoltage. Therefore the PresentVoltage value changes to SNA.
T2	Start of "WeldingDetection" phase <ul style="list-style-type: none"> <li>• Contactors are being opened (control pilot state C to B)</li> <li>• EVSE is changing to "Not Ready" state</li> </ul>
T3	The "SessionStop" request disconnects the high level communication (TCP disconnect). All signal change to SNA or default values
T4	The charger disconnects and the control pilot state changes from B to E.

## 6 Charge Module S CAN-Interface Documentation

### 6.1 Proximity Pilot or Plug Presence

The status is formed from the transmitted ADC voltage. The detected or transmitted status values from the Proximity Pilot are listed here.

Value	Name	Description
0	NOT_CONNECTED	No plug connected.
1	TYPE1_CONNECTED	Obtain value for a type 1 connected plug.
2	TYPE1_CONNECTED_BUTTON_PRESSED	Obtain value for a type 1 connected plug and button is pressed.
3	TYPE2_CONNECTED13_A, TYPE2_CCS	Value for a type 2 connected plug. The cables current rating indicates 13A13A for AC charging. For DC charging, the value means Type2_CCS. The resistor value for AC and DC charging is identical.
4	TYPE2_CONNECTED20_A	Value for a type 2 connected plug. The cables current rating indicates 20A.
5	TYPE2_CONNECTED32_A	Value for a type 2 connected plug. The cables current rating indicates 32A.
6	TYPE2_CONNECTED63_A	Value for a type 2 connected plug. The cables current rating indicates 63A.
14	INVALID	An invalid value was passed.

### 6.2 Description of parameters per phase

Each charge-phase handles specific parameters between EV and EVSE. The following description shows which CAN-signals are needed in which charging phase. The actual charge-phase is signalized by the state-machine state (ChargeInfo::StateMachineState).

### 6.2.1 Init-phase (Indicated by StateMachineState "Init" ('1'))

EV	EVSE	Signal	Description
•		EVStatusControl::ChargeStopIndication	Indication if the charge shall be stopped completely (Terminate = 0) or continued (NoStop = 2) as supposed. Indication that the vehicle is ready to accept a charge or wants to stop it.
	✓	EVSEID	The EVSEID is sent as soon as the EVSE transmits it. The EVSEID is 32 bytes in DIN and 37 bytes in ISO. There are 5 messages in total but for DIN only 4 messages are transmitted. The EVSEID is repeated every 10 seconds but it is also sent immediately after reception if the EVSEID.

### 6.2.2 Authentication-phase (Indicated by StateMachineState "Authentication" ('2'))

EV	EVSE	Signal	Description
•		EVStatusControl::ChargeStopIndication	Indication if the charge shall be stopped completely (Terminate = 0) or continue (NoStop = 2) as supposed.

### 6.2.3 Parameter-phase (Indicated by StateMachineState "Parameter" ('3'))

EV	EVSE	Signal	Description	Option
•		EVStatusControl::ChargeStopIndication	Indication if the charge shall be stopped completely (Terminate = 0) or continue (NoStop = 2) as supposed.	
•		EVDCMaxLimits::EVMaxVoltage	This value indicates the maximum permissible voltage of the EV. Please note that CMS will not start Charge parameter discovery request unless this signal is valid. CMS by default sets SNA so, customer should update other than SNA before start charge parameter discovery.	

		EVDCMaxLimits::EVMaxCurrent	This value indicates the maximum permissible current of the EV. Please note that CMS will not start Charge parameter discovery request unless this signal is valid. CMS by default sets SNA so, customer should update other than SNA before start charge parameter discovery.	
		EVDCMaxLimits::EVMaxPower	This value indicates the maximum permissible power of the EV.	
		EVStatusControl::EVReady	Declares that the vehicle is safe to be charged. This is commonly a combination of various vehicle internal states. For example: a locked inlet, a set parking brake and no fault from the vehicle's battery management system. During the active charging phase (Parameter state to Welding state) a retraction of this signal performs an automatic emergency shutdown of the charging session. Please note that CMS will not start Charge parameter discovery request unless this signal is valid. CMS by default sets SNA so, customer should update other than SNA before start charge parameter discovery.	
		EVStatusDisplay::EVCabinConditioning	When Cabin Conditioning is set to true ('1') the EV is using energy from the DC supply to heat or cool the passenger compartment (DIN only).	
		EVStatusDisplay::EVRESSConditioning	When RESS Conditioning is set to true ('1') the EV is using energy from the DC charger to condition the RESS to a target temperature (DIN only).	

		EVStatusDisplay::EVErrorCode	Indicates the EV internal status. The enumeration value of "EVErrorCode" refers to the ISO15118 standard. Please note that CMS will not start Charge parameter discovery request unless this signal is valid (No SNA). CMS by default sets SNA so, customer should update other than SNA before start charge parameter discovery.	
		EVStatusDisplay::EVSoC	Is the state of charge of the EV's battery. (Range: 0-100) Please note that CMS will not start Charge parameter discovery request unless this signal is valid. CMS by default sets SNA so, customer should update other than SNA before start charge parameter discovery.	
		EVDCEnergyLimits::EVEnergyCapacity	Is the maximum energy capacity supported by the EV.	
		EVDCEnergyLimits::EVEnergyRequest	Is the amount of energy the EV requests from the EVSE.	
		EVDCMaxLimits::EVFullSoC	Is the state of charge at which the EV's battery is fully charged. (Range: 0-100)	
		EVDCMaxLimits::EVBulkSoC	Is the state of charge at which the EV's battery is bulked charged and the EV intends to end the fast charge process. (Range: 0-100)	
		Chargeinfo::SwS2Close	Is this state set to true ('1') and EVStatusControl::EVReady is true ('1'), the customer shall close the swS2 to get to charging state C. (Only for CAN-Configuration)	

