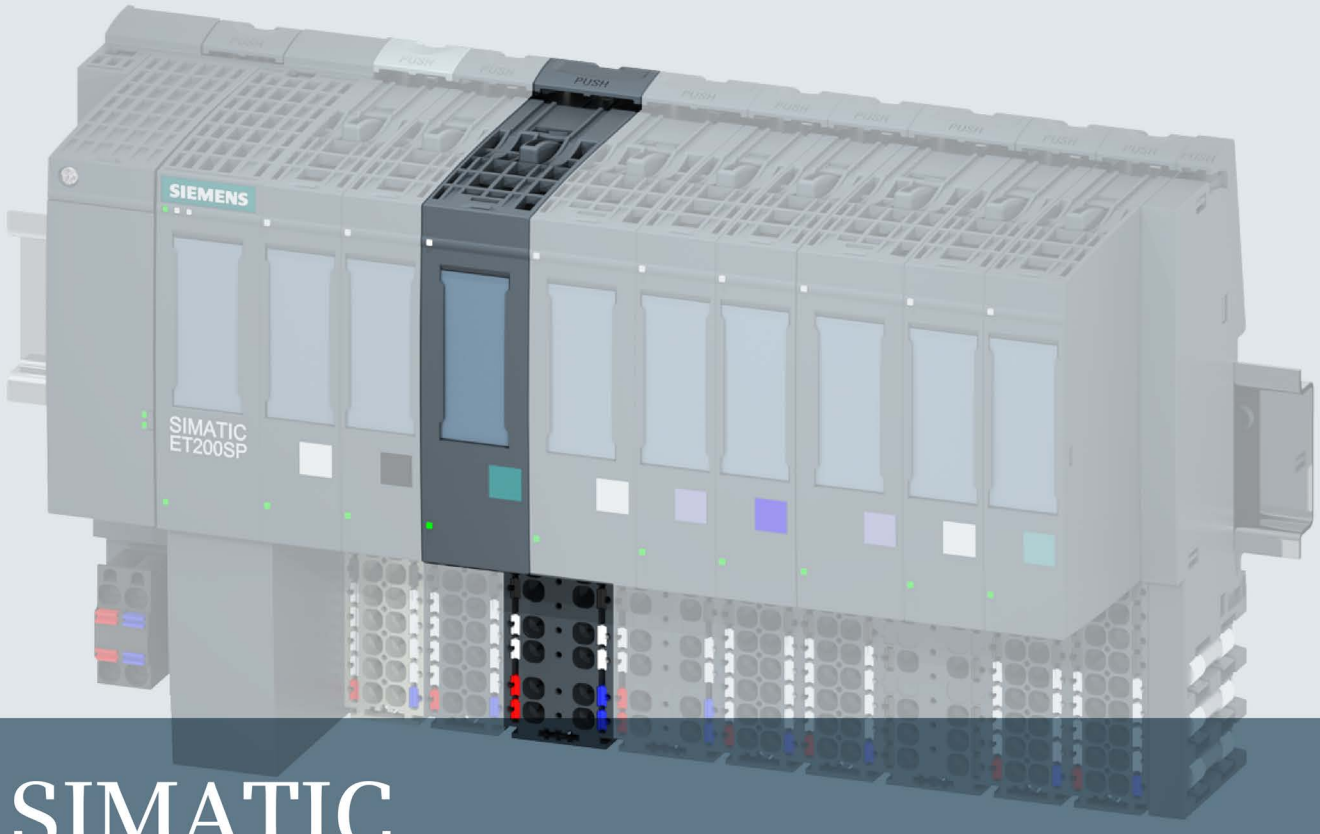
SIEMENS



SIMATIC

ET 200SP

Technology module TM ECC PL ST

Product manual

Version 10/2022

Answers for industry.

SIEMENS

SIMATIC

ET 200SP
Technology module TM ECC PL ST (6FE1242-6TM20-0BB1)

Equipment Manual

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10/2022

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Preface

Preface

Purpose of the documentation

This manual contains module-specific information on wiring, diagnostics as well as the technical specifications of the technology module.

General information on installation and commissioning of the ET 200SP is available in the ET 200SP System Manual.

Conventions

Please take into account the notes marked as follows:

Note

A note contains important information on the product described in this documentation, its handling and to a section of the documentation to which you should pay particular attention.

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Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

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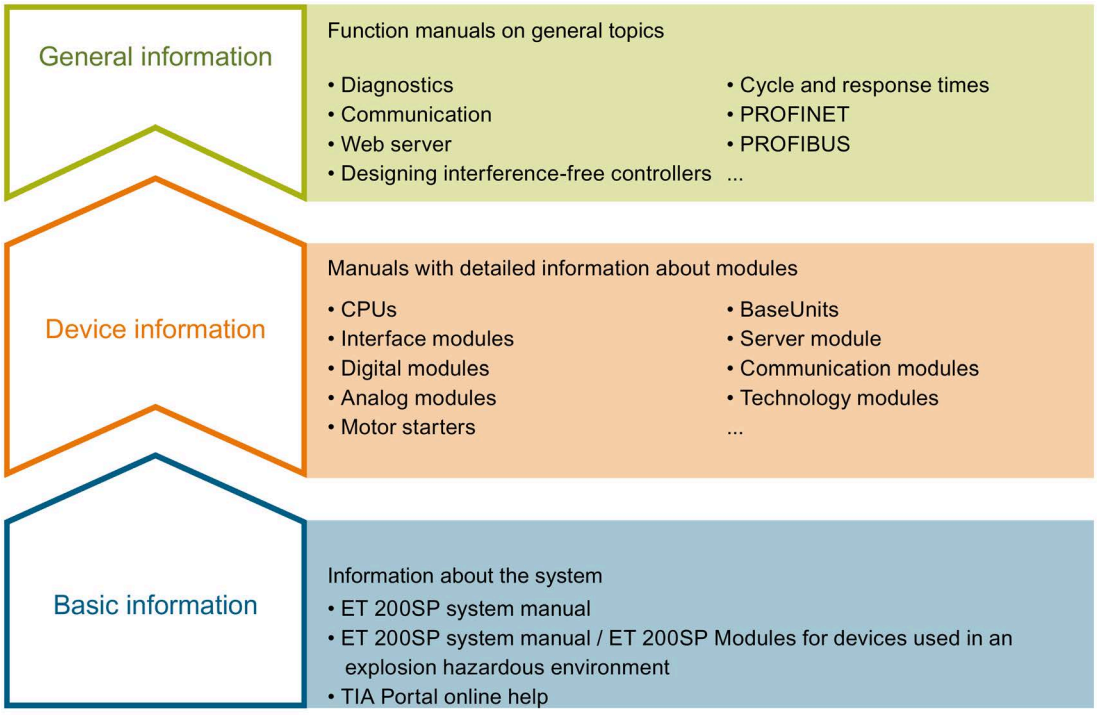
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ET 200SP Documentation Guide

1

The documentation for the SIMATIC ET 200SP distributed I/O system is arranged into three areas.
This arrangement enables you to access the specific content you require.



Basic information

The System Manual and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC ET 200SP distributed I/O system. The STEP 7 online help supports you in the configuration and programming.

Device information

Product manuals contain a compact description of the module-specific information, such as properties, wiring diagrams, characteristics and technical specifications.

General information

The function manuals contain detailed descriptions on general topics regarding the SIMATIC ET 200SP distributed I/O system, e.g. diagnostics, communication, Web server, motion control and OPC UA.

You can download the documentation free of charge from the Internet (https://support.industry.siemens.com/cs/ww/en/view/109742709).

Changes and supplements to the manuals are documented in a Product Information.

You can download the product information free of charge from the Internet (https://support.industry.siemens.com/cs/us/en/view/73021864).

Manual Collection ET 200SP

The Manual Collection contains the complete documentation on the SIMATIC ET 200SP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet (https://support.automation.siemens.com/WW/view/en/84133942).

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You must register once to use the full functionality of "mySupport".

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"mySupport" - CAx data

In the CAx data area of "mySupport", you can access the latest product data for your CAx or CAe system.

You configure your own download package with a few clicks.

In doing so you can select:

- Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files
- Manuals, characteristics, operating manuals, certificates
- Product master data

You can find "mySupport" - CAx data on the Internet (https://support.industry.siemens.com/my/ww/en/CAxOnline).

Application examples

The application examples support you with various tools and examples for solving your automation tasks. Solutions are shown in interplay with multiple components in the system - separated from the focus on individual products.

You will find the application examples on the Internet (https://support.industry.siemens.com/sc/ww/en/sc/2054).

TIA Selection Tool

With the TIA Selection Tool, you can select, configure and order devices for Totally Integrated Automation (TIA).
This tool is the successor of the SIMATIC Selection Tool and combines the known configurators for automation technology into one tool.
With the TIA Selection Tool, you can generate a complete order list from your product selection or product configuration.

You can find the TIA Selection Tool on the Internet (https://w3.siemens.com/mcms/topics/en/simatic/tia-selection-tool).

SIMATIC Automation Tool

You can use the SIMATIC Automation Tool to perform commissioning and maintenance activities simultaneously on various SIMATIC S7 stations as a bulk operation independent of TIA Portal.

The SIMATIC Automation Tool provides a multitude of functions:

- Scanning of a PROFINET/Ethernet system network and identification of all connected CPUs
- Address assignment (IP, subnet, gateway) and station name (PROFINET device) to a CPU
- Transfer of the date and the programming device/PC time converted to UTC time to the module
- Program download to CPU
- RUN/STOP mode switchover
- CPU localization by means of LED flashing
- Reading out of CPU error information
- Reading of the CPU diagnostics buffer
- Reset to factory settings
- Firmware update of the CPU and connected modules

You can find the SIMATIC Automation Tool on the Internet (https://support.industry.siemens.com/cs/ww/en/view/98161300).

PRONETA

SIEMENS PRONETA (PROFINET network analysis) allows you to analyze the plant network during commissioning. PRONETA features two core functions:

- The topology overview automatically scans the PROFINET and all connected components.
- The IO check is a fast test of the wiring and the module configuration of a plant, incl. fail-safe inputs and outputs.

You can find SIEMENS PRONETA on the Internet (https://support.industry.siemens.com/cs/ww/en/view/67460624).

SINETPLAN

SINETPLAN, the Siemens Network Planner, supports you in planning automation systems and networks based on PROFINET. The tool facilitates professional and predictive dimensioning of your PROFINET installation as early as in the planning stage. In addition, SINETPLAN supports you during network optimization and helps you to exploit network resources optimally and to plan reserves. This helps to prevent problems in commissioning or failures during productive operation even in advance of a planned operation. This increases the availability of the production plant and helps improve operational safety.

The advantages at a glance

- Network optimization thanks to port-specific calculation of the network load
- Increased production availability thanks to online scan and verification of existing systems
- Transparency before commissioning through importing and simulation of existing STEP 7 projects
- Efficiency through securing existing investments in the long term and the optimal use of resources

You can find SINETPLAN on the Internet (https://www.siemens.com/sinetplan).

See also

My Documentation Manager (https://support.industry.siemens.com/My/ww/en/documentation)

Product overview

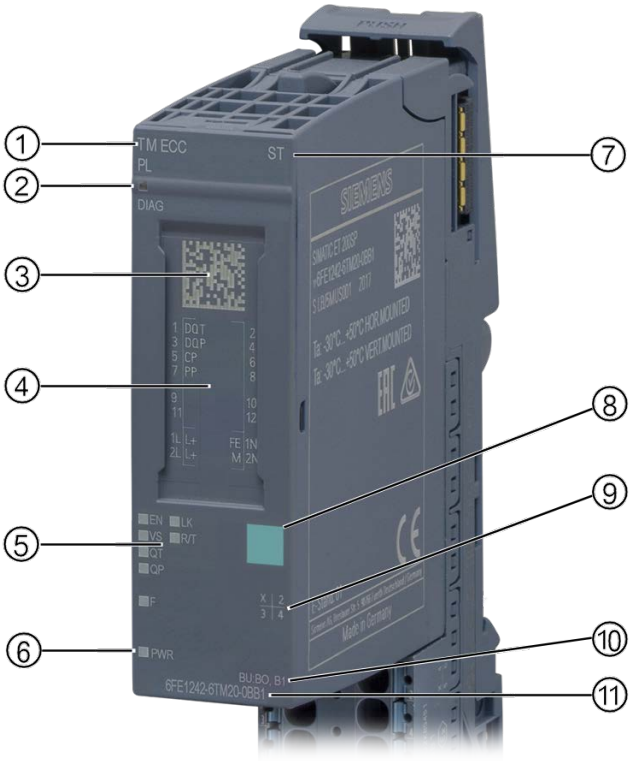
2

2.1 Properties

Article number

SIMATIC ET 200SP TM ECC PL ST 6FE1242-6TM20-0BB1

View of the module



① Module type and name
② LED for diagnostics
③ 2D matrix code
④ Wiring diagram
⑤ Status LEDs
⑥ LED for supply voltage
⑦ Function class
⑧ Color labeling module type
⑨ Function state of the device
⑩ BU type
⑪ Article number

Figure 2-1 View of the module SIMATIC ET 200SP TM ECC PL ST

Properties

The SIMATIC ET 200SP TM ECC PL ST technology module is used for control and monitoring of conductive direct current charging of electric vehicles in accordance with DIN SPEC 70121 and IEC 15118-2, charging mode 4. To this purpose it provides a charging outlet.

Note

This manual does not describe the functional design of a charging station.

The module generates and monitors a CP signal (Control Pilot signal) according to IEC 61851-1.

Communication between the vehicle and the charging station takes place based on "PowerLine Green Phy" (HPGP). This overlays the "Control Pilot Signal". In accordance with the standard the "duty cycle" of the PWM signal is set fixed to 5%.

Its TRIP function (Page 17) is intended to ensure that the charging voltage (dangerous to touch) is only applied to the charging cable when:

- The charging cable is connected correctly
- The vehicle is ready to be charged or is charging (Charging state C or D)

In addition this TRIP function ensures that voltages dangerous to touch on the charging cable (caused for example by the charging connector) are switched off.

In addition the proximity contact PP (Plug Present) is monitored by means of the PP function (Page 18). As soon as the button is pressed at the charging plug or the plug is removed from the vehicle, the associated DQ P is set to "False". This means that the Open Collector output is high-impedance (see "Example circuitry of the switching contacts (Page 31)" in the section "Switching contact DQ T and DQ P").

To integrate the SIMATIC ET 200SP TM ECC PL ST technology module into the TIA environment, you must use the "DIN_70121" (Page 39) or "ISO_15118_DC" (Page 63) function block, depending on the application. The selected function block monitors the respective breakers, initiates the cable check and makes the relevant current and voltage settings of the vehicle available to the associated frequency converters.

If an insulation monitor exists, it is evaluated (warning/fault). If a fault occurs at the insulation monitor, the frequency converter is shut down in a controlled manner - in as far as possible. The CP voltage level changes to -12V.

If an emergency shutdown is required, the frequency converter is shut down in a controlled manner - in as far as possible. The CP voltage level changes to -12V.

Inputs and outputs

- 1x Control Pilot (CP)
- 1x Plug Present (PP) Relevant for Type 1 plugs in accordance with SAE-J1772
- 1x Digital Out (DQ) as Open Collector as TRIP function. Maximum 0.6 A.
  (Control Pilot signaling status)
- 1x Digital Out (DQ) as Open Collector as PP function. Maximum 0.6 A.
  Relevant for Type 1 plugs in accordance with SAE-J1772.
  (Plug Present signaling status)

Diagnostics interface

The device has an interface inside the housing that can be used locally by customers for diagnostic purposes according to precise Siemens instructions. Use of this interface for other purposes is not permitted.

System environment

Firmware version 1.1 or higher:

- TIA Portal V17 or higher

Distributed operation in an S7-1500 system and as of FW version 1.0.3 also in an S7-1200 system:

- TIA Portal V15 or higher

Distributed operation in a system of third-party manufacturers is not possible.

Central operation with an:

- ET 200SP CPU
- Open Controller

Accessories

The following accessories can be used with the module and is not included in the scope of delivery:

- Labeling strips
- Color-coded labels
- Reference identification labels

A BaseUnit of the BU type B1 or BU type B0 is required to operate the technology module. You can find an overview of the BaseUnits that are compatible with the technology module in the Product information for documentation of the ET 200SP Distributed I/O System (https://support.industry.siemens.com/cs/document/73021864?dti=0&lc=en-US).

You will find additional information on installation in the ET 200SP distributed I/O system System Manual (http://support.automation.siemens.com/WW/view/en/58649293).

Disposal



Electric and electronic devices do not belong in household waste. Dispose of the product according to the valid legal regulations at the end of its service life. By doing so you will meet the legal obligations and help protect the environment. WEEE Reg. No. DE 23691322

Configuration example

The charge controller described here is a technology module for SIMATIC ET 200SP. TIA Portal must be used as the configuration software.

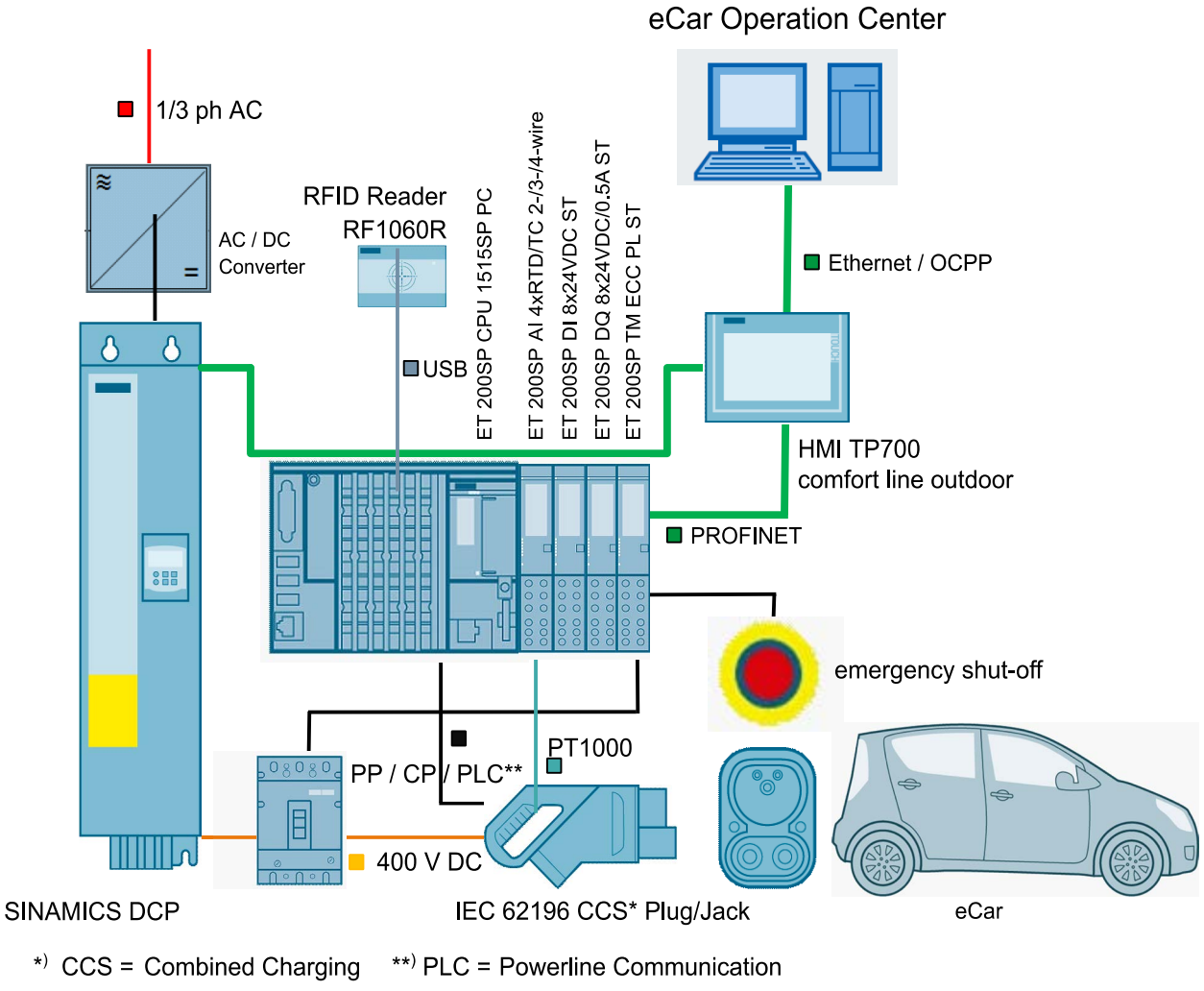


Figure 2-2 Configuration example with one charging outlet

Updating the firmware

Information about carrying out the firmware update is provided in the ET 200SP System Manual.

Note

Firmware update

Note that a firmware update can only be performed in STOP mode. When you initiate the update from TIA Portal, you must switch the CPU to STOP manually. No dialog prompting you to do so appears in this case. If the CPU is not switched to STOP, the update is not executed and the progress bar remains at "0%" and aborts without additional error messages.

Note

Duration of the firmware update

Note that a firmware update can take up to four hours. During the first 10 minutes of a firmware update, a progress of "0%" is displayed via TIA Portal. While the update is already in progress during this time, the progress is less than "4%".

A red flashing DIAG LED indicates that the update is in progress.

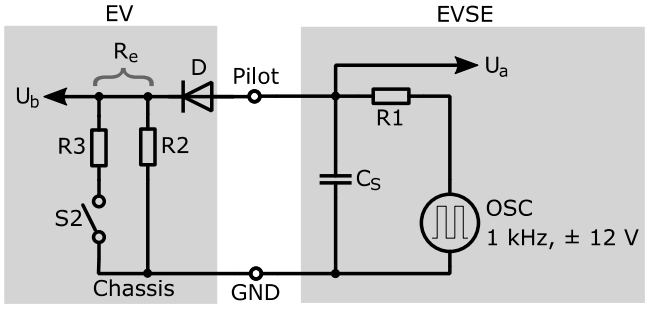
At the end of each successful firmware update, the firmware of the TM ECC PL ST runs internal procedures. At the same time, TIA Portal retrieves the module status to confirm the successful update. However, the module only answers this query after it has fully processed its internal procedures. You cannot operate TIA Portal until it has received all the information it has requested.

NOTICE
Supply voltage during the firmware update The supply voltage of the ET 200SP station as well as the external voltage supply when the Base Unit B1 is used, or the voltage supply of the supplying potential module when the Base Unit B0 is used, must not be switched off during a firmware update. The flashing "EN-LED" indicates that the firmware update was installed without any errors. You must now disconnect the device from the supply voltage. Premature disconnection of the supply voltage results in a functionless state of the TM ECC PL ST technology module that cannot be remedied.

2.2 Control Pilot

Control Pilot CP

The module generates a Control Pilot signal for the charging outlet. This signal is a square wave signal with 1 kHz frequency and an amplitude of +/-12 V. The duty cycle of the Control Pilot signal is set fixed to 5%. This signals to the vehicle that power line communication (HPGP) is possible. At the same time, the voltage level is monitored. This is evaluated by means of the firmware on the module. In parallel the signal is monitored by means of a hardware circuit in the form of the TRIP function. This guarantees low response times as soon as the charging state "C" or "D" is left.