		Chargeinfo::EVSECompatible	This signal checks the EV and EVSE compatibility. For example: The EVSE can deliver only 400 V, but the EV needs 800 V. Then EVSECompatible is false ('0'). It is only a display parameter, further actions must be carried out by the customer.	
	✓	EVSEDCMaxLimits::EVSEMaxVoltage	Is the maximum voltage the EVSE can support.	
	✓	EVSEDCMaxLimits::EVSEMaxCurrent	Is the maximum current the EVSE can deliver.	
	✓	EVSEDCMaxLimits::EVSEMaxPower	Is the maximum power the EVSE can deliver.	
	✓	EVSEDCMaxLimits::EVSEEnergyToBeDelivered	Is the amount of energy to be delivered by the EVSE.	
	✓	EVSEDCRegulationLimits::EVSECurrentRegulationTolerance	Is the absolute magnitude of the regulation tolerance of the EVSE.	
	✓	EVSEDCRegulationLimits::EVSEPeakCurrentRipple	Is the Peak-to-peak magnitude of the current ripple of the EVSE.	
	✓	EVSEDCRegulationLimits::EVSEMinCurrent	Is the minimum current the EVSE can deliver.	
	✓	EVSEDCRegulationLimits::EVSEMinVoltage	Is the minimum voltage the EVSE can deliver.	
	✓	EVSEDCStatus::EVSEIsolationStatus	Is the isolation status of the EVSE. Is typically initialized to "Invalid" ('0') until the EVSE has checked cable status in the isolation-phase.	
	✓	EVSEDCStatus::EVSEStatusCode	Actual status of the EVSE. Typically initialized to "EVSE_NotReady" ('0') until the EVSE is ready for the charging procedure.  This signal also informs the vehicle of a EVSE_Shutdown (2) or EVSE_EmergencyShutdown (5) condition upon which the shutdown of the charging session should be initiated.	

	<input checked="" type="checkbox"/>	EVSEDCStatus::EVSENNotification	The EVCC should perform action according to EVSE Notification. The action should perform with based on the NotificationMaxDelay. The action should perform immediately if the NotificationMaxDelay equal to zero. The EVSENNotification will be "none(0)" in normal operation. The EVSENNotification will be "shutdown(1)" when EVSE want to stop charging. The EVSENNotification will be "SNA(3)" when EVSE provided no selection.	
	<input checked="" type="checkbox"/>	EVSEDCStatus::EVSENNotificationMaxDelay	The NotificationMaxDelay units in seconds(s). This value will be effective based on the EVSENNotification. It is meaningful value when EVSENNotification is "shutdown" otherwise it will be SNA. The EVCC should perform the action within EVSENNotificationMaxDelay time.	

#### 6.2.4 Isolation-phase (Indicated by StateMachineState "Isolation" ('4'))

EV	EVSE	Signal	Description	Option
<input checked="" type="checkbox"/>		EVStatusControl::ChargeStopIndication	Indication if the charge shall be stopped completely ('0') or continue ('2') as supposed.	
<input checked="" type="checkbox"/>		EVStatusControl::EVReady	Indication that the vehicle is ready ('1') for the further process generally. If EVReady is set to false ('0'), charging will be aborted immediately with an emergency shutdown.	
<input checked="" type="checkbox"/>		EVStatusDisplay::EVCabinConditioning	When Cabin Conditioning is set to true ('1') the EV is using energy from the DC supply to heat or cool the passenger compartment (DIN only).	<input checked="" type="checkbox"/>

<input checked="" type="checkbox"/>		EVStatusDisplay::EVRESSConditioning	When RESS Conditioning is set to true ('1') the EV is using energy from the DC charger to condition the RESS to a target temperature (DIN only).	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>		EVStatusDisplay::EVErrorCode	Indicates the EV internal status. The enumeration value of "EVErrorCode" refers to the ISO15118 standard. Typically it sets to either NO ERROR ('0') or SNA ('15').	
<input checked="" type="checkbox"/>		EVStatusDisplay::EVSoC	Is the state of charge of the EV's battery. (Range: 0-100)	
	<input checked="" type="checkbox"/>	EVSEDCStatus::EVSEIsolationStatus	Is the isolation status of the EVSE. If the EVSE is performing the isolation check, the status code shall be set to "EVSE_IsolationMonitoringActive" ('4'). Additionally, the isolation status will be set to "Checking" ('5'). If the cable status is successfully checked, the isolation status should be set to "Valid" ('1') or whatever its result is. The isolation status must be observed and updated throughout the whole charging phase.	
	<input checked="" type="checkbox"/>	EVSEDCStatus::EVSEStatusCode	Actual status of the EVSE. If the isolation status (EVSEDCStatus::EVSEIsolationStatus) is "Valid" ('1') or "Warning" ('2') EVSE-StatusCode must be set to "EVSE_Ready" ('1'). In addition it also informs the vehicle of a EVSE_Shutdown (2) or EVSE_EmergencyShutdown (5) condition upon which the shutdown of the charging session should be initiated.	
	<input checked="" type="checkbox"/>	EVSEDCStatus::EVSENNotification	The EVCC should perform action according to EVSE Notification. The action should perform with based on the NotificationMaxDelay. The action should perform immediately if the NotificationMaxDelay equal to zero. The EVSENNotification will be "none(0)" in normal operation. The EVSENNotification will be "shutdown(1)" when EVSE want to stop charging. The EVSENNotification will be "SNA(3)" when EVSE provided no selection.	