EVSE	Charging station
EV	Vehicle
R1	1000 Ω ± 3%
R2	2740 Ω ± 3%
R3	1300 Ω ± 3% (State C) or 270 Ω ± 3% (State D)
R_e	Input resistance of the vehicle CP interface
C_S	300 pF
U_a	Voltage measurement of the column
U_b	Voltage measurement (level, frequency, duty cycle) of the vehicle

Figure 2-3 Typical pilot current

The vehicle indicates its state by applying corresponding resistances. In order to determine the vehicle state the positive component of the PWM signal is acquired as the peak value (U_a) and is read in:

Table 2- 1 States and level U_a

State	PWM	S2	Vehicle connected with charging station	Vehicle ready for charging	Charging station ready for charging	U_a	Remark [a]
A1	Off	N/A	No	No	No	11 V .. 13 V	U_b = 0 V
A2	On				Yes		
B1	Off	Open	Yes	No	No	8 V .. 10 V	R_e = R2 = 2.74 kΩ [a]
B2	On				Yes		
C1	Off	Closed	Yes	Yes	No	5 V .. 7 V	R_e = R2||R3$_C$ = 882 Ω [a]
C2	On				Yes		Ventilation not required
D1	Off				No	2 V .. 4 V	R_e = R2||R3$_D$ = 246 Ω [a]
D2	On				Yes		Ventilation required
E	Off	N/A	N/A	N/A	No	-1 V .. 1 V	U_b = 0 V: EVSE, main problem or mains not available, pilot wire short-circuit to ground, etc.
Invalid					No	-11 V ... -1 V	Invalid CP voltage
F					No	-13 V ... -11 V	E.g. error in the charging station, charging station in maintenance, etc.

[a] The resistance R_e is the input resistance of the CP interface of the vehicle.

TRIP function

The amplitude of the CP (Control Pilot) pilot signal is evaluated. As soon as the Charge state C or the Charge state D (for the definition of the states please refer to IEC 61851-1) is reached, the associated Open Collector output (DQ T) becomes conductive. Otherwise it is high-impedance.

Note

Since the TRIP function is executed to a great extent in the hardware, state transitions in the charging process can be recognized and signaled very rapidly.

You can use the TRIP signal to observe the switch-off times required by the standard. Use application means to ensure that after the TRIP signal is deactivated (DQ T becomes high-impedance), the power flow is interrupted within the switch-off times required by the standard and that the charging cable is deenergized.

The switch-off delay of the DC output via the "DIN_70121" or "ISO_15118_DC" function block is not suitable for guaranteeing the switch-off times required by the standard.

WARNING

To ensure that a fault state (see IEC 61851-23) is sustained after an interruption of the CP signal as required by the standard, you must prevent, on the application level, the unwanted changeover to standby mode after the CP fault.

2.3 Plug Present

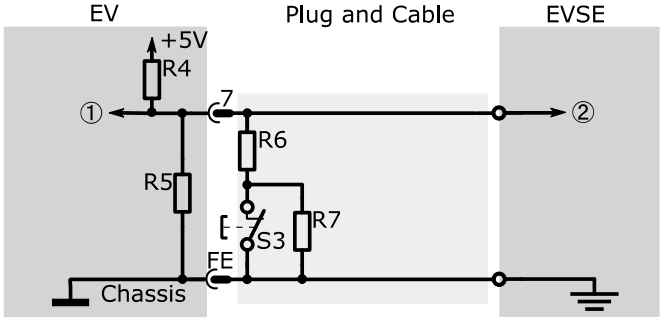
Plug Present (relevant for Type 1 plug in accordance with SAE-J1772)

The state of the proximity contact (Plug Present; PP) is monitored. This is evaluated on the module. At the same time, the signal is monitored via a hardware circuit in the form of the PP function. This guarantees low response times as soon as the charging connector has been disconnected from the vehicle.

The following states are theoretically possible:

- Plug disconnected
- Plug connected and switch operated;
- Plug connected and switch not operated;

These states are additionally output at the associated function block "DIN_70121" or "ISO_15118_DC".



EVSE	Charging station
EV	Vehicle
Chassis	Chassis
R4	330 Ω ± 10%
R5	2740 Ω ± 10%
R6	150 Ω ± 10%
R7	330 Ω ± 10%
①	Recognition logic
②	EVSE control unit

Figure 2-4 Plug Present circuit

Table 2- 2 Plug Present signal

Voltage between terminal (7) and (FE)	Min [V]	Nominal [V]	Max [V]
At the vehicle when the charging cable is not connected	4.13	4.46	4.78
At the charging connector when the charging cable is connected and the S3 button is not activated (closed)	1.23	1.53	1.82
At the charging connector when the charging cable is connected and the S3 button is activated (open)	2.38	2.77	3.16
At the charging station when the charging cable is not connected	-0.1	0	0.1

PP function

To this purpose the amplitude of the PP (Plug Present) voltage is evaluated. As soon as the PP plug is no longer connected to the PP socket, the associated Open Collector output (DQ P) becomes high-impedance; otherwise it is conductive.

Note

Since this trip function is executed to a great extent in the hardware, state transitions in the charging process can be recognized and signaled very rapidly.

To observe the switch-off times required by the standard you can use the PP signal. Use application means to ensure that after deactivation of the PP signal (DQ-P becomes high-impedance) the power flow is interrupted within the switch-off times required by the standard and that the charging cable is deenergized.

2.4 Charging communication according to DIN SPEC 70121

The DIN SPEC 70121 describes the digital communication between a direct current charging station and an electric vehicle for regulating the direct current charge in the combined charging system. This standard does not include the functions "Value added Service", "Plug&Charge", "V2G Energy Transfer" and "TLS encryption".

The Plug&Charge and TLS encryption enhancements are described in section "Enhancements relating to ISO 15118 as of FW Version V1.1.0 (Page 25)".

The charging controller TM ECC PL ST communicates with the vehicle in accordance with DIN SPEC 70121 using "PowerLine Green Phy" (HPGP). The power line communication is modulated to the Control Pilot (CP).

The module assumes the modulation or demodulation of the Ethernet data packages. These themselves are packed in an XML structure and transferred in the EXI format. The advantage of the EXI format is that the data can be packed more densely than in XML format.

Communication between the vehicle (EV) and the charging station (EVSE) is divided into different phases in the standard. Communication takes place in the form that the vehicle always sends a request (Req) and the charging station responds with a response (Res). A response code is always added to each response. This is described in DIN SPEC 70121 and ISO 15118.

The charging station itself is unable, in accordance with the standards, to send a request.

The individual charge phases are:

- Session Setup
- Service Discovery
- Service and Payment Selection
- Contract Authentication
- Charge Parameter Discovery
- Cable Check
- Pre Charge
- Power Delivery
- Current Demand
- Welding Detection (if required by the vehicle)
- Session Stop

The following figure shows the individual phases chronologically.

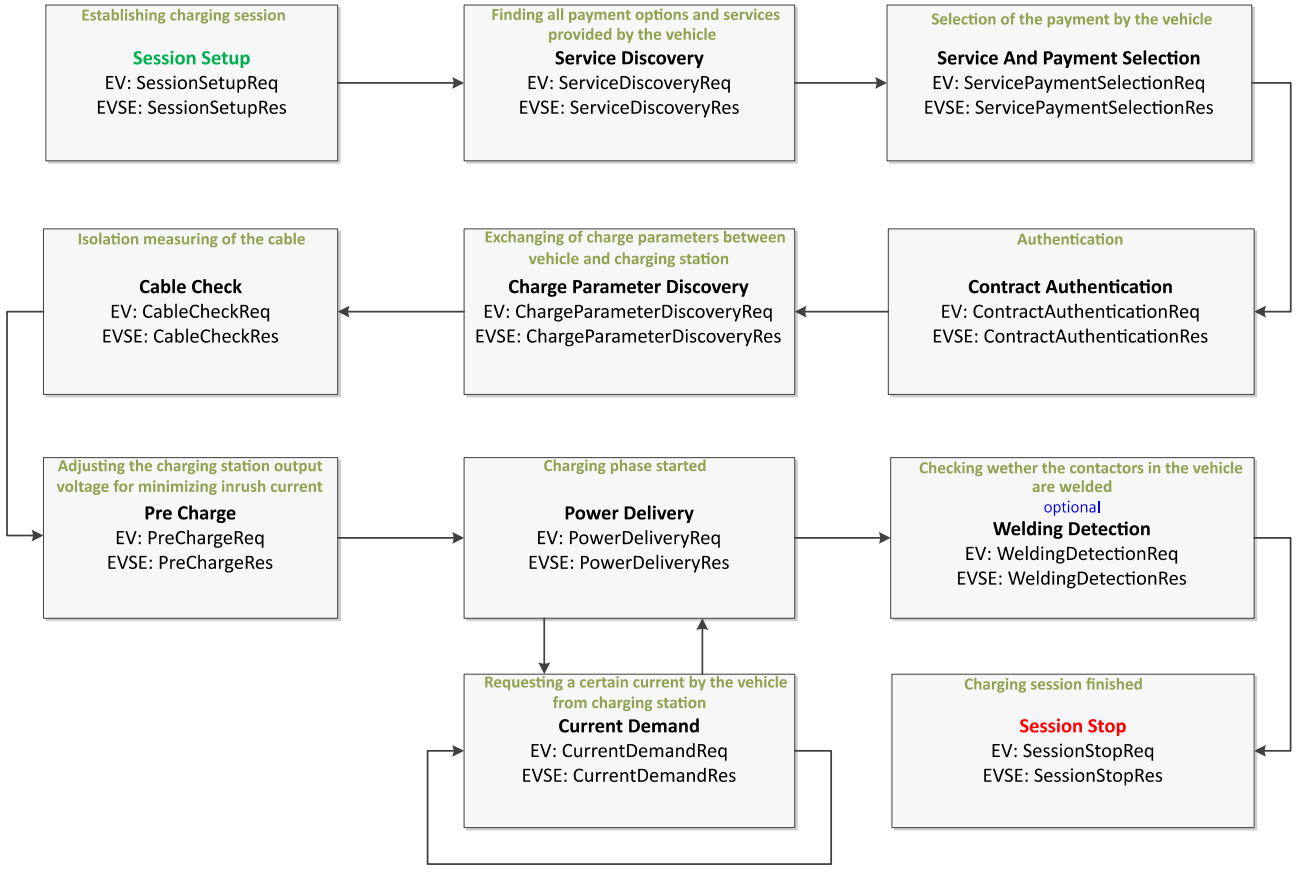


Figure 2-5 Charge phases in accordance with DIN SPEC 70121

Note

The parameters are only listed as an example in the following descriptions of the charge phases. For further information, refer to DIN SPEC 70121.

2.4.1 Session Setup

The communication starts with the setup of a session (Session Setup). To this purpose the vehicle sends a SessionSetupReq message to the charge column. This message contains the EVCCID (EV Charge Controller ID). This consists of the MAC address of the vehicle. The charge column confirms that a session has been set up by sending a SessionSetupRes message. This includes among other things the unique identifier of the charge column (EVSEID).

2.4.2 Service Discovery

After a session has been established successfully the vehicle starts with the search of the offered services. However, DIN SPEC 70121 does not support the search. Therefore no applicable data are exchanged between the vehicle and the charge column in this phase. The vehicle nevertheless sends a ServiceDiscoveryReq message to the charge column. The charge column confirms this by sending a ServiceDiscoveryRes message. This includes, among other things, the payment options of the charge column (in accordance with DIN SPEC 70121 only "External Payment" is supported) and the charge types supported by the charge column.

External Payment

"External Payment" means that the user of the vehicle must authenticate himself directly for a charging process via the charging station (e.g. using RFID).

2.4.3 Service and Payment Selection

After the Service Discovery phase has been completed, the vehicle sends the type of payment as well as the desired services to the charge column.

The DIN SPEC 70121 does not provide any services and only the "External Payment" payment option is available. Therefore no corresponding data are exchanged between the vehicle and the charge column during this phase.

The vehicle nevertheless sends a ServicePaymentSelectionReq message to the charge column. The charge column confirms it by sending a ServicePaymentSelectionRes message.

2.4.4 Contract Authentication

During this phase the authentication data for the payment process are exchanged between the vehicle and the charge column. Since only "External Payment" is available in DIN SPEC 70121, no relevant data is exchanged here.

The vehicle nevertheless sends a ContractAuthenticationReq message to the charge column. The charge column confirms it by sending a ContractAuthenticationRes message.

2.4.5 Charge Parameter Discovery

After the charge contract has been concluded, the basic data relevant for the charging process are exchanged.

The vehicle sends a ChargeParameterDiscoveryReq message to the charging station. This contains the vehicle-specific data, such as:

- Charging method to be used
- Maximum charging current
- Maximum charging voltage

- Maximum charging power during the complete charging process
- Current state of the vehicle
  (the possible states are described in DIN SPEC 70121)

The charging station answers these by sending a ChargeParameterDiscoveryRes message.

This includes for example:

- Maximum charging current
- Maximum charging voltage
- Maximum charging power
- Minimum voltage
- Minimum current
- Current state of the charging station
  (the possible states are described in DIN SPEC 70121)

2.4.6 Cable Check

In the Cable Check phase the check of the charging cable used (among other things the insulation resistances) has to be initiated for the DC charge. The check is carried out by the charge column and the result is communicated to the vehicle.

The vehicle sends a CableCheckReq message to the charge column. This initiates a corresponding cable check.

The charge column responds by sending a CableCheckRes message.

This message exchange can be repeated several times until the Cable Check has been completed or a fault has occurred.

2.4.7 Pre Charge

The so-called Pre Charge phase follows. In this phase the output voltage of the frequency converter is matched as close as possible to the input voltage of the vehicle. This avoids high inrush currents.

The vehicle sends a PreChargeReq message to the charge column.

This includes for example:

- Current state of the vehicle
- Target voltage of the frequency converter
- Target current of the frequency converter

The charge column responds by sending a PreChargeRes message.

This includes for example:

- Current state of the charge column
- Current voltage of the frequency converter

This message exchange can be repeated several times until the vehicle accepts the voltage of the frequency converter that is offered.

2.4.8 Power Delivery

The Power Delivery phase marks the moment as of which the vehicle is connected to the charging station from the point of view of the current flow (the DC breakers in the vehicle are closed) and charging of the battery can be started. On the other hand it marks the moment at which the charging process ends and the current flow is disconnected (the DC breakers in the vehicle are opened).

The vehicle sends a PowerDeliveryReq message to the charging station. This includes the "Ready to Charge" state. If this status is "True", this identifies the start time of the actual charging process. If this bit is "False", it identifies the termination of the actual charging process.

The charging station responds by sending a PowerDeliveryRes message.

2.4.9 Current Demand

After passing through the power delivery phase (the "Ready to charge" status has to be "True" here), the current demand phase takes place. In this phase the charging of the vehicle takes place. To this purpose the vehicle sends the target voltage and the target current to the charge column. The charge column transfers the current voltage and current values of the frequency converter.

The vehicle sends a CurrentDemandReq message to the charge column.

This includes for example:

- Current state of the vehicle
- Target current of the frequency converter
- Target voltage of the frequency converter
- 100% charge of the vehicle reached

The charge column responds by sending a CurrentDemandRes message.

This includes for example:

- Current state of the charge column
- Current voltage of the frequency converter
- Actual current of the frequency converter
- Maximum voltage of the frequency converter reached
- Maximum current of the frequency converter reached
- Maximum power of the frequency converter reached

2.4.10 Welding Detection

After completion of the charge process the DC breakers in the vehicle are checked for "welding". This check is optional and is initiated by the vehicle.

The vehicle sends a WeldingDetectionReq message to the charge column. This includes the current state of the vehicle.

The charge column responds by sending a WeldingDetectionRes message.

This includes for example:

- Current voltage at the charging cable

2.4.11 Session Stop

After completion of the Welding Detection phase the charging session is completed.

Information: If the Welding Detection is not requested by the vehicle, the "Session Stop" is started by the vehicle directly after the PowerDelivery phase.

To this purpose the vehicle sends a SessionSetupReq message to the charge column. This does not contain further data.

The charge column responds by sending a SessionStopRes message. It contains the ResponseCode.

2.5 Enhancements relating to ISO 15118 as of FW Version V1.1.0

ISO 15118 represents an extension of DIN SPEC 70121. That means that all statements regarding FB "DIN_70121" also apply analogously to FB "ISO_15118_DC".

As of FW V1.1.0, payment using "Plug and Charge" (PnC) is possible according to ISO 15118. The corresponding contract data for this is stored in the vehicle. PnC requires encrypted communication (TLS) between the vehicle (EV) and charging station (in this case, the TM ECC PL ST module). On-site payment, e.g. using an RFID card reader, is still possible if this has been implemented in the charging station (EVSE).

Note

If encrypted communication between the EV and EVSE is to be supported, you must set the time and date on the associated controller correctly.

This manual does not describe the Open Charge Point Protocol (OCPP) in detail.

The following figure shows the individual phases chronologically.

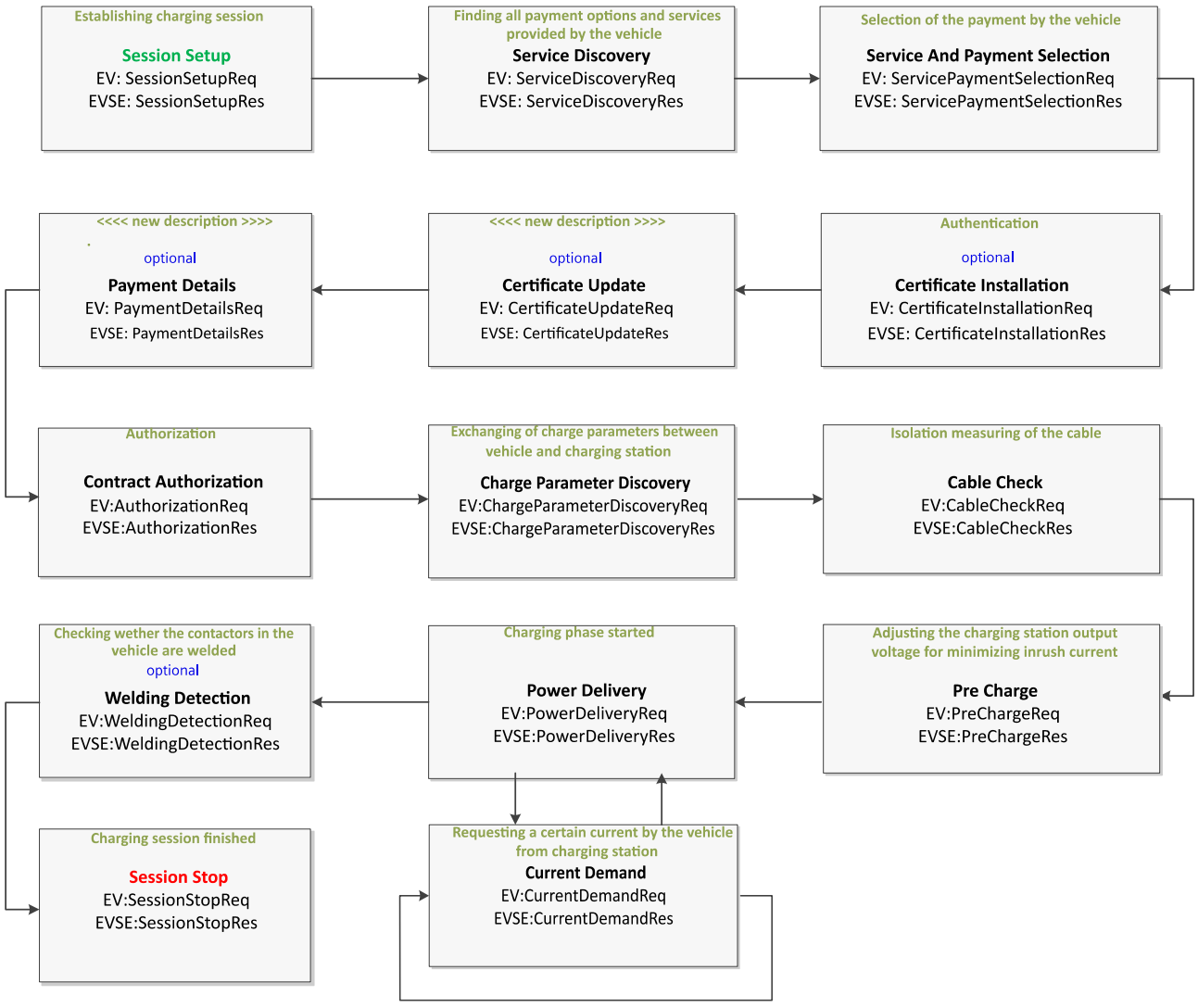


Figure 2-6 Charge phases according to ISO 15118 (relevant phases for PnC)

The following functionalities have been implemented for payment using PnC:

- Certificate Signing Request (CSR)
  Certificate handling relating to TLS encryption (installation or update)
- Contract Certificate (CC)
  Transfer of the contract certificate of a vehicle to the backend

Note

If you only want support for DIN SPEC 70121, you can still use the "DIN_70121" function block (see section ""DIN_70121" function block (Page 39)").

2.5.1 Certificate signing request (CSR)

For encrypted communication using TLS, a valid certificate must exist on the TM ECC PL ST module. A basic distinction is made here between a certificate installation and a certificate update.

- Certificate installation:
  No certificate exists yet. It must be created and stored in the module.
- Certificate update:
  A certificate exists on the module but its validity must be renewed (these certificates have only a limited period of validity).

The installation or update is initiated by the module and signaled accordingly at the output of the "ISO_15118_DC" function block. As soon as a corresponding certificate is available, it can be loaded into the module via the function block (see section "Initiation of the CSR by the TM ECC PL ST module (Page 68)").

However, the CSR can also be initiated, for example, from the backend (see section "External initiation of the CSR (Page 69)").

Note

This process is independent of a pending charging process and can be initiated at any time. This process is not described in ISO 15118.

2.5.2 Contract Certificate (CC)

The contract data is transferred, in accordance with ISO 15118, from the vehicle to the module in the PaymentDetailReq() frame. This is then made available at the output of the "ISO_15118_DC" function block and must be validated subsequently.

The validation takes place in the backend. The Open Charge Point Protocol (OCPP) is normally used for the communication between the charging station and backend.

The result of the validation is applied at the input of the FB and transferred to the vehicle using AuthorizationRes() and PaymentDetailRes() (see also section "Check of the contract of a vehicle (Page 66)")

Wiring

3

3.1 Terminal assignment and power supply

You have to use a BaseUnit of the BU type B1 or BU type B0 for the SIMATIC ET 200SP TM ECC PL ST.

Connect all the required inputs/outputs (CP, PP, DQ T, DQ P) - and in the case of a BaseUnit BU type B1 also a 24 V DC voltage source - to the BaseUnit of the technology module.

Note

Note that interferences with particularly high voltage levels can occur at cables that are routed outside buildings due to environmental factors.

The SIMATIC ET 200SP TM ECC PL ST is designed for overvoltages in industrial environments within buildings.

The supply of several charging stations with a shared 24 V supply is not recommended.

When selecting the locally mounted 24 V power supply unit take into account that it has to be suitable to bridge voltage drops possibly existing on the supply line of the charging station.

NOTICE
All the external connections of the BaseUnit are sourced to the same ground potential For the charging equipment to function without problems, you need a ground rod at the charging station as reference for this ground potential. Galvanic isolation exists to the system bus of the ET 200SP.

Note

Ensure a low resistance connection of the standard mounting rail to the ground potential (FE). Design according to VDE 0100-600.

You must also regularly check the functioning of the functional ground connection during the proof tests that are performed for the charging equipment.

BaseUnit

The BaseUnit is not included in the scope of delivery of the technology module SIMATIC ET 200SP TM ECC PL ST. It must be ordered separately.

You can find an overview of the BaseUnits that are compatible with the technology module in the Product information for documentation of the ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/73021864).

Information regarding selection of a suitable BaseUnit can be found in the ET 200SP Distributed I/O System System Manual

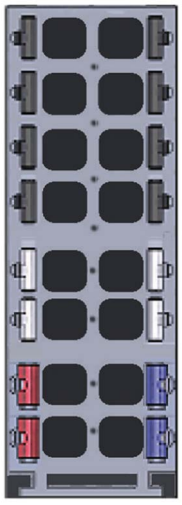
(http://support.automation.siemens.com/WW/view/en/58649293) and in the ET 200SP BaseUnits Manual (https://support.industry.siemens.com/cs/ww/en/ps/14070/man).

Pin assignment of the BaseUnit BU type B1

The table shows the pin assignment of the BaseUnit BU20-P12+A0+4B (6ES7193-6BP20-0BB1). The power supply of this BaseUnit is not looped through, which means downstream BaseUnits are not supplied by this BaseUnit. The same downstream BU requires its own power supply. This means the BaseUnit is its own potential group.

The BaseUnit BU type B1 must be supplied with safety extra-low voltage (SELV) or protective extra-low voltage (PELV).

All 24 V nominal power supplies of the I/O circuits must only be powered by approved sources that fulfill the requirements according to EN61010-2-201 for SELV, PELV, Class 2, voltage limited and/or power limited sources.

Designation	I/O name		View	I/O name		Designation
DQ for TRIP line	DQ T	1		2	-	Not used
DQ for PP	DQ P	3		4	-	Not used
Control Pilot	CP	5		6	-	Not used
Plug Present signal	PP	7		8	-	Reserved
Not used	-	9		10	-	Not used
Not used	-	11		12	-	Not used
External 24 V DC power supply input Pins 13 and 15 are connected internally.	L+	13		14	FE	FE and ground for supply voltage Pins 14 and 16 are connected internally.
		15		16	M	

Pin assignment of the BaseUnit BU type B0

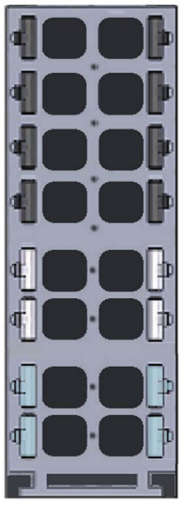
To connect to or use an existing potential group, you must use the following BaseUnit.

A new potential group is not created with the BaseUnit BU type B0 (BU20-P12+A4+0B / 6ES7193-6BP20-0BB0). It continues the potential group. The self-establishing voltage busbars P1, P2 and the AUX rail are looped through to the neighboring module (BaseUnit) on the left.

All 24 V nominal power supplies of the I/O circuits must only be powered by approved sources that fulfill the requirements according to EN61010-2-201 for SELV, PELV, Class 2, voltage limited and/or power limited sources.

Note

The ground of the voltage supply must be connected to the potential group with PE.

Designation	I/O name		View	I/O name		Designation
DQ for TRIP line	DQ T	1		2	-	Not used
DQ for PP	DQ P	3		4	-	Not used
Control Pilot	CP	5		6	-	Not used
Plug Present signal	PP	7		8	-	Reserved
Not used	-	9		10	-	Not used
Not used	-	11		12	-	Not used
	AUX	13		14	AUX	
		15		16		

Switching contact DQ P, DQ T

- The digital outputs are protected against short-circuit.
- The digital outputs are equipped for switching inductive loads with a protective diode.

Note

Connect an external protection element to the relays or contactors to suppress self-inductance when switching off inductive loads.

We recommend using contactors with integrated protection elements.

You have to supply a voltage source with limited voltage and/or power (SELV, PELV to EN61010- 1 and EN61010-2-201, Class 2) to the switching elements.

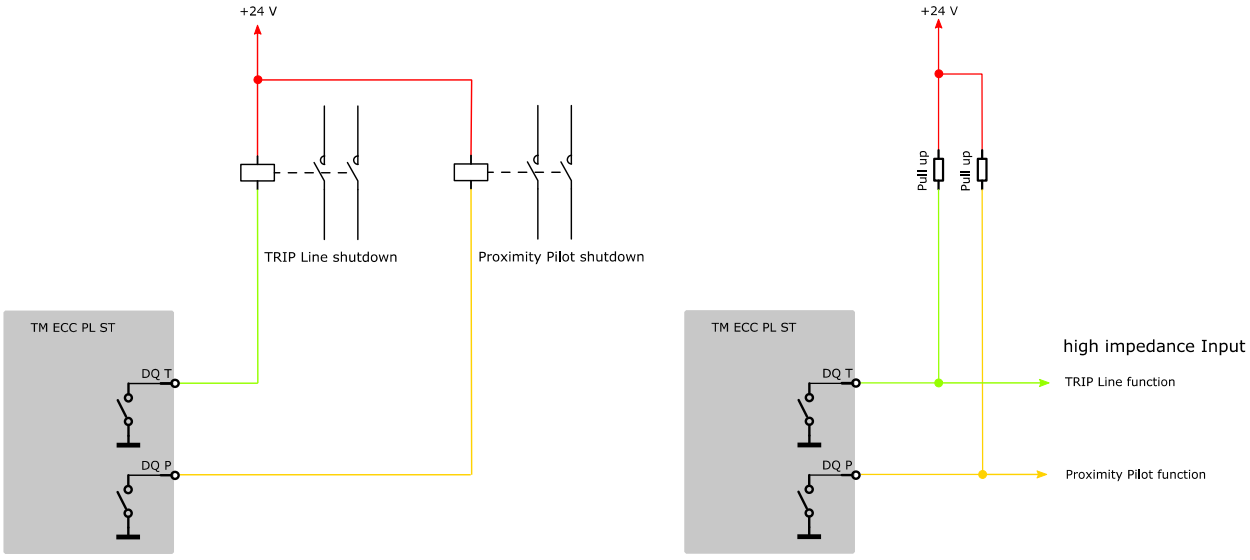


Figure 3-1 Example circuits for the switching contacts

Table 3- 1 Behavior of the outputs DQ T and DQ P

Output	Scenario	Behavior
DQ T	CPU STOP during a charging process (state C)	High resistance
	Module is pulled during a charging process (state C)	High resistance
	PROFINET interruption between CPU and interface module (IM) during a charging process (state C)	High resistance
DQ P	CPU STOP during a charging process (state C)	High resistance
	Module is pulled during a charging process (state C)	High resistance
	PROFINET interruption between CPU and interface module (IM) during a charging process (state C)	Low resistance

External L+ power supply (only for BaseUnit type B1)

Connect an external 24 V DC voltage supply of the type SELV/PELV (to EN61010-2-201, Class 2) to the connections L+ and M in order to supply voltage to the technology module SIMATIC ET 200SP TM ECC PL ST. The voltage input of the technology module has electrical reverse polarity protection.

The technology module monitors only its supply voltage.

Note

L+- and M insulation at the technology module SIMATIC ET 200SP TM ECC PL ST with help of the BaseUnit type B1.

The L+ and M connectors on the BaseUnit of type B1 are galvanically isolated from the neighboring BaseUnits to the left and right. The L+ and M busbars run through the BaseUnit type B1 (without connectors) and expand the busbar with connectors for BaseUnits on the left and right.

3.2 Connection examples

Block diagrams

The circuit diagrams below show the schematic wiring of the technology module with the typical options for use of the feedback input.

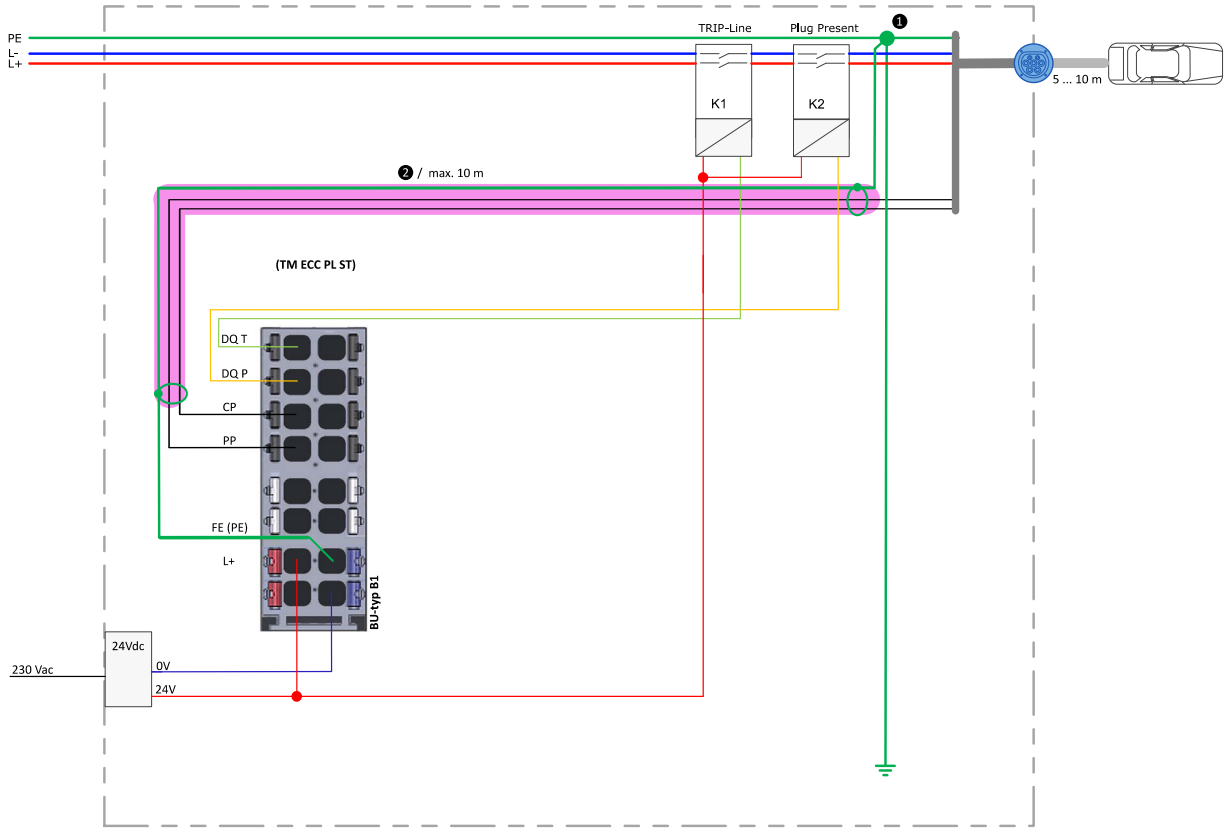


Figure 3-2 Connection example of the technology module with fast shutdown (when a BU type B1 is used)

Note

Wiring

The CP signal uses a bandwidth of 0 Hz ... 30 MHz. For the best possible signal quality we recommend setting the charge controller as close as possible to the connection point ① of the charging cable. If this is not possible due to the spatial layout, use a shielded connection cable for the CP and PP signal in the case of cable lengths exceeding 1.0 m.

We recommend using a PROFIBUS cable (6XV1830..) ②. In this case one conductor must carry the CP signal and the other the PP signal, and the ground potential must be routed from the neutral point ① via the cable shield to the BaseUnit/charge controller.

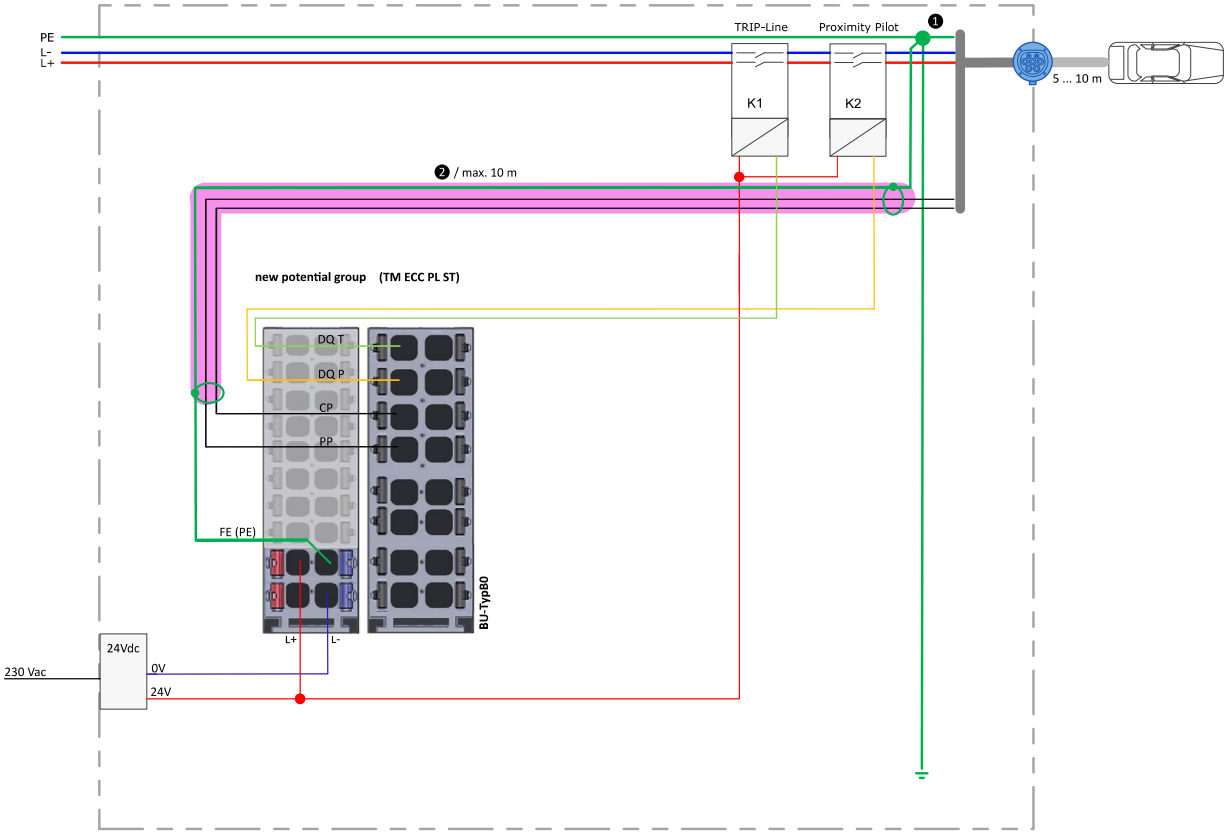


Figure 3-3 Connection example of the technology module with fast shutdown (when a BU type B0 is used)

3.3 Installation instruction

Notes on IT security

To prevent manipulation of the module, measures must be taken by the owner-operator or person responsible for the system so that unauthorized access is prevented. An effective physical/mechanical access restriction to the module and its interfaces is absolutely mandatory.

Configuring / Address space

4

4.1 Configuring

Introduction

You can configure the SIMATIC ET 200SP TM ECC PL ST technology module with the configuration software or use the configuration software to assign parameters.

System environment

You can use the technology module in the following system environments:

Table 4- 1 Possible applications of the technology module with PROFINET I/O

Applications	Required components	Configuration software	In your program
Distributed operation in an S7-1500 system	• S7-1500 Automation system • ET 200SP Distributed I/O System • Technology module SIMATIC ET 200SP TM ECC PL ST	STEP 7 (TIA Portal): Device configuration and parameter settings with the hardware configuration (HWCN)	Access only via the "DIN_70121" / "ISO_15118_DC" function block
Distributed operation in an S7-1200 system (as of FW version 1.0.3)	• S7-1200 Automation system • ET 200SP Distributed I/O System • SIMATIC ET 200SP TM ECC PL ST technology module	STEP 7 (TIA Portal): Device configuration and parameter settings with the hardware configuration (HWCN)	Access only via the "DIN_70121" / "ISO_15118_DC" function block
Centralized or distributed operation in an ET 200SP system	• ET 200SP automation system • Technology module SIMATIC ET 200SP TM ECC PL ST	STEP 7 (TIA Portal): Device configuration and parameter settings with the hardware configuration (HWCN)	Access only via the "DIN_70121" / "ISO_15118_DC" function block

Hardware Support Package (HSP)

If you cannot find the SIMATIC ET 200SP TM ECC PL ST technology module in the hardware catalog of the TIA Portal, you must install the corresponding HSP file (HSP0261 ET200SP ECC PL can be used up to Firmware Version 1.0; use HSP0351 ET200SP ECC PL for FW Version 1.1 or higher).

The Hardware Support Package (HSP) is available for download at (https://support.industry.siemens.com/cs/ww/en/view/72341852).

4.2 Reaction to CPU STOP

At CPU STOP an active charging process is terminated immediately. This means the PWM signal on the CP switches to "-12 V" (EVSE status not available).

Breakdowns in communication, such as an interruption of the PROFINET connection, are treated as CPU STOPs.

4.3 Required I/O address space

Address space of the technology module

Table 4- 2 Scope of the I/O addresses of the technology module SIMATIC ET 200SP TM ECC PL ST

	Inputs	Outputs
Scope	32 bytes	32 bytes

4.4 Parameter

Parameter

You specify the properties of the technology module using various parameters. These can be assigned via the HSP. You cannot change the parameter assignment in the user program.

You have the following options for setting the parameters of the module:

Table 4- 3 Parameter assignment options

Parameter settings using the ...	Basic procedure
Hardware configuration in STEP 7 with HSP file	1. Install the corresponding HSP file. You can then find the module in the hardware catalog under "Distributed IO devices \ ET 200SP \ Technology modules \ Charging \ TM ECC PL 12V ST". 2. Set the device configuration and the parameters in the hardware configuration. 3. Download the parameter assignment to the module.

Adjustable parameters

Table 4- 4 Configurable parameters and their defaults

Parameter	Value range	Default setting	Configuration in RUN
Charge standard	DIN SPEC 70121 / ISO 15118	DIN SPEC 70121 / ISO 15118	No

4.5 Control and feedback interface

4.5.1 Assignment of the control interface

The module must be used with the "DIN_70121" or "ISO_15118_DC" function block.

4.5.2 Assignment of the feedback Interface

The module must be used with the "DIN_70121" or "ISO_15118_DC" function block.

Programming

5

5.1 General information

For operation of the SIMATIC ET 200SP TM ECC PL ST technology module in your application program, you must use the "DIN_70121" or "ISO_15118_DC" function block.

The function blocks can be downloaded from SIEMENS Customer Support (https://support.industry.siemens.com/cs/de/en/ps/18330/dl). They are available in the form of the TIA library "ET200SP TM ECC". There you can find the relevant FB in the Types/DIN_70121 or Types/ISO_15118_DC folder.

See also

SIEMENS Customer Support (https://support.industry.siemens.com/cs/de/en/ps/18330/dl)

5.2 "DIN_70121" function block

Introduction

This section presents the properties of the "DIN_70121" function block. It exists in three versions:

- DIN_70121_1500 (for CPU15xx)
- DIN_70121_1200 (for CPU12xx)
- DIN_70121_OC (for Open Controller)

The three function blocks behave identically. For the sake of clarity, only the "DIN_70121" function block is referred to in the following.

The following figure shows the inputs/outputs of the "DIN_70121" function block.

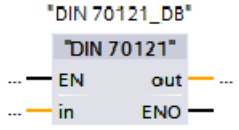


Figure 5-1 "DIN_70121" function block

The "DIN_70121" function block appears in the structure of the TIA library.

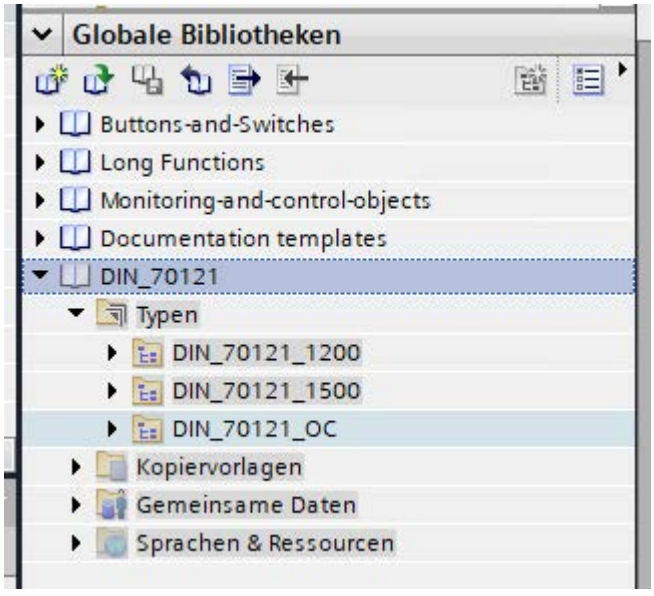


Figure 5-2 Structure of the TIA library "DIN_70121"

The "DIN_70121_1200" folder contains the blocks for the S7-1200 controllers, and the "DIN_70121_1500" folder contains the blocks for the S7-1500 controllers. The blocks for the "Open Controller" are contained in the "DIN_70121_OC" folder.

For configuring, you can only use the "DIN_70121" function block itself. The "DIN_70121 Support" folder contains internal auxiliary functions.

5.2.1 Required memory of the "DIN_70121" function block

Memory requirement

The memory requirement of FB "DIN_70121" is shown below:

Table 5- 1 Memory requirement of the "DIN_70121" function block

	Load memory	Code work memory	Data work memory
First instance	1.04 MB	50.72 KB	3.25 KB
Additional memory required for each additional instance	14.9 KB	0	3.25 KB

5.2.2 Principle of operation of the "DIN_70121" function block

This function block represents the interface between the technology module and the TIA application of the charging station. The block checks the voltage on the charging cable (external voltage check) before the actual cable check takes place. It controls the frequency converter for the cable check and evaluates the result of the associated current measurement. In the "PreCharge" phase the voltage of the frequency converter is increased correspondingly. In the "CurrentDemand" phase the frequency converter is controlled correspondingly with the actual current and voltage specifications of the vehicle and monitored whether the frequency converter has followed the specifications of the vehicle within a defined response time.

The associated breakers are closed or opened respectively in accordance with the individual charge phases for different versions of frequency converters or their circuitry.

Note

The function block transfers the setpoints (out.setpoints), but does not check their plausibility with regard to the actual values (in.values) at its input.

5.2.2.1 Startup characteristics of the function block

After switching on the associated controller or after a STOP⇒RUN transition of the controller, the "hwState" hardware status is set to "Wait state". The IO modules must be switched on so that the breakers, if closed, can be opened.

The startup is finished after 10 seconds. A charging process can be started.

There is no time monitoring of the breakers and the hardware status during start-up.

5.2.2.2 Response to errors

If an error has occurred, the SW status (out.swState) is initially set to "-1". The frequency converter is then ramped down, if necessary, and the breakers are opened. After the frequency converter is ramped down and the breakers are open, the SW status is set to "-2". The SW status is set to "-3" after 10 seconds. Errors not requiring acknowledgment are automatically acknowledged. Errors requiring acknowledgement can now be acknowledged via "in.ackErrors". For acknowledgment "in.ackErrors" must be set to "True". After acknowledgment, "in.ackErrors" must be set to "False" because all other errors are still acknowledged as long as this input is "True".