	<input checked="" type="checkbox"/>	EVSEDCStatus::EVSENNotificationMaxDelay	The NotificationMaxDelay units in seconds(s). This value will be effective based on the EVSENNotification. It is meaningful value when EVSENNotification is "shutdown" otherwise It will be SNA. The EVCC should perform the action within EVSENNotificationMaxDelay time.	
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### 6.2.5 PreCharge-phase (Indicated by StateMachineState "PreCharge" ('5'))

EV	EVSE	Signal	Description	Option
<input checked="" type="checkbox"/>		EVStatusControl::ChargeStopIndication	Indication if the charge shall be stopped completely (Terminate = 0) or continue (No Stop = 2) as supposed.	
<input checked="" type="checkbox"/>		EVStatusControl::ChargeProgressIndication	Indication that the vehicle is ready to accept a charge or wants to stop it. When the EV considers the voltage is successfully adjusted to the target voltage the ChargeProgressIndication must be set to "Start" ('0'). Chargeinfo::VoltageMatch serves as additional Information.	
<input checked="" type="checkbox"/>		EVStatusControl::EVReady	Indication that the vehicle is ready ('1') for the further process generally. If this signal is set to False ('0') an emergency shutdown will be performed.	
<input checked="" type="checkbox"/>		EVStatusDisplay::EVCabConditioning	When Cabin Conditioning is set to true ('1') the EV is using energy from the DC supply to heat or cool the passenger compartment (DIN only).	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>		EVStatusDisplay::EVRESSConditioning	When RESS Conditioning is set to true ('1') the EV is using energy from the DC charger to condition the RESS to a target temperature (DIN only).	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>		EVStatusDisplay::EVErrorCode	Indicates the EV internal status. The enumeration value of "EVErrorCode" refers to the ISO15118 standard. Typically it sets to either NO ERROR ('0') or SNA ('15').	
<input checked="" type="checkbox"/>		EVStatusDisplay::EVSoC	Is the state of charge of the EV's battery. (Range: 0-100)	
<input checked="" type="checkbox"/>		EVDCChargeTargets::EVPreChargeVoltage	Is the target pre charge voltage requested by the EV.	
<input checked="" type="checkbox"/>		EVDCChargeTargets::EVTargetCurrent	Is the target pre charge current (max. 2 A) requested by the EV.	

✓		Chargeinfo::VoltageMatch	When EVPreChargeVoltage and EVSEPresentVoltage are almost the same (+/- 20 V), VoltageMatch will be set to true ('1').	
	✓	EVSEDCStatus::EVSEIsolationStatus	Is the actual isolation status of the EVSE. Is typically set to "Valid" ('1') or "Warning" ('2').	
	✓	EVSEDCStatus::EVSEStatusCode	Actual status of the EVSE. EVSE-StatusCode must be set to "EVSE_Ready" ('1') as long as the isolation status (EVSEDCStatus::EVSEIsolationStatus) is "Valid" ('1') or "Warning" ('2'). In addition it also informs the vehicle of a EVSE_Shutdown (2) or EVSE_EmergencyShutdown (5) condition upon which the shutdown of the charging session should be initiated.	
	✓	EVSEDCStatus::EVSEPresentVoltage	Is the present output voltage of the EVSE. The voltage must be ramped up to the requested EV target voltage.	
	✓	EVSEDCStatus::EVSENNotification	The EVCC should perform action according to EVSE Notification. The action should perform with based on the NotificationMaxDelay. The action should perform immediately if the NotificationMaxDelay equal to zero. The EVSENNotification will be "none(0)" in normal operation. The EVSENNotification will be "shutdown(1)" when EVSE want to stop charging. The EVSENNotification will be "SNA(3)" when EVSE provided no selection.	
	✓	EVSEDCStatus::EVSENNotificationMaxDelay	The NotificationMaxDelay units in seconds(s). This value will be effective based on the EVSENNotification. It is meaningful value when EVSENNotification is "shutdown" otherwise It will be SNA. The EVCC should perform the action within EVSENNotificationMaxDelay time.	

### 6.2.6 Charge-phase (Indicated by StateMachineState "Charge" ('6'))

E V	EVS E	Signal	Description	Opti on

•		EVStatusControl::ChargeStopIndication	Indication if the charge shall be stopped completely ('0') or continued ('2') as supposed. Note: After charging the welding-phase can be skipped by setting this value to "Terminate" ('0').	
•		EVStatusControl::ChargeProgressIndication	Indication that the vehicle is ready to accept a charge or wants to stop it. The EV must be set it to "Start" ('0'), otherwise the charging loop will be interrupted. To end charging, it must be set to "Stop" ('1').	
•		EVStatusControl::EVReady	Indication that the vehicle is ready ('1') for the further process generally. If this signal is set to False ('0') an emergency shutdown will be performed.	
•		EVStatusControl::EVWeldingDetectionEnable	If it is set to true ('0'), the EV carries out the welding detection, as long as EVStatusControl::ChargeStopIndication is set to "NoStop" ('2') and EVStatusControl::ChargeProgressIndication is set to "Stop" ('1').	
•		EVStatusDisplay::EVCabinConditioning	When Cabin Conditioning is set to true ('1') the EV is using energy from the DC supply to heat or cool the passenger compartment (DIN only).	✓
•		EVStatusDisplay::EVRESSConditioning	When RESS Conditioning is set to true ('1') the EV is using energy from the DC charger to condition the RESS to a target temperature (DIN only).	✓
•		EVStatusDisplay::EVErrorCode	Indicates the EV internal status. The enumeration value of "EVErrorCode" refers to the ISO15118 standard. Typically it sets to either NO ERROR ('0') or SNA ('15').	
•		EVStatusDisplay::EVSoC	Is the state of charge of the EV's battery. (Range: 0-100)	
•		EVDCChargeTargets::EVTargetVoltage	Is the target voltage requested by the EV.	
•		EVDCChargeTargets::EVTargetCurrent	Is the target current requested by EV.	
•		EVDCMaxLimits::EVMaxVoltage	Is the maximum voltage supported by the EV.	✓
•		EVDCMaxLimits::EVMaxCurrent	Is the maximum current supported by the EV.	✓
•		EVDCMaxLimits::EVMaxPower	Is the maximum power supported by the EV.	✓
•		EVStatusDisplay::EVBulkChargingComplete	If it is set to true ('1'), the EV indicates that bulk charge (approx. 80% SOC) is complete.	✓
•		EVStatusDisplay::EVChargingComplete	If it is set to true ('1'), the EV indicates that full charge (100% SOC) is complete.	