5.2.2.3 Possible circuitry of a frequency converter

The "DIN_70121" function block has been prepared for various variants of frequency converters. From the "DIN_70121" function block, it is possible to control the DC breaker, a breaker required for the precharge phase and the breaker for a shunt (if a minimum current is necessary to start up the frequency converter). The closing operation or opening operation of the breaker is time-monitored. To this purpose a feedback contact is required.

Controlling of the breakers is respectively optional. The breakers configured at the function block are then closed or opened depending on the pending charging phase.

The voltage and current value of the installed measuring instruments is evaluated in the "DIN_70121" function block according to the individual charging phases or is transferred to the vehicle.

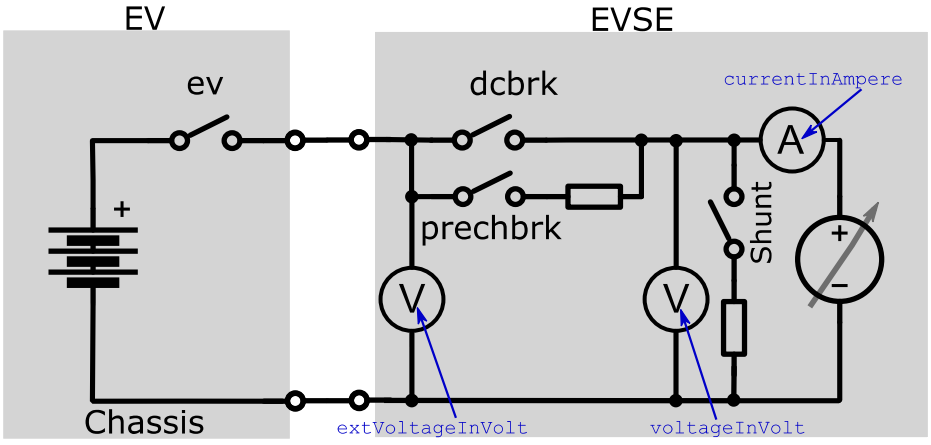


Figure 5-3 Maximum configuration of the circuitry of the frequency converter

Corresponding parameters at the function block:

- DC breaker activated:
  in.evseCfg.dcbrkIsUsed
- PreCharge breaker activated:
  in.evseCfg.prechbrkIsUsed
- Shunt breaker activated:
  in.evseCfg.shuntIsUsed

- Resistance of the Shunt in ohm:
  in.evseCfg.shuntValueInOhm
- Time monitoring of breakers:
  in.evseCfg.maxSwitchTimeBreaker
- Feedback signal of the DC breaker:
  in.values.dcbrk
- Feedback signal of the PreCharge breaker:
  in.values.prechbrk
- Feedback signal of the shunt breaker:
  in.values.shunt
- Voltage measured value at the frequency converter:
  in.values.voltageInVolt
- Voltage measured value between the DC breaker and the vehicle:
  in.values.extVoltageInVolt
- Current measured value:
  in.values.currentInAmpere
- DC breaker control
  out.setpoints.dcbrk
- Pre Charge breaker control
  out.setpoints.prechbrk
- Shunt breaker control:
  out.setpoints.shunt

5.2.2.4 Authentication phase

The input parameter "authAccepted" indicates whether the charging station has been activated for the charging process of a vehicle. It is relevant in the authentication phase.

Here, the vehicle owner must be activated for the charging process, e.g. via RFID.

The status of the authentication is defined by the following three states:

- 0: Authentication is taking place
  There is no feedback signal yet
- 1: Authentication has failed
  The charging process is not started
- 2: Authentication successful
  The charging process can begin

If no explicit activation is required (e.g. free charging), the parameter can remain permanently set to "2".

Note

This input is only evaluated during the authentication phase. As soon as state "1" or "2" is applied, a change to the next charge phase takes place. Subsequent changing of this state does not have any effect.

5.2.2.5 "Parameter Discovery" phase

In this phase the following data is delivered by the vehicle and mapped at the output (out.ev.limits) of the "DIN_70121" function block.

- maxCurrentInAmpere: The maximum charging current permitted by the vehicle (in A)
- maxPowerInkW: The maximum charging power permitted by the vehicle (in kW)
- maxVoltageInVolt: The maximum charging voltage permitted by the vehicle (in V).

The following data is sent by the charging station to the vehicle via the function block inputs (in.evseCfg):

- minVoltageInVolt: The minimum charging voltage (in V) of the charging station.
- maxVoltageInVolt: The maximum charging voltage (in V) of the charging station.
- minCurrentInAmpere: The minimum charging current (in A) of the charging station.
- maxCurrentInAmpere: The maximum charging current (in A) of the charging station.
- peakCurrentRippleInAmpere: Maximal current ripple (in A) on the charging current
- maxPowerInkW: Maximum available power (in kW) of the charging station
- supportedEnergyTransferType: Energy transfer version supported by the vehicle (according to DIN SPEC 70121 only "DC_Core" and "DC_Extended" are permitted)

The Shunt breaker is closed (in as far as the function is activated).

After completion of the parameter discovery phase, the vehicle ID is available at the output of the "DIN_70121" function block.

- evccId: Vehicle ID (max. 8 characters)
  (HEX characters in ASCII representation; for example 0xF ⇒ "F")
- evccIdLength: Length of the vehicle ID

The frequency converter is started in this phase because, according to the standard, a maximum of 40 seconds is available for the cable check. This means that the charging process has to be aborted after 40 seconds if the "Cable Check" has not been terminated by then.

The hwState output parameter now signals with the value "3" that the frequency converter has to be started.

5.2.2.6 Checking safe isolation from supply on the charging cable (External Voltage Check)

Before the cable check (insulation measurement) is carried out, a check can optionally be carried out whether the voltage of the charging cable is de-energized. All breakers are open. The voltage of the corresponding voltmeter at the "in.values.extVoltageInVolt" input is evaluated. If the voltage is less than or equal to the maximum voltage value set at the "DIN_70121" function block plus the voltage tolerance "emvInVolt", the function block changes to the cable check function. If the value is greater, a corresponding error is triggered.

If the voltage value is greater than the maximum value, it is possible that the DC breaker in the vehicle is already closed!

Corresponding parameters at the function block:

- Check activated:
  in.evseCfg.extVoltageCheckIsSupported
- Maximum permissible voltage:
  in.evseCfg.maxExtVoltageInVolt
- Maximum absolute voltage tolerance (in V) of the used measuring instrument.
  in.evseCfg.emvInVolt
- Measured voltage according to the DC breaker
  in.values.extVoltageInVolt

5.2.2.7 Carrying out the Cable Check

The isolation of the cable is checked. The cable isolation is faulty if a maximum DC leakage current is exceeded when the maximum voltage of the frequency converter is applied.

In this phase the breakers of the vehicle are open. This was ensured through checking for external voltage (see chapter Checking whether the voltage is de-energized on the charging cable (Page 43)).

Parallel to the cable check described below, the error output of a mounted insulation monitor is checked. This can be created at the hwError input.

- Bit 0: Insulation warning
- Bit 1: Insulation fault

.

The cable check is carried out in the following steps in the "DIN_70121" function block:

1. Closing of the breakers
   If the PreCharge breaker is activated, it is now closed. The DC breaker remains open. However, if the precharge breaker is deactivated, the DC breaker is closed instead. If the DC breaker of the function block is deactivated as well, the check nevertheless continues to the next step. (the check now assumes that the DC breaker is activated from the outside).
2. Determining the target voltage to be set at the frequency converter
   Calculation of the target voltage:
   Min(in.evseCfg.maxVoltageInVolt, out.ev.limits.maxVoltageInVolt)
3. Setting of the frequency converter to target voltage
   The frequency converter is switched to voltage control (enableCurrentControl=false) and the target voltage to be set is passed to the frequency converter. The specified target current is parameterized at the "DIN_70121" function block and is transferred to the frequency converter. Time monitoring takes place in the function block whether the actual value of the voltage has followed the setpoint of the voltage within the time parameterized in "in.evseCfg.maxTimeRampUpDown".
   The maximum voltage is reached when U ≥ (Target voltage - in.evseCfg.emvInVolt)
4. Measuring the current for 10 seconds
   After the frequency converter has reached the specified maximum voltage, a 10 second measurement phase begins in which the measured current is checked by the "DIN_70121" function block. In the process a constant check is carried out whether the maximum

permitted DC leakage current has been exceeded. If the shunt is activated, its current flow is deducted from the measurement.

5. Shutting down the frequency converter
   After the 10 seconds have expired, the frequency converter is reduced to the minimal voltage. The current specification for the frequency converter is 1 ampere if the target current is greater than 1 ampere. Otherwise the specified target current is used for the current specification.
   The minimum current is reached when
   U ≤ (in.evseCfg.minVoltageInVolt + in.evseCfg.emvInVolt)

Corresponding parameters at the "DIN_70121" function block:

- Maximum charging voltage in Volt of the frequency converter:
  in.evseCfg.maxVoltageInVolt
- Minimum charging voltage in volt of the frequency converter:
  in.evseCfg.minVoltageInVolt
- Monitoring time for reaching the target voltage:
  in.evseCfg.maxTimeRampUpDown
- Maximum allowed DC leakage current in Ampere in the Cable Check
  in.evseCfg.maxCableCheckLeakCurrentInAmpere
- Maximum absolute current tolerance (in A) of the used measuring instrument.
  in.evseCfg.emcInAmpere
- Target voltage in Volt for frequency converter:
  out.setpoints.voltageInVolt
- Maximum absolute voltage tolerance (in V) of the used measuring instrument.
  in.evseCfg.emvInVolt
- Target current in Ampere for frequency converter:
  out.setpoints.currentInAmpere
- Current/voltage control of the frequency converter
  out.setpoints.enableCurrentControl
- Measured voltage according to the DC breaker
  in.values.extVoltageInVolt

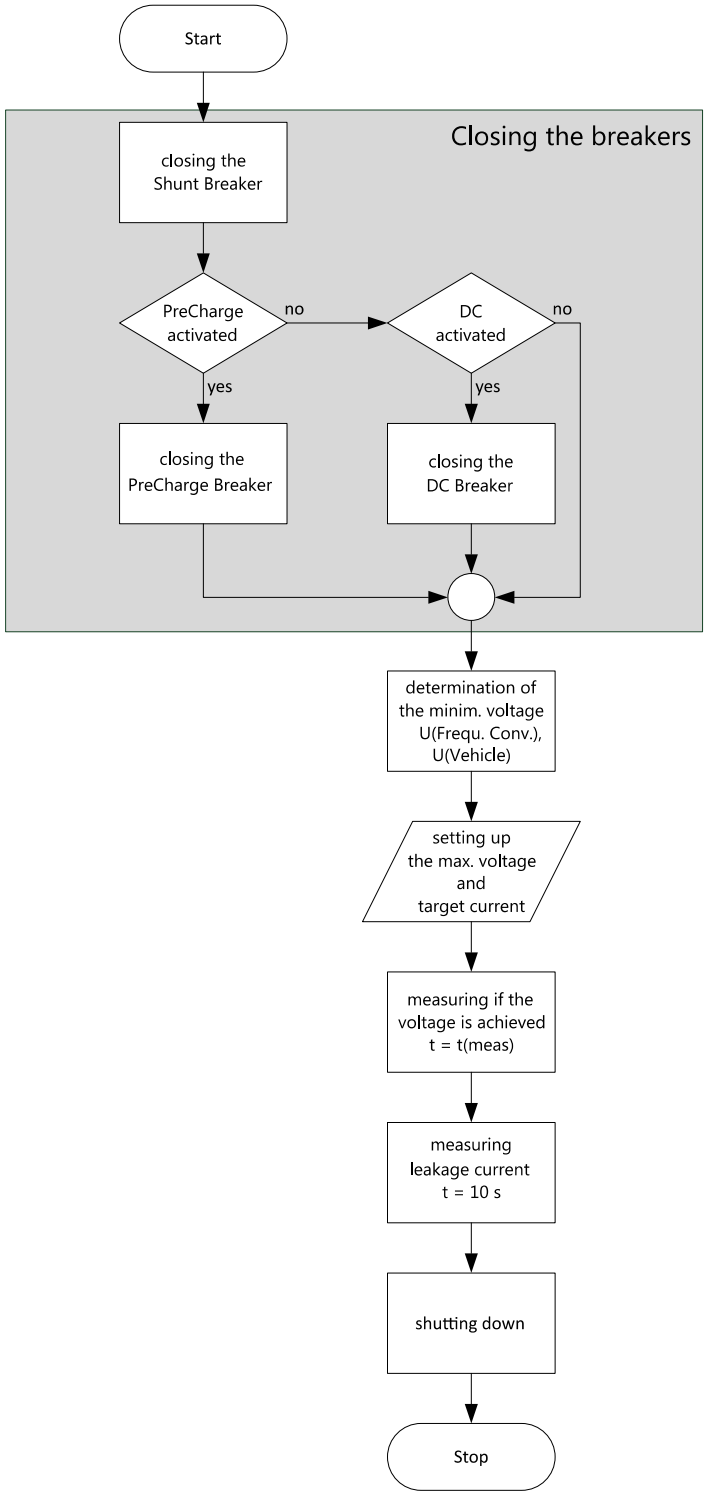


Figure 5-4 "Cable Check" flow diagram

5.2.2.8 Carrying out the voltage equalization of the frequency converter (PreCharge)

In this phase the target voltage and target current for frequency converter are specified by the vehicle.

A check is carried out when the voltage required by the vehicle lies within the valid range.

- Low limit:
  in.evseCfg.minVoltageInVolt
- High limit:
  Min(in.evseCfg.maxVoltageInVolt, out.ev.limits.maxVoltageInVolt)

A check is carried out whether the output voltage of the frequency converter lies within the valid range.

- Low limit:
  in.evseCfg.minVoltageInVolt - in.evseCfg.emvInVolt
- High limit:
  Min(in.evseCfg.maxVoltageInVolt, out.ev.limits.maxVoltageInVolt) + in.evseCfg.emvInVolt)

An error is triggered if the voltages lie outside the valid range for longer than the time period defined in the "in.evseCfg.maxTimeInvalidParametersOrRampCharge" parameter.

The voltage equalization continues until the vehicle switches to the power delivery phase.

Corresponding parameters at the "DIN_70121" function block:

- Maximum charging voltage in Volt of the frequency converter:
  in.evseCfg.maxVoltageInVolt
- Monitoring time for the check of the voltage/current value:
  in.evseCfg.maxTimeInvalidParamsOrRampCharge
- Target voltage in Volt for the frequency converter:
  out.setpoints.voltageInVolt
- Target current in Ampere for the frequency converter:
  out.setpoints.currentInAmpere
- Voltage control of the frequency converter
  out.setpoints.enableCurrentControl:=false
- Measured voltage at the frequency converter
  in.values.voltageInVolt

5.2.2.9 Implementation of the PowerDelivery phase (start charging)

In this phase the DC breaker is switched on and the frequency converter is switched to current control. The target current is set to 0 ampere. Subsequently the PreCharge breaker is opened. The shunt breaker is also opened. The opening or closing operation of the breaker is time-monitored.

5.2.2.10 Execution of the charge process (Current Demand)

In this phase the frequency converter is controlled by the vehicle with the latest current/voltage specifications.

The "DIN_70121" function block monitors whether the voltage, current and power values lie within defined limits. An error is triggered if one of the values to be checked lies outside the valid range for longer than the time period defined in the "in.evseCfg.maxTimeInvalidParametersOrRampCharge" parameter.

The following values are checked permanently:

- The voltage "out.setpoints.voltageInVolt" required by the vehicle
  Low limit:
  in.evseCfg.minVoltageInVolt
  High limit:
  Min(in.evseCfg.maxVoltageInVolt, out.ev.limits.maxVoltageInVolt)
- The output voltage of the frequency converter "in.values.voltageInVolt"
  Low limit:
  in.evseCfg.minVoltageInVolt - in.evseCfg.emvInVolt
  High limit:
  Min(in.evseCfg.maxVoltageInVolt, out.ev.limits.maxVoltageInVolt) + in.evseCfg.emvInVolt)
- The "out.setpoints.currentInAmpere" current required by the vehicle
  Low limit:
  in.evseCfg.minCurrentInAmpere
  High limit:
  Min(in.evseCfg.maxCurrentInAmpere,out.ev.limits.maxCurrentInAmpere)
- The output current of the frequency converter "in.currentInAmpere"
  Low limit:
  in.evseCfg.minCurrentInAmpere - in.evseCfg.emcInAmpere
  High limit:
  Min(in.evseCfg.maxCurrentInAmpere, out.ev.limits.maxCurrentInAmpere) + in.evseCfg.emcInAmpere)
- The maximum charging capacity of the frequency converter
  High limit:
  Min(in.evseCfg.maxPowerInkW, out.ev.limits.maxPowerInkW)
  Calculation of the charging capacity of the converter:
  (in.values.voltageInVolt - in evseCfg.emvinVolt) * (in.values.currentInAmpere - in.evseCfg.emcInAmpere)

The converter continues to run in voltage control mode.

Corresponding parameters at the function block:

- Maximum charging voltage in Volt of the frequency converter:
  in.evseCfg.maxVoltageInVolt
- Maximum charging current in Ampere of the frequency converter:
  in.evseCfg.maxCurrentInAmpere
- Monitoring time for the reaching of the target voltage:
  in.evseCfg.maxTimeInvalidParametersOrRampCharge
- Target voltage in Volt for the frequency converter:
  out.setpoints.voltageInVolt
- Target current in Ampere for the frequency converter:
  out.setpoints.currentInAmpere

- Current/voltage control of the frequency converter:
  out.setpoints.enableCurrentControl
- Measured voltage at the frequency converter
  in.values.voltageInVolt

5.2.2.11 Termination of the charging process

At the end of the charge process there is a final PowerDelivery request from the vehicle. The frequency converter is ramped down and the contactor is open. The individual actions are time-monitored. This is performed in the following steps:

The termination of the charging process is carried out in the following steps in the "DIN_70121" function block:

1. Setting the target current value for the frequency converter to 0 Ampere.
2. Waiting until the current value set at the frequency converter meets the following condition:
   Current value (in.values.currenInAmpere) ≤ Specified current value for opening the DC breakers (evseCfg.stopChargingCurrentInAmpere) + Current tolerance (emcInAmpere)
3. Subsequently the DC breakers are open
4. The frequency converter is switched to voltage control. The target current at the frequency converter is set to 0 Volt.
5. In as far as the shunt is activated, it is closed.
6. As soon as the voltage falls below the minimum voltage at the voltmeter, the breaker is opened for the shunt.
   The minimum voltage U_{min} is calculated as follows:
   U_{min} = Minimum voltage frequency converter (in.evseCfg.minVoltageInVolt) + Voltage tolerance (in.evseCfg.emvInVolt)
7. The charging process is now regarded as complete
8. The frequency converter is switched off. hwState:=2

Corresponding parameters at the function block:

- Specification current value for opening the DC breaker (minimum current value of the frequency converter):
  in.evseCfg.stopChargingCurrentInAmpere
- Minimum charging voltage in Volt of the frequency converter:
  in.evseCfg.minVoltageInVolt
- Voltage tolerance in volt:
  in.evseCfg.emvInVolt
- Current tolerance in ampere:
  in.evseCfg.emcInAmpere
- Monitoring time for reaching the target voltage or the target current:
  in.evseCfg.maxTimeRampUpDown
- Target voltage in Volt for the frequency converter:
  out.setpoints.voltageInVolt
- Target current in Ampere for the frequency converter:
  out.setpoints.currentInAmpere

- Current/voltage control of the frequency converter:
  out.setpoints.enableCurrentControl
- Measured voltage at the frequency converter
  in.values.voltageInVolt
- Measured current at the frequency converter
  in.values.currenInAmpere

Welding Detection

If "Welding Detection" is requested by the vehicle, the applied voltage "extVoltageInVolt" is transferred to the vehicle. This is important since the "voltageInVolt" voltage directly at the frequency converter is always 0. Only by this means you can check whether the breakers in the vehicle are welded.

5.2.2.12 Hardware states

The "DIN_70121" function block can process four different HW states of the charging station and respond accordingly. Furthermore, the "DIN_70121" function block calls for a specific state of the hardware at defined points. If this is not assumed by the hardware within a defined monitoring time, the ongoing charging process is aborted. The hardware status requested by the function block must be taken on by the hardware. The hardware indicates via the following states that it has reached the required state. Exactly this state has to be reached respectively, with the exception of the undefined state (0).

The following 4 states are defined:

- 0: Undefined state
  for example whether the charge column is switched on
- 1: Idle state
  Converter is off, I/O modules for the breakers are off
- 2: Wait state
  Converter is off, I/O modules for the breakers are on
- 3: Ready
  Converter is on, I/O modules for the breaker are on

The individual phases as well as the state to be assumed are represented below.

- Initial state (no charging process active):
  swState = 2 (System in idle state)
  hwState = 1 (Idle state)
- Transition to charging phase:
  swState = 3 (All I/O modules on, all breakers open)
  hwState = 2 (Wait state)
  as soon as hwState = 2 is reached, a change to swState = 4 (System ready for charging) takes place
- Contract Authentication:
  swState = 5 (Authentication phase)
  hwState = 2 (Wait status)

- Charge Parameter Discovery:
  swState = 6 (Phase "Parameter Discovery")
  hwState = 3 (Ready)
- External Voltage Check:
  swState = 7 (Phase "External Voltage Check")
  hwState = 3 (Ready)
- Cable Check:
  swState = 8 (Phase "Cable Check")
  hwState = 3 (Ready)
- Pre Charging:
  swState = 9 (Phase "Pre Charge")
  hwState = 3 (Ready)
- Power Delivery (start of the charging process):
  swState = 10 (Phase "Power Delivery/Current Demand")
  hwState = 3 (Ready)
- Current Demand:
  swState = 10 (Phase "Power Delivery/Current Demand”)
  hwState = 3 (Ready)
- Stop Charging: Wait state (2)
  swState = 11 (Phase "Power Delivery/Current Demand")
  hwState = 3 (Ready)
- Transition to the initial state: Wait state (2)
  swState = 3 (All I/O modules on, all breakers open)
  hwState = 2 (Wait state)
  as soon as hwState = 2 is reached, a change to initial state takes place

If no charge phase is pending the initial state is taken.

Corresponding parameters at the function block:

- Current hardware state of the charge column (0, 1, 2, 3):
  in.value.hwState
- Monitoring time for reaching the required HW state:
  in.evseCfg.maxSwitchTimeHwState
- Hardware status requested by the function block:
  out.setpoints.hwState
- SW state of the function block
  out.swState

5.2.3 DIN_70121 parameter

All parameters have been created in the form of UDTs (User defined data types).

The "in" input is mapped in form of the UDT "UDT_Charger_In".

The "out" output is mapped in form of the UDT "UDT_Charger_Out".

5.2.3.1 UDT_Charger_In

The UDT_Charger_In has the following structure:

Table 5- 2 List of input parameters for the UDT_Charger_In

Parameter	Data type	Description
ackErrors	Bool	Error acknowledgment In the "True" state, all pending errors are acknowledged.
enable	Bool	Charging outlet enable (True = yes, False = no) If this input is set to "False", an ongoing charging process is canceled and the frequency converter is shut down in a controlled manner. Subsequently the CP output signal in the module is set to -12 V. If the Enable input is set to "True", the CP output signal changes to +12 V.
evseCfg	UDT_Charger_EvseCfg	Input parameter for the configuration of the charging station
hw_id	HW_IO	Hardware ID of the technology module SIMATIC ET 200SP TM ECC PL ST for the determination of the offset of the process image of the inputs/outputs. If an invalid HW ID is entered, a corresponding error bit at the output is set to "True" (Error messages (Page 81)).
hwError	Byte	Pending HW errors / warnings of the charging station: • Bit 0: Insulation monitor "warning" • Bit 1: Insulation monitor "Error" • Bit 2: An emergency-off of the charging station has taken place (for example by pressing the emergency-off button) If Bit 1 or Bit 2 is set to "True", the converter is ramped down in a controlled manner if possible. The CP output level is set to "-12V".
values	UDT_Charger_Values	Currently pending parameters of the charging station that are relevant for the charging process.

5.2.3.2 UDT_Charger_EvseCfg

The UDT_Charger_EvseCfg has the following structure:

Table 5- 3 List of input parameters for the UDT_Charger_EvseCfg

Parameter	Data type	Description
cableCheckCurrentIn-Ampere	UInt	Current setpoint (in A) during the "Cable check" phase. This parameter is relevant for converters that need a minimum current value to start up. This current must be greater than the value of "maxCableLeakCurrentIn-Ampere"; otherwise the error message bit 1 (parameterization error) is set. (see chapter on Cable Check (Page 44))
dcbrkIsUsed	Bool	Monitoring of the feedback from the "DC breaker" and control of the corresponding output. (True = yes, False = no) (see chapter on Protective circuit of the frequency converter (Page 41))
emcInAmpere	UInt	Maximum absolute current tolerance (in A) of the used measuring instrument. (relevant in Cable Check phase and when terminating the charging process)
emvInVolt	UInt	Maximum absolute voltage tolerance (in V) of the used measuring instrument. (relevant in External Voltage Check, Cable Check, PreCharge phase and termination of the charging process)
evseId	Array [0..31] of Byte	Unique ID of the charge column. The structure of the ID is defined in the DIN SPEC 91286. Details of the structure can also be found in the DIN SPEC 70121.
evseIdLength	USINT	Length of the evseId address in bytes If this value is greater than "32", the error message bit 1 (parameterization error) is set.
extVoltageCheckIsSup-ported	Bool	Activation of the check of the applied voltage before the pending phase "Cable check". (True = Yes, False = No) (see the chapter on Checking the de-energized state (Page 43)) The voltage "maxExtVoltageInVolt" must be less than or equal to the value of "maxVoltageInVolt"; otherwise the error message bit 1 (parameterization error) is set (see section Error messages (Page 81)).
maxCableCheckLeakCurren-tInAmpere	UInt	The maximum DC leakage current that is allowed during the cable check (see chapter Cable check (Page 44)). If the leakage current is greater, a corresponding error bit at the output is set to "True" (see section Error messages (Page 81)). This current must be less than or equal to the value of "maxCurrentIn-Ampere"; otherwise the error message bit 1 (parameterization error) is set.
maxCurrentInAmpere	UInt	The currently available maximum current which can be delivered by the charge column. This current must be greater than the value of "minCurrentInAmpere"; otherwise the error message bit 1 (parameterization error) is set.
maxExtVoltageInVolt	UInt	The maximum permitted voltage on the cable (external voltage check) before the cable check (see chapter Checking the de-energized state (Page 43)). If exceeded, a corresponding error bit at the output is set to "True" (see section Error messages (Page 81))
maxPowerInkW	UInt	Maximum available power (in kW) of the charge column.

maxSwitchTimeBreaker	Time	The maximum time has been exceeded in which the feedback signal of the DC/Precharge or shunt breaker has to be performed. If this time is exceeded, a corresponding error bit at the output is set to "True" (see Error messages (Page 81)). This time must be greater than "0 ms"; otherwise the error message bit 1 (parameterization error) is set.
maxSwitchTimeHwState	Time	Maximum time available for switching from one HW state to the next (see section HW states (Page 50)) If this time is exceeded, a corresponding error bit at the output is set to "True" (see section Error messages (Page 81)). This time must be greater than "0 ms"; otherwise the error message bit 1 (parameterization error) is set.
maxTimeInvalidParam-sOrRampCharge	Time	The maximum time in which the charging column must follow the specifications of the vehicle (target voltage, target current). If this time is exceeded, a corresponding error bit at the output is set to "True" (see section Error messages (Page 81)). This time must be greater than or equal to the value of "maxTimeRampUpDown"; otherwise the error message bit 1 (parameterization) is set.
maxTimeRampUpDown	Time	The maximum time in which the converter must have reached the desired value (charging voltage or charging current). Affects all charging phases except the "PreCharge" and "CurrentDemand" phase. If this time is exceeded, a corresponding error bit at the output is set to "True" (see section Error messages (Page 81)). This time must be greater than "0 ms"; otherwise the error message bit 1 (parameterization error) is set. The time must be less than or equal to the time parameterized under "maxTimeInvalidParamsOrRampCharge".
maxVoltageInVolt	UInt	The maximum charging voltage (in V) of the charging column. This voltage must be greater than the value of "minVoltageInVolt"; otherwise the error message bit 1 (parameterization error) is set.
minCurrentInAmpere	UInt	The minimum charging current (in A) of the charging station. This current must be less than the value of "maxCurrentInAmpere"; otherwise the error message bit 1 (parameterization error) is set.
minVoltageInVolt	UInt	The minimum voltage (in V) of the charge column. This voltage must be less than the value of "maxVoltageInVolt"; otherwise the error message bit 1 (parameterization error) is set.
peakCurrentRippleInAmpere	UInt	Maximum current ripple (in A) on the charging current.
preChargeCurrentInAmpere	UInt	The maximum allowed charging current (in A) in the "PreCharge" phase. If a minimum current value is required by the frequency converter to start, its high limit is defined here. This current must be less than or equal to the value of "maxCurrentInAmpere"; otherwise the error message bit 1 (parameterization error) is set.
prechbrkIsUsed	Bool	Monitoring the feedback of the "PreCharge breaker" and control of the corresponding output (see section on Wiring of the frequency converter (Page 41)). (True = yes, False = no) If "False" is set, the corresponding output "prechbrk" is also set permanently to "False".

shuntIsUsed	Bool	Monitoring the feedback of the "Shunt breaker" and control of the corresponding output (see the section on Wiring of the frequency converter (Page 41)). (True = yes, False = no) The "shuntValueInOhm" value must be unequal to "0"; otherwise the error message bit 1 (parameterization error) is set.
shuntValueInOhm	UInt	Resistance value of shunt in Ohm (see the chapter on Protective circuit of a converter (Page 41))
stopChargingCurrentIn-Ampere	UInt	If this value is undershot when the charging process is terminated, the DC breaker is opened. This current must be less than or equal to the value of "maxCurrentIn-Ampere"; otherwise the error message bit 1 (parameterization error) is set.
supportedEnergyTransferTypes	Word	With this parameter you select the energy transfer variants supported by the charging station (True = selected; False = not selected). The designations of the types are taken directly from the DIN SPEC 70121. • Bit 0 = AC_single_phase_core is not supported in DIN SPEC 70121 • Bit 1 = AC_three_phase_core is not supported in DIN SPEC 70121 • Bit 2 = DC_core DC charging via the pins in the Type1/Type2 connector is supported • Bit 3 = DC_extended Charging via the extended pins of the CCS connector (Type1/Type2) is supported • Bit 4 = DC_combo_core is not supported in DIN SPEC 70121 • Bit 5 = DC_dual is not supported in DIN SPEC 70121 • Bit 6 = AC_core1p_DC_extended is not supported in DIN SPEC 70121 • Bit 7 = AC_single_DC_core is not supported in DIN SPEC 70121 • Bit 8 = AC_single_phase_three_phase_core_DC_extended is not supported in DIN SPEC 70121 • Bit 9 = AC_core3p_DC_extended is not supported in DIN SPEC 70121 The "DIN_70121" function block supports only DC_core (bit 2) and DC_extended (bit 3). The error message bit 1 (parameterization error) is set for all other variants (bit values). In addition, at least one of these two bits must be set. The variants supported by the charge column are compared to the variants required by the vehicle. If the vehicle requires a variant which is not supported by the charge column, the charge process is aborted.

5.2.3.3 UDT_Charger_Values

The UDT_Charger_Values has the following structure:

Table 5- 4 List of input parameters to the UDT_Charger_Values

Parameter	Data type	Description
authAccepted	Byte	This parameter indicates whether the charging station is authorized for the charging of a vehicle. It is relevant in the authentication phase. Here the vehicle owner has to, for example, authorize the charging process via RFID. The status of the authentication is defined by the following three states: • 0: Authentication is taking place There is no feedback signal yet • 1: Authentication has failed The charging process is not started • 2: Authentication successful The charging process can begin • 3 .. 255: Authentication has failed The charging process is canceled. If no explicit activation is required (e.g. free charging), the parameter can be permanently set to "2".
currentInAmpere	Int	Currently measured voltage of the current measuring unit (in A)
dcbrk	Bool	The feedback contact of the DC breaker (False = Open; True = Closed). This parameter is only used if the control of the DC breaker is activated (see section Possible circuitry of a frequency converter (Page 41)).
extVoltageInVolt	Int	Currently measured voltage of the voltage measuring unit (in V) at the charging outlet.
hwState	Int	HW state of the charging station (see section Hardware states (Page 50)). The following 4 states are defined: • 0: Undefined state When the charging station is switched on • 1: Idle state Converter is off, IO modules for the breakers are switched off • 2: Wait state Converter is off, IO modules for the breakers are on • 3: Ready Converter is on, IO modules for the breakers are on
prechbrk	Bool	The feedback contact of the PreCharge breaker (False = Open; True = Closed). This parameter is only used when the control of the PreCharge breaker is activated (see section Possible circuitry of a frequency converter (Page 41)).
shunt	Bool	The feedback contact of the shunt breaker (False = Open; True = Closed). This parameter is only used when the control of the shunt breaker is activated (see section Possible circuitry of a frequency converter (Page 41)).

stopCharging	Bool	Setting this bit to "True" indicates to the vehicle that the charging procedure is to be ended. The vehicle decides whether and when the charging process is terminated. If "stopCharging" is set to "True" for longer than the current charging process, no other charging process can be started until this bit has been reset to "False".
voltageInVolt	Int	Currently measured voltage of the voltage measuring unit (in V) at the frequency converter output.

5.2.3.4 UDT_Charger_Out

The UDT_Charger_Out has the following structure:

Table 5- 5 List of input parameters to the UDT_Charger_Out

Parameter	Data type	Description
ev	UDT_Charger_Ev	Information with regard to the vehicle
pilotState	USINT	Charging state At this output the state is output according to IEC 61851-1. • 0: State A1 (100% PWM) Charging station not ready for charging / Vehicle not connected (State according to IEC 61851-1) • 1: State B1 (100% PWM) Charging station not ready for charging / Vehicle not ready for charging (State according to IEC 61851-1) • 2: State B2 (5% PWM) Charging station ready for charging / Vehicle not ready for charging (State according to IEC 61851-1) • 3: State C1 (100% PWM) Charging station not ready for charging / Vehicle ready for charging (State according to IEC 61851-1) • 4: State C2 (5% PWM) Charging station ready for charging / Vehicle ready for charging (State according to IEC 61851-1) • 5: State D1 (100% PWM) Charging station not ready for charging / Vehicle ready for charging / Ventilation required (State according to IEC 61851-1) • 6: State D2 (5% PWM) Charging station ready for charging / Vehicle ready for charging / Ventilation required (State according to IEC 61851-1) • 7: State E (100% PWM) e.g. if charging station is current-free or short-circuit between CP and protective conductor (State according to IEC 61851-1) • 8: State F Charging station not ready for charging e.g. Error occurred or charging station in maintenance - charging outlet locked (State according to IEC 61851-1) • 9: Invalid state CP current outside the permitted range

ppState	USINT	State of Plug Present (only relevant for Type 1 connector) • 0: Vehicle is not connected to the charging station. • 1: Vehicle is connected to the charging station, the button at the connector is pressed • 2: Vehicle is connected to the charging station, the button at the connector is not pressed • 0xFF: Invalid voltage at Plug Present (U > 3.5 V)
setpoints	UDT_Charger_Setpoints	Current manipulated variables for the charging station.
swError (for TIA library version 1.0)	LWord	Pending SW errors
swError1 (for TIA library version > 1.0)	DWord	Pending SW errors corresponds to swError bits no 0 to 31
swError2 (for TIA library version > 1.0)	DWord	Pending SW errors corresponds to swError bits no 32 to 63
swState	Int	SW states • -3: An error has occurred. The error can be acknowledged. The status "-2" automatically changes to the status "-3" after 10 seconds. • -2: An error has occurred. The charging station has shut down. • -1: An error has occurred. The charging station is shutting down. • 0: Initialization phase (after cold restart). The basic HW checks are performed. Are all the modules on and the breakers open? • 1: System ready • 2: System in idle state (no charging process active). The IO modules are off, all the breakers are open. • 3: The I/O modules are on, all breakers are open. • 4: System is ready for charging (communication with the vehicle has started). This phase is very short and therefore not always visible at the output. • 5: Authentication phase (in accordance with DIN SPEC 70121) • 6: Parameter discovery (in accordance with DIN SPEC 70121) • 7: ExtVoltageCheck This phase is very short and therefore not always visible at the output. • 8: Cable Check (in accordance with DIN SPEC 70121) • 9: PreCharge/Power Delivery (according to DIN SPEC 70121) • 10: Current Demand (according to DIN SPEC 70121) • 11: Termination of the charging process (according to DIN SPEC 70121)

5.2.3.5 UDT_Charger_Ev

The UDT_Charger_Ev has the following structure:

Table 5- 6 List of input parameters for the UDT_Charger_Ev

Parameter	Data type	Description
Diagnostics	UDT_Charger_Ev_Diagnostics	Status and diagnostic information with regard to the vehicle.
evccId	Array [0..7] of Byte	Unique ID of the vehicle. Details on structure can be found in DIN SPEC 70121.
evccIdLength	USINT	Length of the vehicle ID
Limits	UDT_Charger_Ev_Limits	Electrical limiting values of the vehicle.

5.2.3.6 UDT_Charger_Ev_Diagnostics

The UDT_Charger_Ev_Diagnose has the following structure:

Table 5- 7 List of input parameters to the UDT_Charger_Ev_Diagnose

Parameter	Data type	Description
cabinConditioning	Bool	Information by the vehicle (e.g. heating is on) According to DIN SPEC 70121
evEnergyTransferType	Int	Energy transfer type supported by the vehicle The designations of the types are taken directly from the DIN SPEC 70121. • 0 = AC_single_phase_core is not supported in DIN SPEC 70121 • 1 = AC_three_phase_core is not supported in DIN SPEC 70121 • 2 = DC_core DC charging via the pins in Type 1/Type 2 plug-in connectors is required • 3 = DC_extended charging via the extended pins of the CCS connector (Type1/Type2) is required • 4 = DC_combo_core is not supported in DIN SPEC 70121 • 5 = DC_dual is not supported in DIN SPEC 70121 • 6 = AC_core1p_DC_extended is not supported in DIN SPEC 70121 • 7 = AC_single_DC_core is not supported in DIN SPEC 70121 • 8 = AC_single_phase_three_phase_core_DC_extended is not supported in DIN SPEC 70121 • 9 = AC_core3p_DC_extended is not supported in DIN SPEC 70121

remainingTimeToBulkSoC	Time	Information from the vehicle: Estimated time until the battery is charged to 80%
remainingTimeToFullSoC	Time	Information from the vehicle; estimated time until the battery is charged to 100%
ressConditioning	Bool	Information from the vehicle: The battery is in the service mode and is therefore charging with reduced performance
stateOfChargeInPercent	USINT	Information from the vehicle: Current charge state (in %)

5.2.3.7 UDT_Charger_Ev_Limits

The UDT_Charger_Ev_Limits has the following structure:

Table 5- 8 List of input parameters for the UDT_Charger_Ev_Limits

Parameter	Data type	Description
maxCurrentInAmpere	UInt	The maximum charging current permitted by the vehicle (in A)
maxPowerInkW	UInt	The maximum charging power permitted by the vehicle (in kW)
maxVoltageInVolt	UInt	The maximum charging voltage permitted by the vehicle (in V).

5.2.3.8 UDT_Charger_Setpoints

The UDT_Charger_Setpoints has the following structure:

Table 5- 9 List of input parameters to the UDT_Charger_Setpoints

Parameter	Data type	Description
currentInAmpere	DInt	The current (in A) which is required by the vehicle or the maximum current. Depends on whether current control or voltage control is called for from the frequency converter via the function block.
dcbrk	Bool	Required state of the DC breaker (see chapter Possible circuitry of a frequency converter (Page 41)). (False = Open; True = Closed).
enableCurrentControl	Bool	Determination current/voltage control for the frequency converter • True: The converter must be set to current control. (The "currentInAmpere" parameter defines the current specification, the "voltageInVolt" parameter defines the maximum current) • False: The frequency converter has to be set to voltage control. (The "currentInAmpere" parameter defines the maximum current, the "voltageInVolt" parameter defines the voltage specification)
hwState	Int	The setpoint HW status of the charge column requested by the function block. The following 4 states are defined (see chapter Hardware states (Page 50)): • 0: Undefined state for example whether the charge column is switched on • 1: Idle state Converter is off, I/O modules for the breakers are off • 2: Wait state Converter is off, I/O modules for the breakers are on • 3: Ready Converter is on, I/O modules for the breaker are on
prechbrk	Bool	Required state of the PreCharge breaker (see chapter Possible circuitry of a frequency converter (Page 41)). (False = Open; True = Closed).
shunt	Bool	Required state of the shunt breaker (see chapter Possible circuitry of a frequency converter (Page 41)). (False = Open; True = Closed).
voltageInVolt	DInt	The voltage (in V) which is required by the vehicle or the maximum voltage. Depends on whether current control or voltage control is called for from the frequency converter via the function block.

5.3 "ISO_15118_DC" function block

Introduction

This section presents the properties of the "ISO_15118_DC" function block. It exists in three versions:

- ISO_15118_DC_1500 (for CPU15xx)
- ISO_15118_DC_1200 (for CPU12xx)
- ISO_15118_DC_OC (for Open Controller)

The three function blocks behave identically. For the sake of clarity, only the "ISO_15118_DC" function block is referred to in the following.

The following figure shows the inputs/outputs of the "ISO_15118_DC" function block:

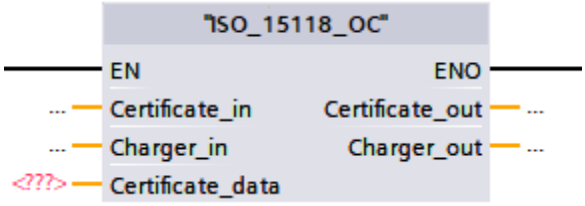


Figure 5-5 "ISO_15118_DC" function block

The "ISO_15118_DC" function block appears in the structure of the TIA library.

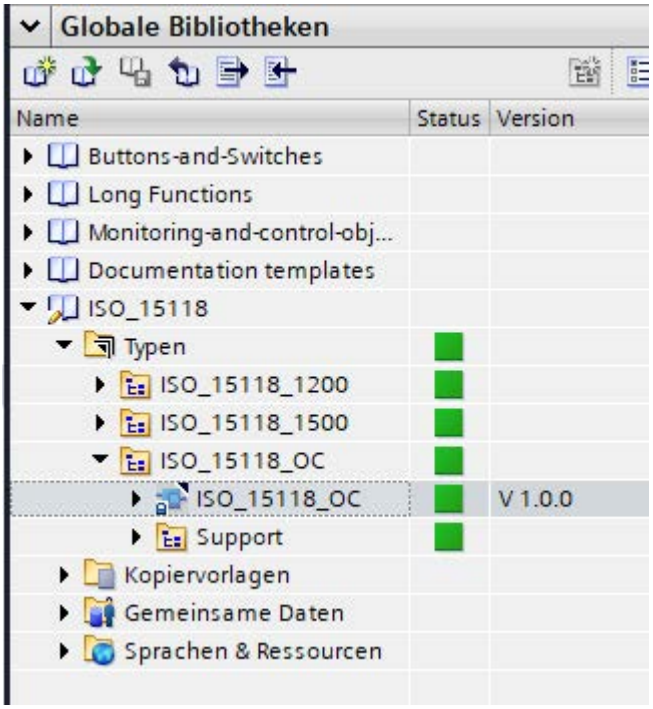


Figure 5-6 Structure of the TIA library ISO_15118

The "ISO_15118_DC_1200" folder contains the blocks for the S7-1200 controllers, and the "ISO_15118_DC_1500" folder contains the blocks for the S7-1500 controllers. The blocks for the "Open Controller" are contained in the "ISO_15118_DC_OC" folder.

For configuring, you can only use the "ISO_15118_DC" function block itself. The "ISO_15118_DC Support" folder contains internal auxiliary functions.

5.3.1 Required memory of the "ISO_15118_DC" function block

Memory requirement

The memory requirement of FB "ISO_15118_DC" is shown below:

Table 5- 10 Memory requirement of the "ISO_15118_DC" function block

	Load memory	Code work memory	Data work memory
First instance	1.41 MB	57.26 KB	25.52 KB
Additional memory required for each additional instance	41.88 KB	0	25.52 KB

5.3.2 Principle of operation of the "ISO_15118_DC" function block

The principle of operation of this block basically corresponds to that of FB "DIN_70121" (see section "Principle of operation of the "DIN_70121" function block (Page 40)") and includes the communication defined in DIN SPEC 70121.

The "ISO_15118_DC" function block also contains all the features that enable payment using PnC. These are:

- Certificate handling relating to TLS encryption (installation or update)
  Certificate Signing Request (CSR)
- Transfer of the contract certificate of a vehicle to the backend
  Contract Certificate (CC)

The inputs under "Charger_in" correspond essentially to the inputs "in" of FB "DIN_70121". The outputs under "Charger_out" correspond essentially to the outputs "out" of FB "DIN_70121".

The inputs under "Certificate_in", the outputs under "Certificate_out" and the "Certificate_data" inputs/outputs contain the parameters that are relevant for the TLS encryption (between charging station and vehicle) and the contract data handling (between vehicle and backend).

These extensions are described in the following sections:

Note

The function block transfers the setpoints (out.setpoints), but does not check their plausibility with regard to the actual values (in.values) at its input.

5.3.2.1 "UDT_Charger_In" extensions with regard to FB "DIN_70121"

FB "ISO_15118_DC" has been extended to include the input parameter "evseCfg.paymentVar" (Byte data type). You can use this to specify the supported payment variants. You can allow payment for the charging process through an external identification or using automatic identification over a TLS-encrypted connection (PnC), or both. EIM with TLS encryption is also possible. The corresponding backend infrastructure must then be available independent of EIM or PnC. See also table "List of additional input parameters for UDT_Charger_In" (Page 71).

5.3.2.2 "UDT_Charger_Out" extensions with regard to FB "DIN_70121"

FB "ISO_15118_DC" has been extended to include the output parameter "setpoints.paymentType" (Byte data type). The vehicle (EV) uses this to signal which payment variant is used.

You can find the values that the output parameter "setpoints.paymentType" can assume in table "List of additional output parameters for UDT_Charger_Out" (Page 73).

FB "ISO_15118_DC" has been extended to include the output parameter "setpoints.usedStandard" (Byte data type). The vehicle (EV) uses this to signal which charging standard is used.

You can find the values that the output parameter "usedStandard" can assume in table "List of additional output parameters for UDT_Charger_Out" (Page 73).