✓		EVStatusDisplay::EVTimeToBulkSoC	Is the remaining time until bulk charge (approx. 80% SOC) is complete.	✓
✓		EVStatusDisplay::EVTimeToFullSoC	Is the remaining time until full charge (100% SOC) is complete.	✓
✓		Chargeinfo::SwS2Close	Is this state set to false ('0'), the customer shall open the swS2 to get back to charging state B. (Only for CAN-Configuration).	
	✓	EVSEDCStatus::EVSEIsolationStatus	Is the actual isolation status of the EVSE. Is typically set to "Valid" ('1') or "Warning" ('2').	
	✓	EVSEDCStatus::EVSEStatusCode	Actual status of the EVSE. EVSE-StatusCode must be set to "EVSE_Ready" ('1') as long as the isolation status (EVSEDCStatus::EVSEIsolationStatus) is "Valid" ('1') or "Warning" ('2'). In addition it also informs the vehicle of a EVSE_Shutdown (2) or EVSE_EmergencyShutdown (5) condition upon which the shutdown of the charging session should be initiated.	
	✓	EVSEDCStatus::EVSEPresentVoltage	Is the present output voltage of the EVSE. The EVSE shall follow the requested target values of the EV.	
	✓	EVSEDCStatus::EVSEPresentCurrent	Is the present output current of the EVSE. The EVSE shall follow the requested target values of the EV.	
	✓	EVSEDCStatus::EVSECurrentLimitAchieved	Indicates if the EVSE has reached its current limit.	
	✓	EVSEDCStatus::EVSEVoltageLimitAchieved	Indicates if the EVSE has reached its voltage limit.	
	✓	EVSEDCStatus::EVSEPowerLimitAchieved	Indicates if the EVSE has reached its power limit.	
	✓	EVSEDCMaxLimits::EVSEMaxVoltage	Is the maximum voltage the EVSE can support.	✓
	✓	EVSEDCMaxLimits::EVSEMaxCurrent	Is the maximum current the EVSE can deliver.	✓
	✓	EVSEDCMaxLimits::EVSEMaxPower	Is the maximum power the EVSE can deliver.	✓
	✓	EVSEDCStatus::EVSENNotification	The EVCC should perform action according to EVSE Notification. The action should perform with based on the NotificationMaxDelay. The action should perform immediately if the NotificationMaxDelay equal to zero. The EVSENNotification will be "none(0)" in normal operation. The EVSENNotification will be "shutdown(1)" when EVSE want to stop charging. The EVSENNotification will be "SNA(3)" when EVSE provided no selection.	

	<input checked="" type="checkbox"/>	EVSEDCStatus::EVSENNotificationMaxDelay	The NotificationMaxDelay units in seconds(s). This value will be effective based on the EVSENNotification. It is meaningful value when EVSENNotification is "shutdown" otherwise It will be SNA. The EVCC should perform the action within EVSENNotificationMaxDelay time.	
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### 6.2.7 Welding-phase (Indicated by StateMachineState "Welding" ('7'))

EV	EVSE	Signal	Description	Option
.	.	EVStatusControl::ChargeStopIndicator	If the EV has finished the welding detection the EV sets the value to "terminate" ('0').	
.	.	EVStatusControl::EVReady	Indication that the vehicle is ready ('1') for the further process generally.	
.	.	EVStatusDisplay::EVCabConditioning	When Cabin Conditioning is set to true ('1') the EV is using energy from the DC supply to heat or cool the passenger compartment (DIN only).	<input checked="" type="checkbox"/>
.	.	EVStatusDisplay::EVRESSConditioning	When RESS Conditioning is set to true ('1') the EV is using energy from the DC charger to condition the RESS to a target temperature (DIN only).	<input checked="" type="checkbox"/>
.	.	EVStatusDisplay::EVErrorCode	Indicates the EV internal status. The enumeration value of "EVErrorCode" refers to the ISO15118 standard. Typically it sets to either NO ERROR ('0') or SNA ('15').	
.	.	EVStatusDisplay::EVSoC	Is the state of charge of the EV's battery. (Range: 0-100)	
.	.	EVSEDCStatus::EVSEIsolationStatus	Is the EVSE's actual isolation status.	
.	.	EVSEDCStatus::EVSEStatusCode	Is the actual status of the EVSE. In addition it also informs the vehicle of a EVSE_Shutdown (2) or EVSE_EmergencyShutdown (5) condition upon which the shutdown of the charging session should be initiated.	

	EVSEDCStatus::EVSEPresentVoltage	Is the present output voltage of the EVSE. During the welding phase, the EVSE typically drops the actual EVSE voltage to zero.	
	EVSEDCStatus::EVSENNotification	The EVCC should perform action according to EVSE Notification. The action should perform with based on the NotificationMaxDelay. The action should perform immediately if the NotificationMaxDelay equal to zero. The EVSENNotification will be "none(0)" in normal operation. The EVSENNotification will be "shutdown(1)" when EVSE want to stop charging. The EVSENNotification will be "SNA(3)" when EVSE provided no selection.	
	EVSEDCStatus::EVSENNotificationMaxDelay	The NotificationMaxDelay units in seconds(s). This value will be effective based on the EVSENNotification. It is meaningful value when EVSENNotification is "shutdown" otherwise It will be SNA. The EVCC should perform the action within EVSENNotificationMaxDelay time.	

### 6.2.8 StopCharge-phase (Indicated by StateMachineState "StopCharge" ('8'))

Indicates the charging session will be stopped. No additional conditions will be checked and charging automatically progresses to the next state.

### 6.2.9 SessionStop-phase (Indicated by StateMachineState "SessionStop" ('9'))

Indicates the charging session is being stopped. No additional conditions will be checked and charging automatically progresses to the next state.

### 6.2.10 Shutoff-phase (Indicated by StateMachineState "ShutOff" ('A'))

Indicates the charging session has been stopped successfully and the PLC connection is closed. This is the final state of the charging session. The EV waits for the EVSE to be unplugged by the user.

## 6.2.11 Error-phase (Indicated by StateMachineState "Error" ('C'))

If for some reason you get into the error phase, you should report the error or otherwise process it. To clear the Error the EV must be unplugged.

## 6.3 General CAN-Messages

There are three further CAN messages that inform the customer about Software Info, Error Codes and SLAC Info.