5.3.2.3 Payment using external identification (e.g. RFID card reader)

The input parameter "authAccepted" indicates whether the charging station has been activated for the charging process of a vehicle. It is relevant in the authentication phase.

Here, the vehicle owner must be activated for the charging process, e.g. via RFID.

The status of the authentication is defined by the following three states:

- 0: Authentication is taking place
  There is no feedback signal yet
- 1: Authentication has failed
  The charging process is not started
- 2: Authentication successful
  The charging process can begin

If no explicit activation is required (e.g. free charging), the parameter can remain permanently set to "2".

Note

This input is only evaluated during the authentication phase. As soon as state "1" or "2" is applied, a change to the next charge phase takes place. Subsequent changing of this state does not have any effect.

5.3.2.4 Payment through automatic identification (PnC)

In order for an automatic payment (PnC) through the vehicle to take place, the existing contract in the vehicle must be checked. The contract data is available in the form of a certificate. The input "authAccepted" is not evaluated here.

An edge change from "0" to "1" (false to true) of the "Certificate_out.reqCCDataAvailable" output signals that the contract data of the vehicle must be checked. When the edge change occurs, the contract data to be checked is in "Certificate_data.reqCCData" and the length of the data (in bytes) in "Certificate_data.reqCCDataLength". The EMAID and its length can be found in "Certificate_data.reqCCEMAID" and "Certificate_data.reqCCEMAIDLength", respectively.

As soon as the check has been started by the user program, you must set the "Certificate_in.resCCManagement" input to "1" (Processing). The check can, but does not have to, be carried out in two steps.

- In the first step, you check the certificate in the charging station for consistency, without a connection to the backend.
  - If the check was successful, you enter information (e.g. Accepted = 2) at the "Certificate_in.resCertCheck" input and transfer the contract data to the backend.
  - If the check was not successful, you enter the result (e.g. Certificate unknown = 7) in "Certificate_in.resCertCheck". You can skip the following step (check by the backend) and set "Certificate_in.resCCManagement" to "3" (Finished Error) right away.
- If the contract check in the backend was successful, you must set the "Certificate_in.resCCManagement" input to "2" (Finished OK) and "Certificate_In.resContCheck" to "2" (Accepted).
- If the contract check in the backend was not successful, you must set the "Certificate_in.resCCManagement" input to "3" (Finished OK) and "Certificate_In.resContCheck" to the check result (e.g. Error = 1).
- If the module cancels the CC (e.g. due to a timeout), the FB sets "Certificate_out.reqCCDataAvailable" to "false".

Regardless of the result, the FB now sets the "Certificate_out.reqCCDataAvailable" output to "false". To finish, you must set the inputs "Certificate_in.resCCManagement", "Certificate_in.resCertCeck" and "Certificate_in.resContCheck" to "0" (Idle/Not Checked).

The EV monitors the Contract Certificate process (CC) for adherence to the following time limits: Time allowed from initiation by the EV until "resCCManagement = 1": 1.7 seconds; until "resCertCheck" is received: 4.5 seconds; until "resContCheck" is received: total of 55 seconds. After that, you can expect the EV to cancel the charging process.

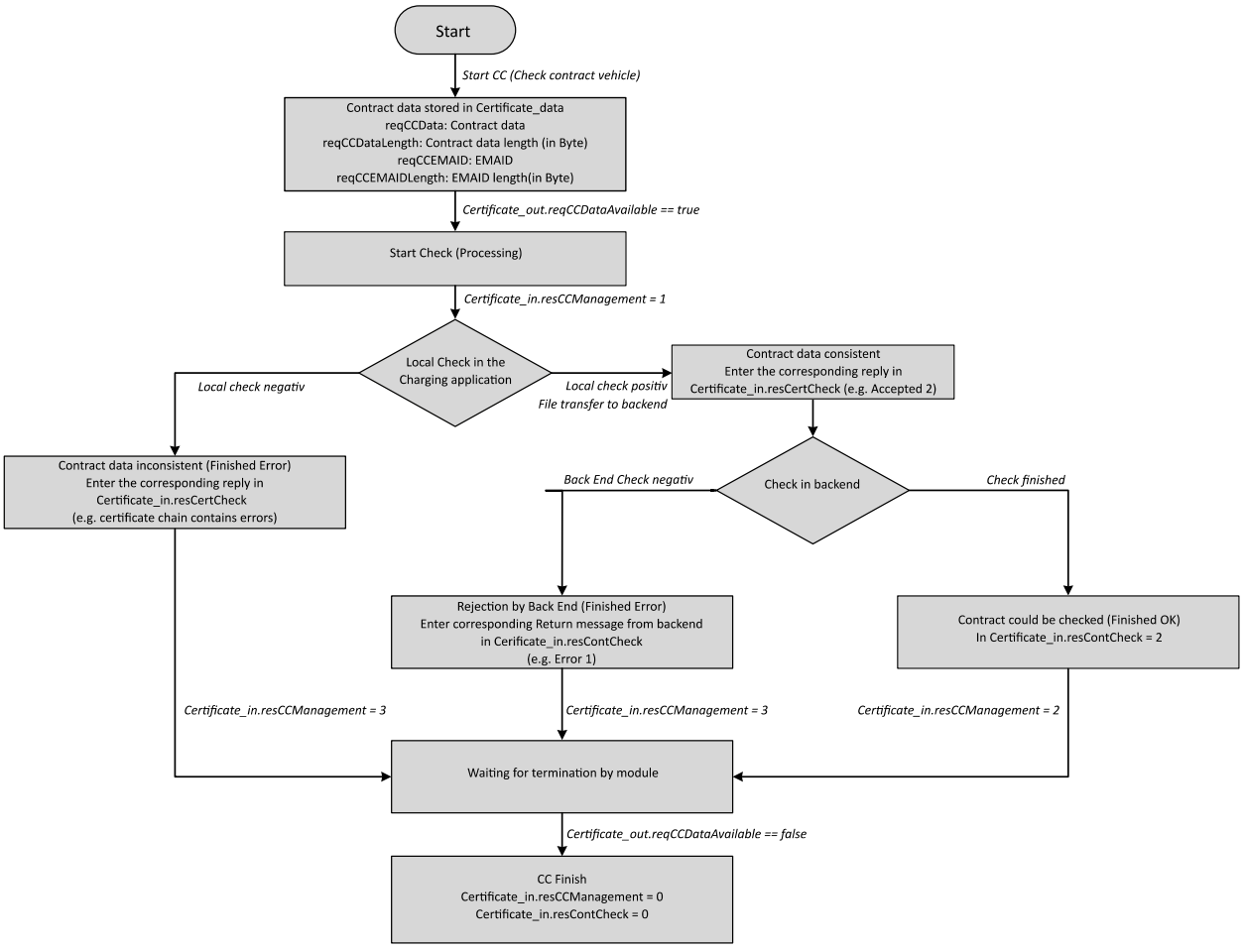


Figure 5-7 Status diagram for CC

5.3.2.5 Certificate signing request (CSR)

Precondition for encrypted communication according to the TLS standard is the existence of a valid certificate in the TM ECC PL ST module. This can be installed or updated.

The installation and update of a certificate are the same process from the perspective of the module. For this reason, only the update is described here.

The update takes place independent of an active charging process. However, the new certificate is not used until the next charging process.

The CSR can be initiated by the module itself or externally (e.g. from the backend).

Both variants are described in detail in the following.

Note

A stored certificate can be deleted by a firmware update. After a firmware update, ensure that a connection to the backend exists before the next charging process with TLS encryption. In this case, the technology module independently requests a new certificate, as described here.

Initiation of the CSR by the TM ECC PL ST module

An edge change from "0" to "1" (false to true) of the "Certificate_out.reqCSRDataAvailable" output signals that the TLS certificate must be updated. When the edge change occurs, the certificate request is in "Certificate_data.reqCSRData". Its length is stored in "Certificate_data.reqCSRDataLength".

This certificate request must now be processed (e.g. by the backend).

As soon as the update has been started by the user program, you must set the "Certificate_in.resCCManagement" input to "1" (Processing).

- If the update of the TLS certificate was successful, you must store it in "Certificate_data.resCSRData" and its length in "Certificate_data.resCSRDataLength". You must set the "Certificate_in.resCSRManagement" input to "2" (Finished OK). The module now adopts the new certificate.
- If the certificate could not be updated (e.g. because the certificate chain contains errors or is unknown to the backend), you must set the "Certificate_in.resCSRManagement" input to "3" (Finished Error).
- If the module cancels the CSR (e.g. due to a timeout), the FB sets "Certificate_out.reqCSRDataAvailable" to "false".

Regardless of the result, the FB now sets the "Certificate_out.reqCSRDataAvailable" output to "false". To finish, you must set the "Certificate_in.resCCManagement" input to "0" (Idle).

The CSR is monitored for adherence to time limits. Time allowed from initiation by the module until "resCCManagement = 1": 1.7 seconds. A maximum of 50 seconds is permitted to elapse between the rising edge of "Certificate_out.reqCSRDataAvailable" and "Certificate_in.resCSRManagement" = 2.

Note

If the CSR is not supported by the infrastructure, "resCSRManagement = 3" must be set.

Note

If the CSR fails, it is repeated automatically by the module at variable intervals.

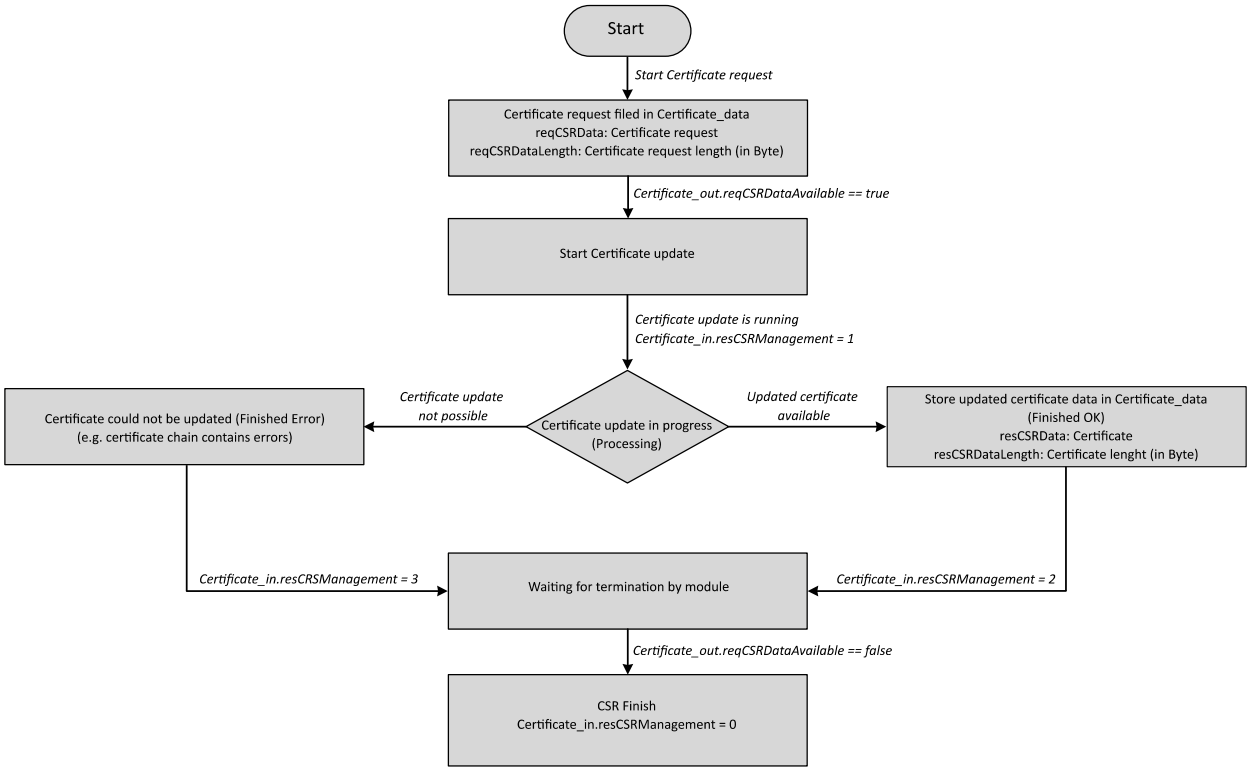


Figure 5-8 Status diagram for "Module-internal" CSR

External initiation of the CSR

The behavior is essentially the same as when initiated by the module.

Here, the external initiation takes place via an edge change of "Certificate_in.reqCSRUser" from "0" to "1" (false to true).

You are signaled at the "Certificate_out.reqCSRDataAvailable" output that the TLS certificate request has been stored in the FB. When the edge change occurs, the certificate request is in "Certificate_data.reqCSRData". Its length is stored in "Certificate_data.reqCSRDataLength".

This certificate must now be updated (e.g. by the backend).

As soon as the update has been started by the user program, you must set the "Certificate_in.resCCManagement" input to "1" (Processing).

- If the update of the TLS certificate was successful, you must store it in "Certificate_data.resCSRData" and its length in "Certificate_data.resCSRDataLength". You

must set the "Certificate_in.resCSRManagement" input to "2" (Finished OK). The module now adopts the new certificate.

- If the certificate could not be updated (e.g. because the certificate chain contains errors or is unknown to the backend), you must set the "Certificate_in.resCSRManagement" input to "3" (Finished Error).
- If the module cancels the CSR (e.g. due to a timeout), the FB sets "Certificate_out.reqCSRDataAvailable" to "false".

Regardless of the result, the FB now sets the "Certificate_out.reqCSRDataAvailable" output to "false". You must then set the "Certificate_in.resCCManagement" input to "0" (Idle).

To finish, the FB outputs the result of the overall CSR request (result from the backend and transfer to the module) in "Certificate_out.reqCSRManagement". Then, please revoke "Certificate_in.reqCSRUser" (false).

The CSR is monitored for adherence to time limits. Time allowed from initiation by the module until "resCCManagement = 1": 1.7 seconds. A maximum of 50 seconds is permitted to elapse between the rising edge of "Certificate_out.reqCSRDataAvailable" and "Certificate_in.resCSRManagement" = 2.

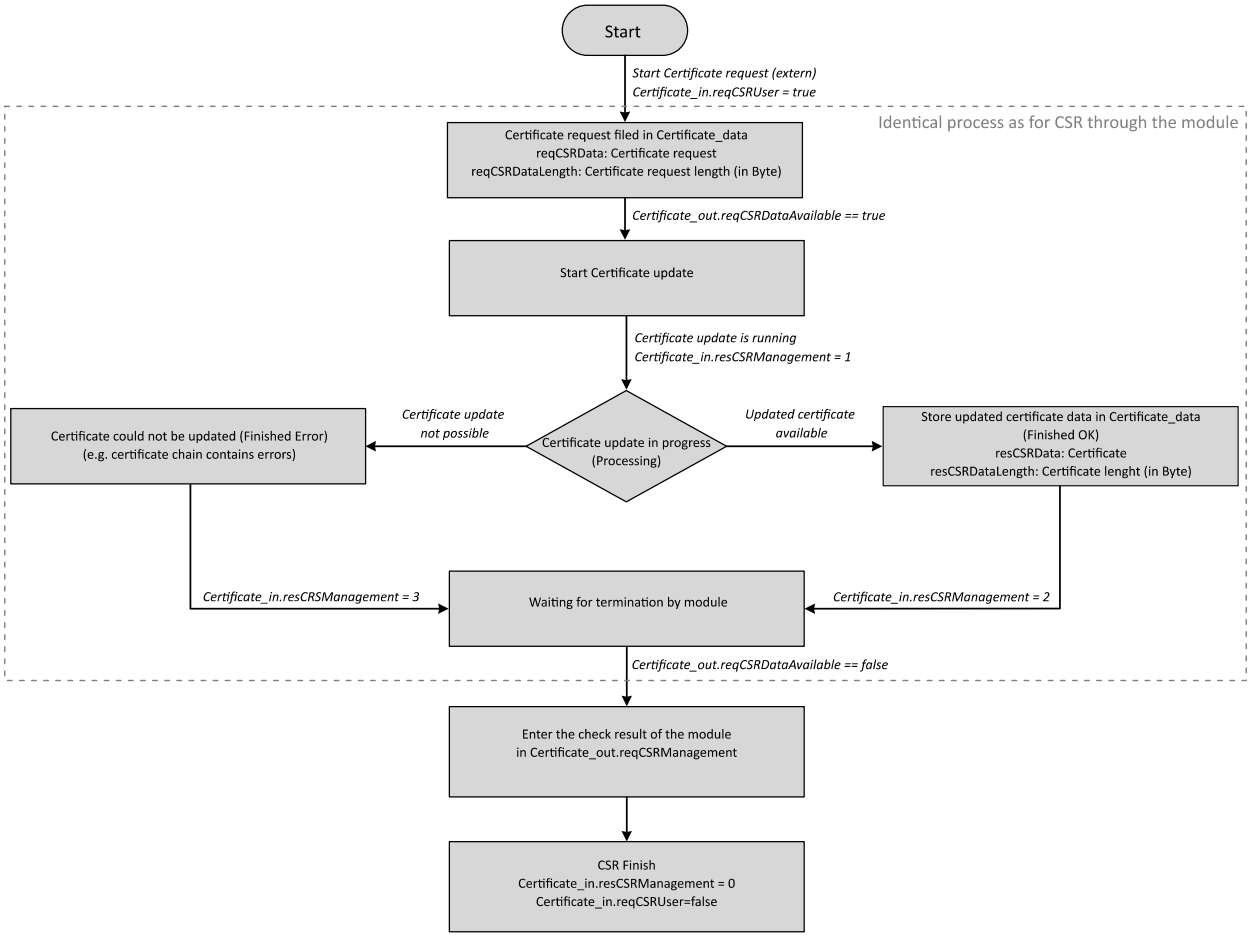


Figure 5-9 Status diagram for "Module-external" CSR

5.3.3 ISO_15118_DC parameters

All parameters have been created in the form of UDTs (User defined data types).

The "Charger_in" input is mapped in the form of the UDT "UDT_Charger_In". This input corresponds essentially to the inputs "in" of FB "DIN_70121".

The "Certificate_in" input is mapped in the form of the UDT "UDT_Certificate_In".

The "Charger_out" output is mapped in the form of the UDT "UDT_Charger_Out". This output corresponds essentially to the outputs "out" of FB "DIN_70121".

The "Certificate_out" output is mapped in the form of the UDT "UDT_Certificate_Out".

The "Certificate_data" input/output is mapped in the form of the UDT "UDT_Certificate_InOut".

5.3.3.1 UDT_Charger_In

Only the additional extensions compared with FB "DIN_70121" (Page 52) are described in the following.

Table 5- 11 List of additional input parameters for UDT_Charger_In.evseCfg

Parameter	Data type	Description
paymentVar	Byte	Possible payment variants of the charging station • 1 = Only payment via EIM without TLS possible. • 2 = Only payment via PnC possible. • 3 = Payment via EIM without TLS and PnC possible. • 5 = Only payment via EIM including with TLS possible. • 7 = Payment via EIM, including with TLS and PnC possible. • 0, 4, 6, 8 .. 255 result in a configuration error (swError1.1)

5.3.3.2 UDT_Certificate_In

UDT_Certificate_In is structured as follows:

Table 5- 12 List of input parameters for UDT_Certificate_In

Name	Data type	Description
reqCSRUser	Bool	Initiate CSR by the user
resCSRManagement	Byte	Feedback to the FB regarding the processing status of the CSR (see Certificate Signing Request (Page 67)) • 0: Idle • 1: Processing • 2: Finished OK • 3: Finished Error • 4 .. 255: Not permitted. Handled like "Finished Error"
resCCManagement	Byte	Feedback to the FB regarding the processing status of the CC (see Contract Certificate (Page 66)) • Coding same as for resCSRManagement
resCertCheck	Byte	Result of the local contract certificate check in the CC (see Contract Certificate (Page 66)) • 0: Not checked / Check not yet complete • 1: Error, only in conjunction with resCCManagement = 3 • 2: Accepted • 3: Accepted, certificate expires "soon" • 5: Rejected, certificate is valid but has expired • 6: Rejected, error in the signature • 7: Rejected, the certificate does not exist • 9: Rejected, error in the certificate chain • 10: Rejected, certificate not permitted at this charging point • 11: Rejected, certificate invalidated before expiration • 4, 8, 12 .. 255: Not permissible. Handled like "Error"
resContCheck	Byte	Result of the backend check of the contract certificate in the CC (see Contract Certificate (Page 66)) • 0: Not checked / Check not yet complete • 1: Error, only in conjunction with resCCManagement = 3 • 2: Accepted • 3: Rejected, processing canceled • 4 .. 255: Not permissible. Handled like "Error"

5.3.3.3 UDT_Charger_Out

Only the additional extensions compared with FB "DIN_70121 (Page 58)" are described in the following.

Table 5- 13 List of additional output parameters for UDT_Charger_Out

Parameter	Data type	Description
setpoints.paymentType	Byte	Payment variant selected by the vehicle • 0: No decision has yet been made by the EV regarding the payment variant • 1: Payment using external identification (e.g. RFID card reader) • 2: Payment via automatic identification (PnC) • 3 .. 255: Reserve
setpoints.usedStandard	Byte	Charging standard used by the vehicle • 0: Charging standard not yet specified (If no current charging process is pending or the "Authentication" phase has not yet been reached, the output is set to "0".) • 1: DIN 70121 is used • 2: ISO 15118 is used • 3 .. 255: Reserve
ev.evccmac	Array [0..5] of Byte	MAC address of the EV

If no current charging process is pending or the "Authentication" phase has not yet been reached, the output is set to "0".

5.3.3.4 UDT_Certificate_Out

The UDT_Certificate_Out parameter is structured as follows:

Table 5- 14 List of parameters for UDT_Certificate _Out

Name	Data type	Description
errorStateCSR	Bool	Error state of the last CSR transaction
errorStateCC	Bool	Error state of the last CC transaction
tlsCertificatePresent	Bool	Valid TLS certificate exists in the TM
encCommunication	Bool	Communication via an encrypted connection between EV and EVSE
resCSRManagement	Byte	Feedback of FB regarding the processing status of the CSR in the module (see also Certificate Signing Request (Page 69)) Coding same as "resCSRManagement" (see "List of input parameters for UDT_Certificate_In (Page 72)")
reqCSRDataAvailable	Bool	Message to the user: There is a CSR by the TM
reqCCDataAvailable	Bool	Message to the user: There is a CC request by the TM

5.3.3.5 UDT_Certificate_InOut

The UDT_Certificate_InOut parameter is structured as follows:

Table 5- 15 List of parameters for UDT_Certificate _InOut

Name	Data type	Description
reqCSRData	Array of Byte	Container for CSR data to the backend
reqCSRDateLength	UInt	Valid length of the CSR data to the backend
resCSRData	Array of Byte	Container for CSR data from the backend (TLS certificate)
reqCSRDateLength	UInt	Valid length of the CSR data from the backend
reqCCData	Array of Byte	Container for CC data to the backend
reqCCDateLength	UInt	Valid length of the CC data to the backend
reqCCEMAID	Array of Byte	Vehicle identification (EMAID) for CC to the backend
reqCCEMAIDLength	UInt	Valid length of the EMAID

5.4 "Update_PL_ST" function block

Introduction

This section presents the properties of the "Update_PL_ST" function block. It exists in three versions:

- Update_PL_ST_1500 (for CPU15xx)
- Update_PL_ST_1200 (for CPU12xx)
- Update_PL_ST_OC (for Open Controller)

The three function blocks behave identically. For the sake of clarity, only the "Update_PL_ST" function block is referred to in the following.

The following figure shows the inputs/outputs of the "Update_PL_ST" function block:

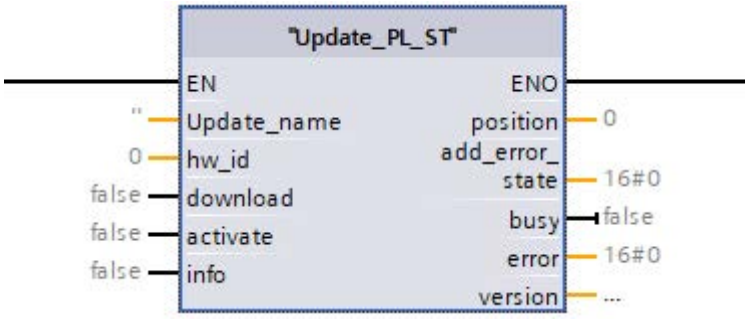


Figure 5-10 "Update_PL_ST" function block

The "Update_PL_ST" and "Log_PL_ST " function blocks are available for download as their own TIA library:

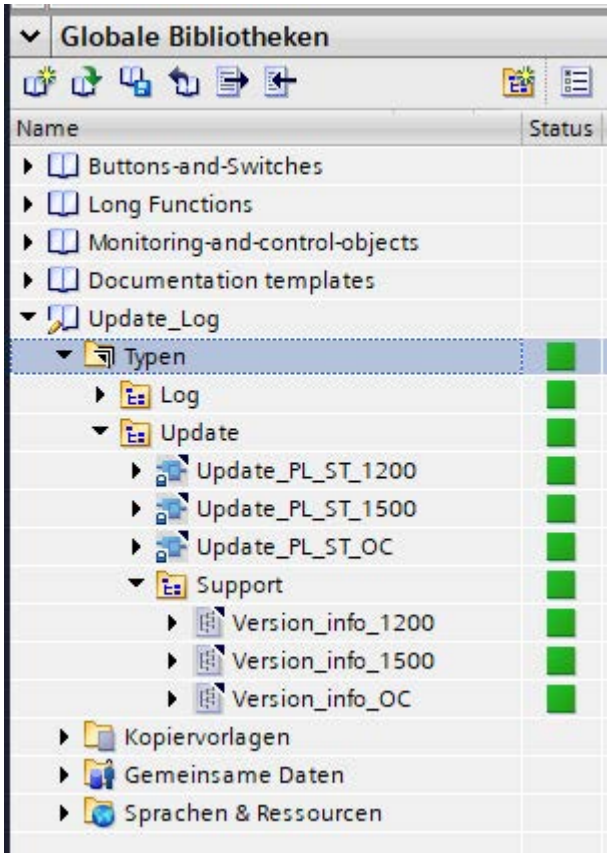


Figure 5-11 Structure of the library Update_PL_ST

The "Update_PL_ST_1200" folder contains the blocks for the S7-1200 controllers, and the "Update_PL_ST_1500" folder contains the blocks for the S7-1500 controllers. The blocks for the "Open Controller" are contained in the "Update_PL_ST_OC" folder.

5.4.1 Required memory of the "Update_PL_ST" function block

Memory requirement

The memory requirement is shown below:

Table 5- 16 Memory requirement of the "Update_PL_ST" function block

	Load memory	Code work memory	Data work memory
First instance	77.95 KB	3.75 KB	12.55 KB
Additional memory required for each additional instance	1.27 KB	0	12.55 KB

5.4.2 Principle of operation of the "Update_PL_ST" function block

Unlike the "DIN_70121" and "ISO_15118_DC" function blocks, the "Update_PL_ST" is not required for operation of the ET 200SP TM ECC PL ST technology module. You can configure it additionally in order to make use of additional update options and information.

- Transfer of the interim updates provided by Siemens AG (minor function update or corrections) that are suitable for the current basic FW version on the technology module (even during a charging process).
- Activation of previously transferred interim updates at a time of your choosing.
- Query of information regarding the current basic FW version (TIA), a currently active interim update and the size of a previously downloaded interim update.

Note

The function block can be used starting from FW Version V1.1.

Inputs

Parameter	Data type	Description
update_name	String	Name and path of the interim update on the CPU MMC
hw_id	HW_IO	Hw_id of the ET 200SP TM ECC PL ST as used in the DIN/ISO FB
download	Bool	Start/cancel download of the interim update
activate	Bool	Activate previously downloaded interim update
info	Bool	Query information

Outputs

Parameter	Subparameter	Data type	Description
position		UDint	Transferred bytes of an interim update
add_error_state		Word	Additional error information
busy		Bool	Download/activation/information query active
error		Byte	Error during the last action
version		version_info	
	type	Char	Letter of the TIA version, normally "V"
	major	Byte	First digit of the TIA version number
	minor	Byte	Second digit of the TIA version number
	increment	Byte	Third digit of the TIA version number
	updateSize	Dint	Size of an interim update that is waiting for activation, or zero
	linux	Dword	Identifier of an active interim update or corresponding identifier of a basic version

As a precondition for an interim update, the update file concerned must be on the MMC inserted in the CPU. You can copy it to there, e.g. using the web server of the CPU. Ensure

that the parameter "hw_id" has been set correctly and the parameter "update_name" contains the name and path of the interim update.

- A positive edge at the "info" input loads the status information from the technology module and makes it available at the "version" output. During this process, "busy" is high and then changes to low.
- A positive edge at the "activate" input attempts to activate an interim update located on the technology module. During this process, "busy" is high and changes after the message is sent to low. There is no direct response of the technology module, especially if no interim update is available. You can check the result by using "info" to read out the version (see above).

Note

When an interim update has been activated successfully, the TM behaves the same as at the end of a regular TIA update. You must heed the notes regarding the firmware update (Page 11), especially those regarding the power supply.

Ignore all error messages of an active function block (DIN_70121 or ISO_15118_DC) during this process.

- A positive edge at the "download" input starts the transfer of the interim update stored under "update_name" to the technology module. During this process, "busy" is high. The portion of the update already transferred, in bytes, is displayed in "position". The process can be canceled with a negative edge at "download".

If an error occurs during one of these actions, this is indicated at a falling edge at the "busy" output by a non-zero value at the "error" output. If necessary, you can obtain more information of subordinate system functions from the "add_error_state" output:

error		See system function
0	No error, action successful	-
1	Error when writing to the TM	WRREC output "Status" Bytes 1 and 2
2	Error when reading from the TM	RDREC output "Status" Bytes 1 and 2
3	Error when reading from the MMC	FileReadC output "Status"
4	TM signals an error	-

See also

Properties (Page 11)

5.5 "Log_PL_ST" function block

Introduction

This section presents the properties of the "Log_PL_ST" function block. It exists in three versions:

- Log_PL_ST_1500 (for CPU15xx)
- Log_PL_ST_1200 (for CPU12xx)
- Log_PL_ST_OC (for Open Controller)

The three function blocks behave identically. For the sake of clarity, only the "Log_PL_ST" function block is referred to in the following.

The following figure shows the inputs/outputs of the "Log_PL_ST" function block:

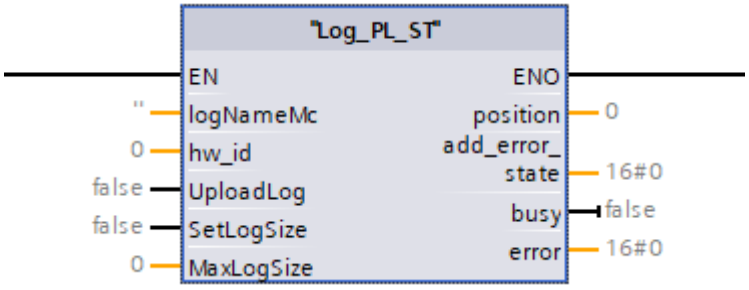


Figure 5-12 "Log_PL_ST" function block

The "Update_PL_ST" and "Log_PL_ST " function blocks are available for download as their own TIA library:

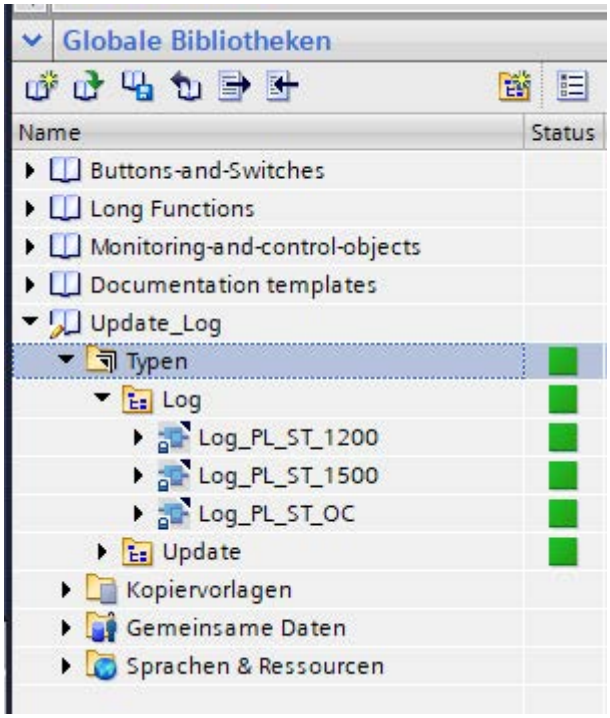


Figure 5-13 Structure of the library Log_PL_ST

The "Log_PL_ST_1200" folder contains the blocks for the S7-1200 controllers, and the "Log_PL_ST_1500" folder contains the blocks for the S7-1500 controllers. The blocks for the "Open Controller" are contained in the "Log_PL_ST_OC" folder.

5.5.1 Required memory of the "Log_PL_ST" function block

Memory requirement

The memory requirement is shown below:

Table 5- 17 Memory requirement of the "Log_PL_ST" function block

	Load memory	Code work memory	Data work memory
First instance	80.73 KB	3.94 KB	12.53 KB
Additional memory required for each additional instance	15.86 KB	0	12.53 KB

5.5.2 Principle of operation of the "Log_PL_ST" function block

Unlike the "DIN_70121" and "ISO_15118_DC" function blocks, the "Log_PL_ST" is not required for operation of the ET 200SP TM ECC PL ST technology module. You can configure it additionally in order to gain access to log information.

You can

- set the maximum size of a log file to be transferred later
- upload the current log file from the technology module

Note

The function block can be used starting from FW Version V1.1.

Inputs

Parameter	Data type	Description
LogNameMc	String	Name and path of the interim update on the CPU MMC
hw_id	HW_IO	Hw_id of the ET 200SP TM ECC PL ST as used in the DIN/ISO FB
uploadLog	Bool	Start/cancel upload of the log
setLogSize	Bool	Set new maximum size of the log file
maxLogSize	UInt	Maximum size of the log file in kilobytes

Outputs

Parameter	Data type	Data type	Description
position	UDint	UDint	Transferred bytes of a log file
add_error_state	Word	Word	Additional error information
busy	Bool	Bool	Download/activation/information query active
error	Byte	Byte	Error during the last action

In order to upload the log, you must ensure there is enough free memory space on the MMC inserted in the CPU (the last value transferred with setLogSize or the default value if no setting was made). Precondition for the upload is that the parameter "hw_id" has been set correctly.

Note

Note that any "LogNameMc" file located on the MMC is overwritten even if the upload is interrupted prematurely.

- A positive edge at "setLogSize" transfers the value applied at "maxLogSize" to the TM. It is used there as the new maximum size for the compressed log file. During this process, "busy" is high and changes after the transfer has finished to low.
- A positive edge at the "uploadLog" input starts the transfer of the current log file on the technology module to the CPU MMC. During this process, "busy" is high. The portion of the update already transferred, in bytes, is displayed in "position". The process can be canceled with a negative edge at "download".

If an error occurs during one of these actions, this is indicated at a falling edge at the "busy" output by a non-zero value at the "error" output. If necessary, you can obtain more information of subordinate system functions from the "add_error_state" output:

error		**See system function**
0	No error, action successful	-
1	Error when writing to the TM	WRREC output "Status" Bytes 1 and 2
2	Error when reading from the TM	RDREC output "Status" Bytes 1 and 2
3	Error when reading from the MMC	FileReadC output "Status"
4	TM signals an error	-

5.6 Error messages

The error messages of the function block are described in the following table.

When the "DIN_70121" function block is used:

- These error messages refer to the output parameter "out.swError" or "out.swError1" (bit no. 0 .. 31) and "out.swError2" (bit no. 32 .. 63):

When the "ISO_15118_DC" function block is used:

- These error messages refer to the output parameters "Charger_out.swError1" (bit no. 0 .. 31) and "Charger_out.swError2" (bit no. 32 .. 63)

Table 5- 18 List of the error messages at the output of the function block

Bit No.	Requires acknowledgment	Description	Remark
0	No	Hardware (communication module) not ready	The communication module does not report back, for example, because of a PROFINET fault or a fault of the ET 200SP backplane bus communication. The frequency converter is ramped down in a controlled manner.
1	Yes	Invalid configuration (in.evseCfg)	An invalid configuration exists at the function block input. Possible causes of the fault: • "EVSEID" is greater than "32" • "maxCurrentInAmpere" is greater than "minCurrentInAmpere" • "maxVoltageInVolt" is less than "minVoltagetInVolt" • "maxSwitchTimeBreaker" is less than 0 ms • "maxSwitchTimeHwState" is less than 0 ms • "maxTimeInvalidParamsOrRampCharge" is less than 0 ms • "maxTimeRampUpDown" is less than 0 ms • "maxTimeInvalidParamsOrRampCharge" is less than "maxTimeRampUpDown" • "cableCheckCurrentInAmpere" is greater than "maxCurrentInAmpere" • "preChargeCurrentInAmpere" is greater than" maxCurrentInAmpere" • "stopChargingCurrentInAmpere" is greater than "maxCurrentInAmpere" • If the voltage "maxExtVoltageInVolt" is greater than "maxVoltageInVolt" during the check "extVoltageCheckIsSupported" • If the resistance "shuntValueInOhm" is "0" during the check "shuntIsUsed" • "cableCheckCurrentInAmpere" is less than or equal to "maxCableCheckLeakCurrentInAmpere" • "maxCableCheckLeakCurrentInAmpere" is greater than "maxCurrentInAmpere" • "supportedEnergyTransferTypes" is not equal to "Bit 2" or "Bit 3" (The "DIN_70121" and "ISO_15118_DC" function blocks support only DC_core (Bit 2) and DC_extended (Bit 3)) • No possible payment variant parameterized in "paymentVar"

2	No	Module not ready	• The module is not ready yet for the next charging process. • The communication module does not report back. Possible causes of the fault: External 24 V supply of the module is faulty. If possible, the frequency converter is ramped down in a controlled manner. • This bit can also occur in combination with other error bits.
3	-	Reserved	-
4	No	Cable Check	External voltage too high • Before the Cable Check phase, a voltage is measured that is greater than the value set in the "in.evseCfg.maxExtVoltageInVolt" parameter. • This error is vehicle-specific and is automatically acknowledged. The charging process is canceled.
5	Yes		Target voltage could not be reached • The target current required by the vehicle could not be reached or lies outside the allowed range. The frequency converter is ramped down in a controlled manner.
6	Yes		DC leakage current too high • The measured leakage current is higher than the value set by the "in.evseCfg.cableCheckCurrentInAmpere" parameter. The frequency converter is ramped down in a controlled manner.
7	Yes		Voltage could not be ramped down. • The voltage could not be ramped down at the end of the CableCheck phase. If possible, the frequency converter is shut down in a controlled manner.
8	Yes	Pre Charge	Target voltage could not be reached • The output voltage of the frequency converter "in.values.voltageInVolt lies outside the valid range. The frequency converter is ramped down in a controlled manner.
9	-	Reserved	-

10	Yes	Current Demand	Range errors current, voltage, power • The "out.setpoints.voltageInVolt" voltage required by the vehicle lies outside the valid range. • The "out.setpoints.currentInAmpere" current required by the vehicle lies outside the valid range. • The output voltage of the frequency converter "in.values.voltageInVolt" lies outside the valid range. • The output voltage of the frequency converter "in.values.currentInAmpere" lies outside the valid range. • The maximum charging capacity is exceeded. If possible, the frequency converter is shut down in a controlled manner.
11	Yes		Invalid parameters • The target values required by the vehicle lie outside the permitted range. The frequency converter is ramped down in a controlled manner.
12	Yes	Termination of the charging process	The current could not be ramped down. Possible causes of the fault: • Frequency converter errors • Time "in.evseCfg.maxTimeRampUpDown" set too low • Maximum charging current set too small when opening the "in.evseCfg.stopChargingCurrentInAmpere" breaker If possible, the frequency converter is shut down in a controlled manner.
13	Yes	Timeout error	The PreCharge breaker has not opened or closed within the response time defined in "in.evseCfg.maxSwitchTimeBreaker". The frequency converter is ramped down in a controlled manner.
14	Yes		The DC breaker has not closed or opened within the response time defined in "in.evseCfg.maxSwitchTimeBreaker". The frequency converter is ramped down in a controlled manner.
15	Yes		The Shunt breaker has not opened or closed within the reaction time defined in "in.evseCfg.maxSwitchTimeBreaker". The frequency converter is ramped down in a controlled manner.
16	Yes		The frequency converter does not reach the corresponding "out.setpoints.hwState" HW state within the response time defined in "in.evseCfg.maxSwitchTimeHwState". If possible, the frequency converter is shut down in a controlled manner.
17	Yes		The IO modules do not reach the corresponding HW state "out.setpoints.hwState" within the response time defined in "in.evseCfg.maxSwitchTimeHwState".

18	Yes		The hardware state "in.values. hwState" has not adjusted to the corresponding HW state "out.setpoints.hwState" within the response time defined in "in.evseCfg.maxSwitchTimeHwState".
19	Yes		The maximum time "in.evseCfg.maxSwitchTimeBreaker" in which the feedback of the DC/PreCharge or Shunt circuit breaker has to occur has been exceeded. This error bit is set if you cannot differentiate which breaker caused the error. In part several breakers are opened and closed at the same time. The frequency converter is ramped down in a controlled manner.
20	Yes	The hardware of the charging station has reported an error.	• An error is set at input "in.hwError". Bit 1 (insulation fault) or Bit 2 (emergency off). • At the input, "in.values.hwState" changes the status without a change of "out.setpoints.hwState". The frequency converter is ramped down in a controlled manner.
21	Yes	Hardware ID "in.hw_Id" of the technology module is incorrect.	The frequency converter is ramped down in a controlled manner.
22	No	Errors when reading/writing data record	The frequency converter is ramped down in a controlled manner.
23	-	Serious internal error	Remedy only possible through reinitialization of the block or through Stop⇒Run transition of the associated CPU.
24	Yes	Faulty feedback by the DC breaker, Pre-Charge breaker or Shunt breaker.	• If, for example, "setpoint.dcbrk" = "true" and "values.dcbrk" = "true" are applied and "values.dcbrk" suddenly changes to "false" (due to a HW error), without this being requested by the "DIN_70121" or "ISO_15118_DC" function block. The frequency converter is ramped down in a controlled manner.
25	Yes	During termination of the charging process, the voltage could not be reduced.	If possible, the frequency converter is shut down in a controlled manner.
26	No	Time monitoring is not possible. If the system time of the S7 could not be determined.	Remedy only possible through reinitialization of the block or through Stop⇒Run transition of the associated CPU.
27	-	An unexpected charge interruption by the vehicle or the technology module has happened.	The frequency converter is ramped down in a controlled manner.
28... 31	-	Reserved	-
32	No	CP error	Malfunction of the CP hardware. The current pilot status cannot be determined. If the HW error allows this, the pilot is switched off.
33	No	Timeout during status change of the CP from B to C	The charging protocol provides for a CP transition from State B to State C at this point. This bit is set if the transition is not made within 1.5 s.
34	No	Timeout during state change of the CP from C to B	The charging protocol provides for a CP transition from State B to State C at this point. This bit is set if the transition is not made within 1.5 s.
35	No	Unexpected change of the CP to B	The CP is in State B. This is not allowed in the current status within the charging procedure.

36	No	Unexpected change of the CP to C	The CP is in State B. This is not allowed in the current state within the charging procedure.
37	No	SLAC error	Error during the PLC connection setup (SLAC process).
38	No	Timeout for V2G message	Vehicle does not send a message packet within the prescribed time (e.g. 60 s). The frequency converter is ramped down in a controlled manner.
39	No	Unexpected V2G request from vehicle	The vehicle sends a request that is not permissible at this time (e.g. EVSE expects CableCheck, EV sends PreCharge). The frequency converter is ramped down in a controlled manner
40	No	V2G connection between module and vehicle interrupted	The response packet could not be sent, e.g. because the socket connection to the EV was terminated. The frequency converter is ramped down in a controlled manner
41	No	Charging process canceled	The EVSE has detected an error that makes continuation of charging impossible. An error response is sent to the vehicle. The frequency converter is ramped down in a controlled manner
42	No	Unexpected change of pilot state from B or C to A	For example, if the charging cable is removed before proper completion of the charging process. The frequency converter is ramped down in a controlled manner
43 ... 47	-	Reserved	-
48	No	Messages of the vehicle These messages are only passed through and have no direct influence on the currently pending charging processes. (For further information, refer to the DIN SPEC 70121)	FAILED_RESSTemperatureInhibit
49	No		FAILED_EVShiftPosition
50	No		FAILED_ChargerConnectorLockFault
51	No		FAILED_EVRESSMalfunction
52	No		FAILED_ChargingCurrentDifferential
53	No		FAILED_ChargingVoltageOutOfRange
54	No		Reserved A
55	No		Reserved B
56	No		Reserved C
57	No		INFO_EVNotReadyToCharge - or FAILED_ChargingSystemIncompatibility
58	No		NoData
59	No	No TLS encryption possible	The module does not support TLS encryption even though it is requested by the vehicle
60	No	No suitable payment variant	Charging process not possible, because the payment variants (charging station, vehicle) are different
61... 63	-	Reserved	-

Calibration of the power line signal

6

6.1 Introduction and mode of operation

The "Calibration Kit TM ECC CCS2" (6FE1244-0AD10-0AA0) in connection with the "ECC_Calibration" function block enables you to calibrate the power line signal to the individual characteristics of your charging station.

Please note that calibration is only possible as of firmware version 1.0.3.

Note

When installing a firmware update, the calibration data may be reset to the default values. See the comments for the pending firmware updates.

We recommend backing up the calibration data prior to a firmware update.

Reason for calibration

Data is exchanged between the vehicle and the charging station via so-called power line communication. There, communication takes place via the CP connection in the frequency band of 2 MHz to 32 MHz. DIN SPEC 70121 (and ISO 15118 (Page 64)) stipulates a signal level -75 dBm ± 2 dBm over all communication frequencies. To ensure the correct level, we recommend calibrating your setup, because significantly different attenuations of the individual frequencies occur depending on the wiring in the charging station and the length of the connected charging cable.