### 6.3.1 Software Info (Indicated by SoftwareInfo)

The CAN message SoftwareInfo provides information about the software, which is used. For example, if SW-version 0.4.1 (CAN-Configuration) is used, the CAN message looks like this:

- SoftwareVersionMajor: 0x00
- SoftwareVersionMinor: 0x04
- SoftwareVersionPatch: 0x01
- ConfigurationInfo: 0x01

### 6.3.2 Error Codes (Indicated by ErrorCodes)

The CAN message ErrorCodes is sent cyclic each second. Duplicated errors will not be sent. This holds a list of 4 error codes. Level 0 is the present error, others are previous errors. New errors will shift all previous error codes down in the list. The meaning of the error codes is listed in chapter 7 "Error codes".

### 6.3.3 SLAC Info (Indicated by SLACInfo)

The CAN message SLACInfo provides information about the status of the SLAC. This message is sent event-based, not cyclic. It informs the customer about the current SLACState, LinkStatus and the measured attenuation.

### 6.3.4 HardwareStatus

The HardwareStatus message is sent from CMS to VCU (EV). We can select the GPIO as either GPIO or ADC. The GPIO value will be SNA if it is configured as an ADC and GPIOADCValue will be SNA if it is configured as GPIO. It sends the GPIO status HIGH or LOW and ADC the raw values.

### 6.3.5 HardwareConfig

The HardwareConfig message is send from the VCU (EV) to CMS. Customers can configure GPIO either low or high when the GPIO is configured as an output.

### 6.3.6 EVMacAddress

The EVMacAddress message contains the MAC address of the charging interface. First, it is sent on startup of the system and then cyclic every 10 seconds.

## 6.4 Stop charging and error shutdown on EVSE side

The EVSE also can stop the charging with EVSE Status Code. The default status code is SNA and later it can be configured as "Not Ready" ('0') or "Ready" ('1') state. The status code as NotReady for standby or maintenance states and Ready for start normal operation. To initiate a shutdown for a non-critical reason (Customer initiated shutdown etc.), the error status can be set to "Shutdown" ('2'). But this error status can be ignored by the EV.

In case of emergency shutdown (E-stop button is pressed etc.), the status shall be set to "Emergency Shutdown" ('5'). In case of a non-recoverable malfunction (isolation failure etc.), the status code shall be set to "Malfunction" ('6'). In both cases the charging session is aborted immediately.

## 7 Module Reset

It is possible to reset the complete module using specific CAN message. The message needs to be sent on event based.

CAN Msg ID: 0x667

Frame type : standard

Msg Payload : 1stByte= 0xFF, 2ndByte = 0x00

Msg length : 2

Please make sure that our module GPIO6 X50 Pin is not set high by your PCB design. Otherwise the module will stay in bootloader.

## 8 CAN communication enable/disable

In case customers need to disable the CAN communication in CMS module, the customer SPI CS (chip select) pin could be used to control CAN communication. If the SPI CS pin is pulled high, module will not send or receive CAN messages, if pulled down, CAN communication will resume.

In order to use this feature, the customer needs to activate it using the "HW Configuration" tab of the CMx tool.

## 9 SLAC Attenuation Threshold

The SLAC pairing procedure that establishes the physical communication channel between the EV and EVSE measures the attenuation of the physical channel. A threshold can be set which is used to decide whether a measured attenuation is acceptable by the EV. This threshold by default is set to 60dB. If tighter margins are required, for example for situation with many EVSEs in close proximity, a lower threshold can be written into internal configuration memory via UDS.

The CMx tool provides an easy user interface for the customer to adjust this threshold value graphically.

## 10 Customer GPIOs

There are 7 customer GPIOs available for customers to configure. Three of the GPIOs could be configured as ADC or GPIO. The other four GPIOs could be only configured as GPIO.

Customers can utilize the "GPIO Configuration" tab of the CMx tool in order to configure the GPIO accordingly.

The status of each GPIO is shown and sent via CAN message 0x2004 HardwareConfig, if GPIO1 or GPIO2 was configured as ADC channel, the value read by our module will be also sent via CAN. The following table shows the possibilities to configure the six GPIOs.

Should the customer configure GPIO 1 or GPIO 2 as ADC channel, the customer shall implement Low Pass filter circuit connected to the GPIO, and the cut off frequency is lower than frequency of 160 KHz. The host processor reference voltage is 3.3V.

Should the customer configure GPIO 7 as ADC channel, the customer should be aware that a Low Pass filter circuit is connected to the GPIO7.

GPIOs	configuration (GPIO or ADC)	If configured as GPIO	If configured as ADC channels
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		Messages from customer to CMS Rx			Messages from CMS to customer Tx
		Direction	Pull Config	Drive Strength (if configured as GPIO output)	
GPIO1	possible to configure as ADC channel	Output or Input	Pull not enabled or Pull down enabled or Pull up enabled	Low drive strength or High drive strength	ADC value will be sent via CAN in HardwareConfig message
GPIO2	possible to configure as ADC channel	Output or Input	Pull not enabled or Pull down enabled or Pull up enabled	Low drive strength or High drive strength	ADC value will be sent via CAN in HardwareConfig message
GPIO3	only possible as GPIO	Output or Input	Pull not enabled or Pull down enabled or Pull up enabled	Low drive strength or High drive strength	Not possible
GPIO4	only possible as GPIO	Output or Input	Pull not enabled or Pull down enabled or Pull up enabled	Low drive strength or High drive strength	Not possible
GPIO5	only possible as GPIO	Output or Input	Pull not enabled or Pull down enabled or Pull up enabled	Low drive strength or High drive strength	Not possible
GPIO6	only possible as GPIO	Output or Input	Pull not enabled or Pull down enabled or	Low drive strength or High drive strength	Not possible

			Pull up enabled		
GPIO7	possible to configure as ADC channel	Output or Input	Pull not enabled or Pull down enabled or Pull up enabled	Low drive strength or High drive strength	ADC value will be sent via CAN in HardwareConfig message

## 11 Error codes

In case of errors during the charging, errors will be buffered and the last four errors will be transmitted to the CAN message 0x2002 (ErrorCodes). After plugging out, error codes are cleared.

If there is an error code, which is not listed in the table below, it is a code for an internal error.

Value (dec)	Value (hex)	Enum value	Comments
0	0x00	UNPLUGGED	Indicates the default state. The EV and EVSE are not connected to each other.
1	0x01	STATUS_OK	Indicates the plugged-in state without errors.
2-138	0x02-0x8A		Used for internal errors. If such an error code occurs, please notify us. You can then also get more information about the error.
139	0x8B	SM_SAP_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
140	0x8C	SM_SESSIONSETUP_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
141	0x8D	SM_SERVICEDISCOVERY_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
142	0x8E	SM_SERVICEPAYMENTSELECTION_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
143	0x8F	SM_CONTRACT_AUTHENTICATION_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
144	0x90	SM_CHARGE_PARAMETER_DISCOVERY_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
145	0x91	SM_CABLE_CHECK_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
146	0x92	SM_PRE_CHARGE_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.

147	0x93	SM_POWER_DELIVERY_PRECHARGE_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
148	0x94	SM_CURRENT_DEMAND_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
149	0x95	SM_POWER_DELIVERY_POSTCHARGE_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
150	0x96	SM_WELDING_DETECTION_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
151	0x97	SM_SESSION_STOP_RESPONSE_FAILED	Occurs if dinresponseCodeType_FAILED <= response_code.
152	0x98	SM_CHARGE_PARAMETER_EVSESTATUSCODE_FAILED	Occurs if EVSE emergency shutdown or malfunction.
153	0x99	SM_CABLE_CHECK_EVSESTATUSCODE_FAILED	Occurs if EVSE emergency shutdown or malfunction.
154	0x9A	SM_PRE_CHARGE_EVSESTATUSCODE_FAILED	Occurs if EVSE emergency shutdown or malfunction.
155	0x9B	SM_PRECHARGE_EVSESTATUSCODE_FAILED	Occurs if EVSE emergency shutdown or malfunction.
156	0x9C	SM_CURRENT_DEMAND_EVSESTATUSCODE_FAILED	Occurs if EVSE emergency shutdown or malfunction.
157	0x9D	SM_POSTCHARGE_EVSESTATUSCODE_FAILED	Occurs if EVSE emergency shutdown or malfunction.
158	0x9E	SM_CABLE_CHECK_ISOLATION_NOTVALID	Occurs if EVSE emergency shutdown or malfunction.
159	0x9F	SM_SHUTDOWN_ERR	Occurs if we go to session stop with error.
160	0xA0	V2G_HLC_INIT_TIMEOUT	V2G Init took over 20s, abort.
161	0xA1	EVSE_EMERGENCY	EVSE emergency shutdown.
162	0xA2	LIMITS_MSG_TIMEOUT	This CAN message timeout occurs when this message missing for 1000 ms (10 messages in sequence). The error code sends via CAN. This message is used in charge parameter discovery request so the state machine drives to V2G invalid state if it missing in HLC after charge parameter discovery state(V2G state).

163	0xA3	STATUS_MSG_TIMEOUT	This CAN message timeout occurs when this message missing for 1000 ms (10 messages in sequence). The error code sends via CAN. This message is used in charge parameter discovery request so the state machine drives to V2G invalid state if it missing in HLC after charge parameter discovery state(V2G state).
164	0xA4	PLUGSTATUS_MSG_TIMEOUT	This CAN message timeout occurs when this message missing for 1000 ms (10 messages in sequence). The error code sends via CAN. The Plug status message only important in CAN configuration and it ignores in GPIO configuration. The plug status messages important from plugged state to charge finish. So, state machine drive CP_PP error if this msg missing only in CP/PP state machine and also state machine drives V2G state invalid if it missing in HLC.
165-166	0xA5..0xA6		Used for internal errors. If such an error code occurs, please notify us. You can then also get more information about the error.
167	0xA7	EVSE_MAX_CURRENT_RANGE_OVERFLOW	Signals that the value for the maximum current is not within the specified range.
168	0xA8	EVSE_MAX_VOLTAGE_RANGE_OVERFLOW	Signals that the value for the maximum voltage is not within the specified range.
169	0xA9	EVSE_MAX_POWER_RANGE_OVERFLOW	Signals that the value for the maximum power is not within the specified range.
170	0xAA	EVSE_ENERGY_TO_BE_DELIVERED_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
171	0xAB	EVSE_MIN_CURRENT_RANGE_OVERFLOW	Signals that the value for the minimum current is not within the specified range.
172	0xAC	EVSE_MIN_VOLTAGE_RANGE_OVERFLOW	Signals that the value for the minimum voltage is not within the specified range.
173	0xAD	EVSE_PEAK_CURRENT_RIPPLE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.

174	0xAE	EVSE_CURRENT_REGULATION_TOLERANCE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
175	0xAF	EVSE_PRESENT_VOLTAGE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
176	0xB0	EVSE_PRESET_CURRENT_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
177	0xB1	EVSE_ISOLATION_STATUS_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
178	0xB2	EVSE_CURRENT_LIMIT_ACHIEVED_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
179	0xB3	EVSE_VOLTAGE_LIMIT_ACHIEVED_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
180	0xB4	EVSE_POWER_LIMIT_ACHIEVED_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
181	0xB5	EVSE_STATUS_CODE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
182	0xB6	STATE_MACHINE_STATE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
183	0xB7	PROXIMITY_PIN_STATE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
184	0xB8	SW_S2_CLOSE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
185	0xB9	ACTUAL_CHARGE_PROTOCOL_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
186	0xBA	TCP_STATUS_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
187	0xBB	CONTROL_PILOT_DUTY_CYCLE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
188	0xBC	CONTROL_PILOT_STATE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
189	0xBD	VOLTAGE_MATCH_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
190	0xBE	EVSE_COMPATABLE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
191	0xBF	SLAC_STATE_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
192	0xC0	LINK_STATUS_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.

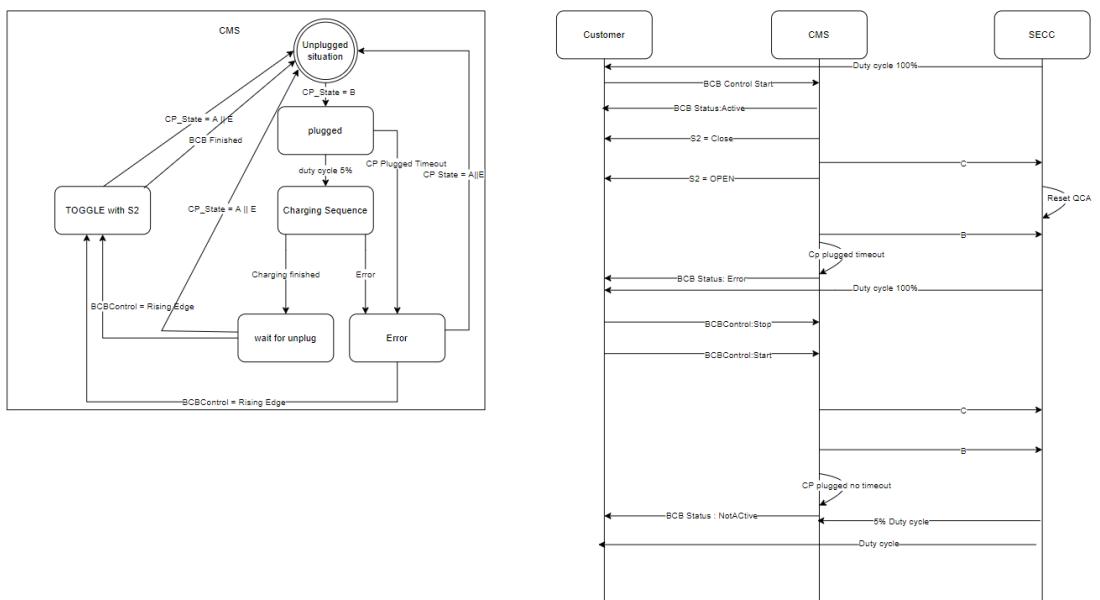
193	0xC1	MEASUREMENT_ATTENUATION_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
194	0xC2	CHARGE_PROGRESS_INDICATION_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
195	0xC3	CHARGE_STOP_INDICATION_RANGE_OVERFLOW	Signals that the value for this signal is not within the specified range.
196	0xC4	EV_SNA_ERROR	Occurs if the EVSE sends a value out of range.
197	0xC5	UNSUPPORTED_CHARGE_STACK	Occurs if the EVSE sends a value out of range.
198	0xC6	SAP_INVALID_SCHEMA_ID	Occurs if the EVSE sends a value out of range.
199-214	0xC7-0xD6		Used for internal errors. If such an error code occurs, please notify us. You can then also get more information about the error.
215	0xD7	SM_AUTHENTICATION_ONGOING_TIMEOUT	Contract authentication ongoing timeout because it took more than 60s in authentication phase.
216	0xD8	SM_CPD_ONGOING_TIMEOUT	ongoing timeout 60s in charge parameter discovery phase.
217	0xD9	SM_CABLECHECKTIMER_TIMEOUT	CableCheck timeout 40s reached.
218	0xDA	SM_PRECHARGETIMER_TIMEOUT	PreCharge timeout 7s reached.
219	0XDB	SM_READYTOCHARGE_TIMEOUT	ReadyToCharge timeout reached 150s from plugin to first power delivery message.
220	0xDC	GPIO1_ADC_RANGE_OVERFLOW	GPIO1 ADC value range overflow.
221	0xDD	GPIO2_ADC_RANGE_OVERFLOW	GPIO2 ADC value range overflow.
222	0xDE	GPIO1_STATUS_OVERFLOW	GPIO1 configuration range overflow If such an error code occurs, please notify us.
223	0xDF	GPIO2_STATUS_OVERFLOW	GPIO2 configuration range overflow If such an error code occurs, please notify us.
224	0xE0	GPIO3_STATUS_OVERFLOW	GPIO3 configuration range overflow If such an error code occurs, please notify us.
225	0xE1	GPIO4_STATUS_OVERFLOW	GPIO4 configuration range overflow If such an error code occurs, please notify us.
226	0xE2	GPIO5_STATUS_OVERFLOW	GPIO5 configuration range overflow

			If such an error code occurs, please notify us.
227	0xE3	GPIO6_STATUS_OVERFLOW	GPIO6 configuration range overflow If such an error code occurs, please notify us.
228	0xE4	GPIO7_STATUS_OVERFLOW	GPIO7 configuration range overflow If such an error code occurs, please notify us.
229	0xE5	GPIO7_ADC_RANGE_OVERFLOW	GPIO7 ADC value range overflow.
230	0xE6	EV_CP_SNA	ControlPilotState was interrupted during charging. CP state not equal to B or C during high level communication charging. CP reading is not stable probably.
231	0xE7	EV_PWM_SNA	PWM was interrupted during charging. PWM either SNA or INVALID during charging. Probably PWM evaluation is not stable.
232	0xE8	EV_MAC_ADDRESS_RANGE_OVERFLOW	EV MAC address range overflow If such an error code occurs, please notify us.
233	0xE9	EVSE_NOTIFICATION_RANGE_OVERFLOW	EVSE Notification range overflow.
234	0xEA	EVSE_NOTIFICATION_MAX_DELAY_RANGE_OVERFLOW	EVSE Notification max delay range overflow.
235	0xEB	SLAC_ATTENUATION_HIGH	SLAC attenuation less than 10db over threshold.
236	0xEC	SLAC_ATTENUATION_TOO_HIGH	SLAC attenuation more than 10db over threshold.
237	0xED	LOW_VOLTAGE_DETECTED	Supply voltage is lower than specification.
238	0xEE	SM_SAP_SCHEMA_ID_NOT_SUPPORTED_BY_EVSE	EVCC list of schema Ids not supported by EVSE.
239	0xEF	EEPROM_CHECKSUM_ERROR	EEPROM checksum mismatch.
240	0xF0	EV_ERROR_CODE_SNA	Mandatory signal not set.
241	0xF1	EV_READY_SNA	Mandatory signal not set.
242	0xF2	EV_SOC_SNA	Mandatory signal not set.
243	0xF3	EV_TARGET_CUR_SNA	Mandatory signal not set.
244	0xF4	EV_TARGET_VOL_SNA	Mandatory signal not set.
245	0xF5	EV_CHARG_COMP_SNA	Mandatory signal not set.
246	0xF6	EV_MAX_VOLT_SNA	Mandatory signal not set.
247	0xF7	EV_MAX_CUR_SNA	Mandatory signal not set.
248	0xF8	EV_PRE_VOLT_SNA	Mandatory signal not set.
249	0xF9	EV_E_STOP_TRIGGERED	E-Stop triggered by EV.
250	0xFA	BCB_STATUS_OVERFLOW	BCB status range overflow, internal error.

251	0xFB	PARAMETERS_TIMEOUT	Timeout error, no valid charge parameters received during Parameters phase within timeout 60s (ev_max_current, float ev_max_voltage, float ev_ready, float ev_soc, float ev_error_code).
252	0xFC	WARNING_SAP_MINOR_DEVIATION	Warning during supported app protocol (SuccessfulNegotiationWithMinorDeviation received).
253-258	0xFD-0x102		Used for internal errors. If such an error code occurs, please notify us. You can then also get more information about the error.
259	0x103	PAUSE_ERROR_NO_SHUTOFF	Customer unplugged and did not power off CMS module.
260	0x104	RESUME_ERROR_NO_BCB_TOGGLE	Customer unplugged and did not send BCB control = start.
261	0x105	PAUSE_INVALID_SCHEDULETUPLEID	CPD Error SAScheduleTupleID before sleep doesn't match TupleID after wakeup.
262	0x106	ISO_RESUME_SOCKET_CREATION_FAILED	Create socket after charging pause failed.
263	0x107	ISO_RESUME_SOCKET_CONNECT_FAILED	TCP connection failed after charging pause.

## 12 B-C-B restart

Currently, the B-C-B restart is implemented as use case for start charging without disconnect the CP line. This feature is supported only by a few charging stations, so for more information about this feature please contact us.



## 13 Firmware update via CAN

It is possible to update the firmware via the CAN-Bus. To do this, you need the small program Microboot.exe and a CAN-USB Device, e.g. Peak System PCAN-USB. Microboot requires no installation and can be started simply by double-clicking. After starting the application, you should check the settings. They should be as shown below. After selecting the new firmware file, the flash process starts automatically and the progress is shown.

Microboot terminates itself when the new firmware has been written to the module.

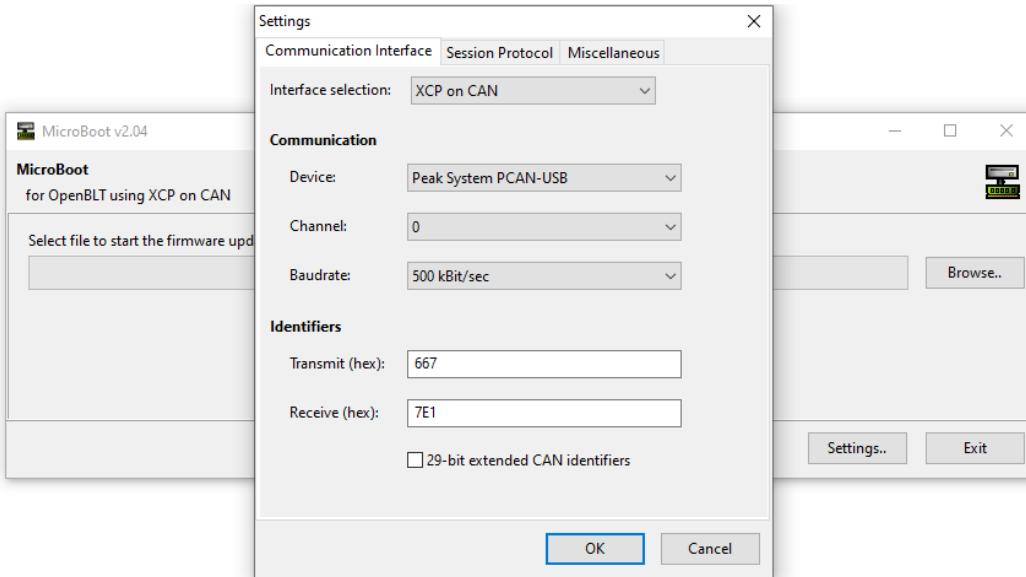
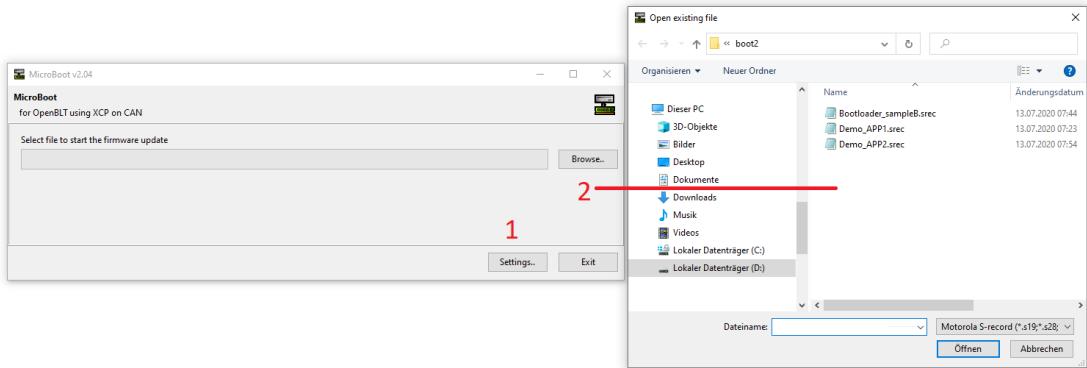


Figure 1 Microboot settings



## 14 Contact

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