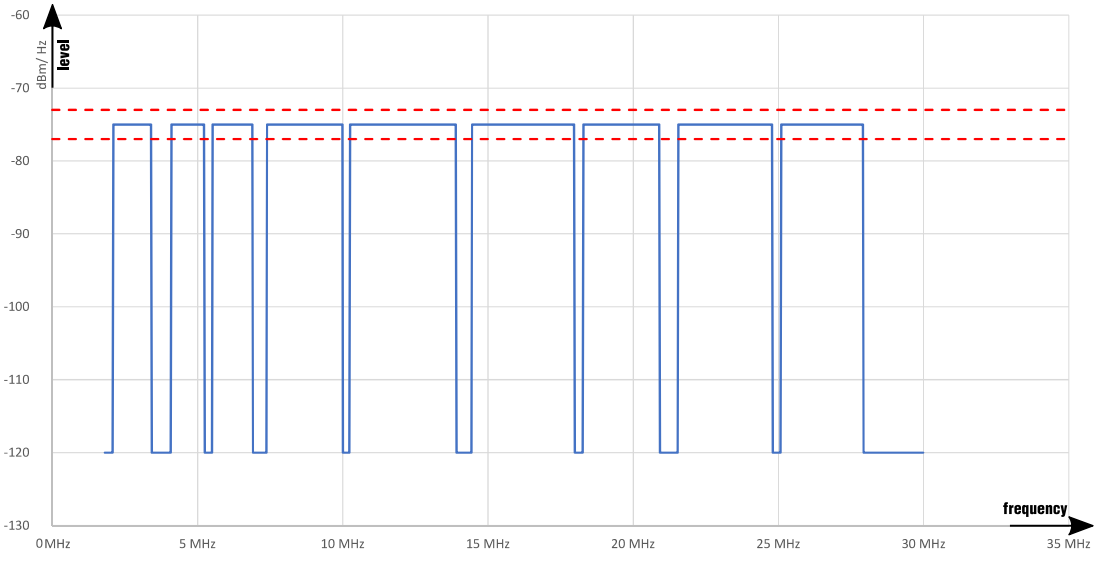


Figure 6-1 Signal level after calibration

The calibration data consists of 1155 individual values of 1 byte each. Each byte stands for one carrier each and contains a combination of level and calibration values.

After the calibration, the calibration result can be read out using the "ECC_Calibration" function block and the calibration quality can be evaluated using the values in psdDiff.

The values in psdDiff hereby describe the deviation of the signal level (after the calibration) from the -75 dBm/Hz required according to DIN SPEC 70121/ISO 15118. They are coded as signed tenth dBm/Hz. A value of -25 for the carrier 500, for example, thus corresponds to a deviation of -2.5 dBm/Hz for the carrier 500. The resulting output power spectral density is therefore 2.5 dBm/Hz too low at the carrier 500.

Note

In a multi-station charging system, no calibration or charging process may take place on any other charging outlet during a calibration process

This applies also to directly adjacent charging systems.

No charging may take place on the charging system parallel to the calibration.

Note

De-energize the respective module after successful calibration before you use it.

Calibration requirements

The Calibration Kit TM ECC CCS2 loads the CP signal (Page 17) in the frequency range from 2 .. 30 MHz with ca. 50 ohms.

Note

Note that, if you measure with a measuring instrument whose input resistance is not 50 ohms (for example, a high-impedance spectrum analyzer or a power line sniffer), the measurement signal is distorted.

Valid measurements, therefore, are only possible with measuring instruments with an input resistance of 50 ohms.

6.2 "ECC_Calibration" function block

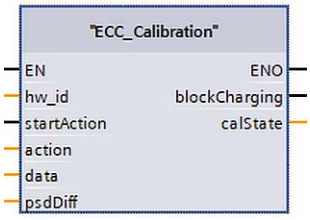


Figure 6-2 "ECC_Calibration" function block

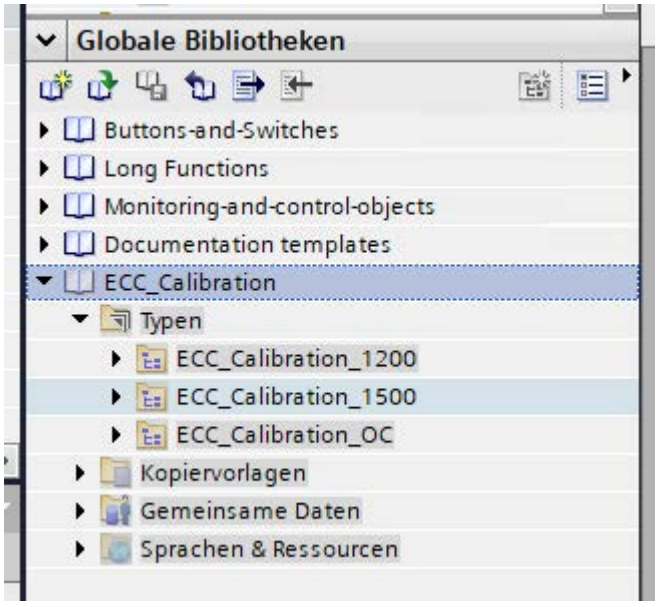


Figure 6-3 Structure of the TIA library

Introduction

This function block (short form: FB) represents the interface between the TIA application and the calibration function of the technology module.

With the "ECC_Calibration" function block, you can perform the calibration in individual steps. Furthermore, the FB indicates any errors that occur.

Calibration scenarios

Two different calibration scenarios can be handled with the FB.

- **Calibration with the Calibration Kit TM ECC CCS2**
  In this case, the "Calibration Kit TM ECC CCS2" (6FE1244-0AD10-0AA0) is required in addition to the module to be calibrated. You need to connect the supplied power supply unit and the charging station (module) to be calibrated with the Calibration Kit. After successful completion, the calibration data on the module is set optimally for this charging station setup (including cables, connectors, transitions, etc.). Calibration with the "Calibration Kit TM ECC CCS2" is triggered by a rising edge at the "startAction" input

and a "1" at the "action" input (see Parameter list for "ECC_Calibration" function block (Page 90)). When the calibration data is read out afterward, the calibration quality can be evaluated based on the values in "psdDiff".

- **Calibration with calibration data**
  For calibration with calibration data, you do not need a Calibration Kit, but a module that has already been calibrated (e.g. with the Calibration Kit on the reference setup). The calibration data can be read out of this module. The module to be calibrated is also connected to an "ECC_Calibration" FB and the calibration data is transferred. Reading and writing of the calibration data does not necessarily need to take place in the same setup or the same configuration. You can save and archive the calibration data and use it later. Only use this data when the setup of the charging station to be calibrated is identical to the reference setup.

Performing the calibration function

The "action" input is requested and the function is triggered with a rising edge at the "startAction" input, in calState "IDLE". All values not defined here result in the error code 16#8086 (see table Error codes (Page 92)). Changing the value at "action" later has no effect on the running calibration. Re-evaluation, and possibly generation of an error, only takes place at the next rising edge at "startAction", in state "IDLE".

The error code 16#8086 is also set when the data area at the "data" and "psdDiff" inputs is too small for an attempted data transfer.

ECC_Calibration parameters

Table 6- 1 List of parameters for the "ECC_Calibration" function block

Parameter	Declaration	Data type	Default	Description
hw_id	Input	HW_IO	0	Hardware ID of the TM ECC PL ST technology module to determine the offset of the process image inputs/outputs. The number is assigned automatically and is stored in the properties of the component or the interface in the hardware configuration.
startAction[2)]	Input	Bool	False	A rising edge triggers the corresponding calibration action according to the value at the "action" input. With a falling edge, the "ECC_Calibration" FB • is reset after a calibration from the VALID state or an error state back to the IDLE state (acknowledgment).
action	Input	USInt	0	Selection of the calibration action to be performed. 1: Start calibration with Calibration Kit 2: Activating the calibration data on the module 3: Transfer calibration data to the module (but do not activate) 4: Read calibration data and the deviation of the signal level (psdDiff) from the module [1)] 0, 5-255: Results in error: 16#8086
blockCharging	Output	Bool	False	1: Calibration running You must ensure that no charging process is initiated. For this purpose, this output can be connected inverted to the "enable" input of a "DIN_70121"/"ISO_15118_DC" function block.

Parameter	Declaration	Data type	Default	Description
calState [2]	Output	Word	0	This parameter indicates the state of the module. 0: **IDLE** No calibration is currently taking place and no error has occurred. 1: **PENDING** A calibration request by the user has been recognized and the state of the module (correct type, correct charge status) is being verified. A calibration is only possible in charge status "A" or "F" (see explanations of charge status (Page 17) (pilotState). 2: **DATA_ACCESS** Access to calibration data is running. Waiting for completed message from module. 3 / 8 / 9 / 10: **RUNNING** Calibration with the Calibration Kit is running. Waiting for reset of the module. 4: **ACTIVATING** Activation of the calibration data is running. Waiting for reset of the module. 6: **RESETTING** Module reset detected. Waiting for restart. 7: **VALID** Calibration/data transfer successfully completed. Waiting for acknowledgment by falling edge at "startAction". With values 16#80xx, an error has been detected. For details, see table Error codes (Page 92).
data [3]	InOut	Array [*] of Byte		Source/destination for data access. Calibration data: 1155 bytes
psdDiff [3]	InOut	Array [*] of Word		Destination for the values for deviation from the required -75dBm/Hz per carrier. The minimum size of the range, if used, is 1155 words.

1) If new calibration data has been written since the last startup of the module without being activated, this is read back instead of the currently active parameters. Otherwise, the currently valid calibration data is read out.

2) In the states 3, 4, 6, 8, 9 and 10, the module processes the action independently. The FB monitors and reports the progress. Cancellation with "startAction" is NO LONGER possible.

3) The buffer sizes are only verified if they are actually needed. Otherwise, you can also connect smaller dummy arrays (e.g. Array [0...0] of Byte/Word) in the project.

Description

With the "ECC_Calibration" instruction, you access the calibration functions of an ECC PL ST technology module addressed via HW ID. This can be a centrally inserted module or a distributed component.

Note

You can only calibrate the ECC PL ST technology module with the "ECC_Calibration" FB if it has a FW version 1.0.3 (or higher).

You can use the "ECC_Calibration" FB with SIMATIC 1500 CPUs as of FW version 2.0 and with SIMATIC 1200 CPUs as of FW version 4.2.

- Using the "hw_id" parameter, you select the module for which calibration should be carried out. Use the hardware ID (HW ID) of the module for the "hw_id" parameter. You can find the hardware ID of the module under "PLC tags" → System constants. It is displayed as "Name of the TM ECC module" with the data type "Hw_SubModule".
- You start and end a calibration/read/write operation via the "startAction" input.
- You define the calibration action via the "action" input.

See also

SIOS (https://support.industry.siemens.com/cs/de/en/ps/18330/man)

Module fault

If an error occurs during an active calibration process, this error is displayed at the "calState" output. See Error codes (Page 92) table and Parameter list (Page 90) table.

Note

Please note that the following state of the block is undefined if an error occurs during a calibration action.

In this case, repeat the calibration process.

Table 6- 2 List of error codes of the FB

Error code	Cause of error
16#8082	No modules could be found under the HW ID "hw_id".
16#8083	The module indicated an error during the calibration process or the module itself was not recognized. Check the module, the entire cabling and the Calibration Kit. If the error cannot be resolved in this way, proceed as described under error code "16#8088".
16#8084	The module has rejected calibration data as invalid.
16#8086	Value at "action" input not permissible (at rising edge of "startAction") or buffer at "data" or "psdDiff" is too small for the selected "action".
16#8087	The FB is in an unforeseen state.
16#8088	The module indicated an error during the calibration process. Restart the module. If the error continues to occur, the module is defective.

Reading and writing of calibration data uses the SFBs "RDREC" and "WRREC". These can generate error messages themselves (in the format 0x80xx). If such error messages occur, the "ECC_Calibration" function block switches to the error state and outputs the corresponding message at "calState". The error numbers generated by the FB itself are in "gaps" of the system messages. This means that, if an error code is not listed in the Error codes (Page 92) table, it has been passed through by the SFB and you need to refer to the help documents of the "RDREC" and "WRREC" SFBs for its meaning.

Note

The status of a RDREC or WRREC call is 4 bytes long. The important information is contained in the middle two bytes. These are included in the "calState".

Example:

Status RDREC: 0xDE**80B1**00 → calState: 0x80B1

6.3 Calibration Kit TM ECC CCS2

6.3.1 Description

The Calibration Kit must be ordered separately.

Version	Order number (MLFB)
Calibration Kit TM ECC CCS2	6FE1244-0AD10-0AA0

Task of the Calibration Kit

Using the Calibration Kit, the charging controller measures the power line signal level arriving at the charging plug. The signal levels of all relevant frequencies are then adjusted for this setup.



Figure 6-4 Calibration Kit TM ECC CCS2

LEDs of the Calibration Kit

Status LEDs

LEDs	Meaning
EN	**Status Calibration Kit (enable)**
□ Off	Calibration Kit is not ready
■ On	Calibration Kit is ready
VS	
□ Off	No function

Startup of the Calibration Kit

Startup of the Calibration Kit takes about 20 seconds.

Connections of the Calibration Kit

The Calibration Kit has a CCS Type 2 charging socket for receiving the charging cable. Interlocking of the connector is not supported here. The power supply connection can be found on the side. Connect the supplied power supply unit here.

6.3.2 Technical specifications of the Calibration Kit TM ECC CCS2

Table 6- 3 **Technical specifications of the Calibration Kit**

	6FE1244-0AD10-0AA0
General information	
Product family	ECC4000
Product designation	Calibration Kit TM ECC CCS2
Installation type/mounting	
Mounting type	DIN rail
Supply voltage	
Type of supply voltage	24 V
Rated value (DC)	24 V; optional: external infeed
Permitted range, low limit (DC)	19.2 V
Permitted range, high limit (DC)	28.8 V
Reverse polarity protection	Yes
Load voltage L+	
Short-circuit protection	Yes
Reverse polarity protection	Yes
Input current	
Current consumption, max.	0.5 A
Interfaces	
Number of other interfaces	2; 1x CCS (Combined Charging System) according to IEC 62196 1x power supply DC adapter 24 V (for hollow plug connector Ø 5.50 / 2.10 mm x 9.5 mm)
Protocols	
Vehicle communication according to IEC 61851	Yes; Mode 4
EMC	
Electrostatic discharge in accordance with IEC 61000-4-2	4 kV contact discharging / 8 kV air discharging
Field-based interference in accordance with IEC 61000-4-3	10 V/m (80 ... 1 000 MHz), 3 V/m (1.4 ... 2.0 GHz), 1 V/m (2.0 ... 2.7 GHz)

	6FE1244-0AD10-0AA0
Degree of protection and protection class	
IP degree of protection	IP30 (when all connectors are inserted)
Standards, approvals, certificates	
Certificate of suitability	CE
Ambient conditions	
Ambient temperature during operation	
Min.	0 °C
Max.	40 °C
Ambient temperature during storage/transport	
Storage, min.	-30 °C
Storage, max.	85 °C
Operating height in relation to sea level	
Installation altitude above sea level, max.	2000 m
Ambient temperature, air pressure and altitude	Max. 2000 m
Relative humidity	
Operation, max.	95%
Mechanics/material	
Enclosure material	Plastic: Polycarbonate, symbol: PC-GF 10 FR
Dimensions	
Width	250 mm
Height	122 mm
Depth	160 mm
Weights	
Weight, approx.	1.5 kg

Alarms / diagnostics alarms

7

7.1 State and error displays

Front view of the technology module SIMATIC ET 200SP TM ECC PL ST



Figure 7-1 Device front with LED displays

Meaning of the LED displays

The following table shows the meaning of the state and error displays. You can find details on troubleshooting in the section Diagnostics alarms (Page 100).

LED DIAG

□ Off	Backplane bus supply of the ET 200SP not OK.	Check or switch on the supply voltage of the head station. Ensure that the SIMATIC ET 200SP TM ECC PL ST technology module is correctly plugged into the BaseUnit.
☼ Flashes	Technology module not ready to operate (not parameterized)	
■ On	Technology module parameterized and no module diagnostics (no error exists)	
☼ Flashes	• Technology module parameterized and module diagnostics (at least one error exists) • Firmware update is being performed	Check the configuration and parameterization in your engineering tool (for example TIA Portal) or evaluate the diagnostic interrupts and troubleshoot.

LED PWR

□ Off	Supply voltage L+ missing	• BU type B1: Check the external 24 V DC supply voltage between L+ and M. • BU type B0: Check the 24 V DC supply voltage of the supplying potential group.
■ On	Supply voltage L+ available	

Status LEDs

LEDs	Meaning
EN	**Enable state**
□ Off	Charging outlet (EN) locked by user program. The corresponding VS LED and Status LED F are also off in this case.
■ On	Charging outlet (EN) activated
☼ flashes, 1 Hz	• S7 communication fault at the charging outlet (EN) • CPU stop. • Firmware update transferred error-free
VS	**Vehicle state**
□ Off	No vehicle is connected to the charging station. (State "A") in as far as LED F = "off" (State "F") in as far as LED F = "on"
■ On	A vehicle is connected to the charging station and ready for charging. (State "B")
☼ flashes, 1 Hz	Vehicle charging (State "C")
☼ flashes, 2 Hz	Vehicle charging, ventilation required (State "D")
QT	**TRIP function** (see in section Control Pilot (Page 16))
□ Off	Output (DQ T) switched off (see Figure 3-1 Example circuits for the switching contacts (Page 31))
■ On	Output (DQ T) switched on.
QP	**PP function** (see in section Plug Present (Page 18))
□ Off	Output (DQ P) switched off (compare Figure 3-1 Example circuits for the switching contacts (Page 31))
■ On	Output (DQ P) switched on.
LK	**Power line link** (EV)
□ Off	No link available.
■ On	Link exists
R/T	**Power line traffic** (receive/transmit) (EV)
□ off	No data communication
■ On	Data communication available.
F	**Status CP**
□ Off	CP state A, B, C or D
■ On	CP state E, F or invalid
☼ Flashes	Restart of the module

See also

Terminal assignment and power supply (Page 28)

7.2 Alarms

The TM ECC PL ST technology module does not have process alarms.

7.3 Diagnostic messages

The DIAG LED flashes red when a diagnostics alarm is pending.

The diagnostics are displayed in the online and diagnostics view in STEP 7 (TIA Portal). You can evaluate the error codes via the user program.

The following diagnostics can be reported:

Table 7- 1 Diagnostic messages, their meaning and corrective measures

Diagnostic messages	Error code	Meaning	Remedial measures
Error	9H	Communication error (is briefly displayed during ramp-up)	
Load voltage is missing	11H	Supply voltage L+ the technology module is missing	• Checking BaseUnit type • Checking wiring at the supply voltage L+ at the BaseUnit
Channel / components temporarily not available	1FH	Update of the firmware was just performed or was canceled. The module is this state does not read process values.	• Waiting for firmware update • Starting firmware update again

7.4 Device defect

Repairs

Repairs by the user or service engineers are not permitted. In case of error please contact Service&Support (https://support.industry.siemens.com/cs/ww/en/sc/3098).

WARNING

Electric shock hazard

May cause death or serious injury

Unauthorized opening of the device might place the user in danger or result in substantial damage to property.

Technical specifications

8

8.1 Technical specifications

	6FE1242-6TM20-0BB1
General information	
Product brand name	SIMATIC
Product range	ET 200SP
Product category	Technology module
Product type designation	TM ECC PL ST
Product designation	Charge controller for conductive charging of electric vehicles
Firmware version	V1.1 or later
• FW update possible	Yes
Type of product	Technology module
Number of channels	1; in accordance with DIN SPEC 70121/ISO 15118-2
Product function	
I&M data	Yes; I&M 0
Isochronous mode	No
Engineering with	
STEP 7 TIA Portal can be configured/integrated as of Version	STEP 7 V15 and higher (starting from FW1.1: STEP 7 V17 and higher)
Structure/mounting	
Mounting type	Mounting rail
Mounting position	Vertical or horizontal
Supply voltage	
Type of supply voltage	DC
Rated value (DC)	24 V
Permissible range, lower limit (DC)	19.2 V
Permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes; against irreparable damage
Input current	
Current consumption, typ.	40 mA
Current consumption, max.	100 mA
Digital inputs	
Number of inputs	0
Functions digital inputs, parameterizable	
Freely usable digital input	0

	6FE1242-6TM20-0BB1
Digital outputs	
Type of digital output	Transistor
Number of outputs	2
Short-circuit proof	Yes
Short-circuit protection	Yes, electronic / thermal
Functions digital outputs, parameterizable	
PWM output	Yes; according to IEC 61851
• Max. number	1
• Cycle duration parameterizable	No; 1 kHz
Switching capacity of the outputs	
With resistive load, max.	0.6 A
Output voltage	
Type of output voltage	DC
Output voltage	24 V
Cable length	
unshielded, max.	10 m
Protocols	
Bus communication	Yes (backplane bus)
Vehicle communication in accordance with DIN SPEC 70121 / ISO 15118-2	Yes; MODE 4
Alarms/Diagnostics/State information	
Alarms	
Diagnostic interrupt	No
Diagnostic messages	
Supply voltage monitoring	Yes
Short circuit	No
Overload	Yes
Diagnostics indicator LED	
Supply voltage monitoring (PWR-LED)	Yes; green PWR-LED
Channel status display	Yes; green LED
For module diagnostics	Yes; green / red DIAG-LED
Electrical isolation	
Electrical isolation channels	
Between the channels	No (only one channel available)
Between the channels and backplane bus	Yes
Isolation	
Isolation tested with	DC 707 V
Degree of pollution	2

	6FE1242-6TM20-0BB1
EMC	
Electrostatic discharge in accordance with IEC 61000-4-2: 2008	
Field-related interference to IEC 61000-4-3: 2006	
Conducted interference, through burst according to IEC 61000-4-4: 2012	
Conducted interference, through surge according to IEC 61000-4-5: 2014	
Conducted interference by high-frequency interference according to IEC 61000-4-6: 2013	
Test degree and evaluation criteria according to IEC 61000-6-1: 2007	
E DIN EN 61851-21-2: 2013 EMC requirements for external charge systems for electric vehicles	
DIN EN 61851-21-1: 2018 EMC requirements for on-board chargers for electric vehicles for the conductive connection to an AC/DC power supply	
Degree of protection and protection class	
IP degree of protection	IP20
Standards, approvals, certificates	
Certificate of suitability	CE
Ambient conditions	
Ambient temperature during operation	
Minimum	-30 °C
Horizontal mounting position, max.	60 °C
Vertical mounting position, max.	50 °C
Ambient temperature during storage/transportation	
Storage min.	-40 °C
Storage max.	70 °C
Min. transportation	-40 °C
Max. transportation	70 °C
Relative humidity	
Operation min.	5%
Operation max.	95%; no condensation
Height in operation	
Ambient temperature air pressure installation altitude (referenced to mean sea level)	T_{min} ... T_{max} at 1080 hPa ... 795 hPa (-1000 m ... +2000 m)
Distributed operation	
on SIMATIC S7-1500	Yes
on SIMATIC S7-1200 (as of FW version 1.0.3)	Yes
Dimensions	
Width	20 mm
Height	73 mm
Depth	58 mm
Weight	32 g

Technical specifications related to the BaseUnit

See Manual of the ET 200SP BaseUnits (https://support.industry.siemens.com/cs/ww/en/ps/14070/man).

Glossary

CP

Control pilot signal. This signals to the vehicle that power line communication (→ HPGP) is possible.

CPU

Central Processing Unit

CSR

A Certificate Signing Request (CSR) is used to request the signing of a certificate. This can be necessary, for example, when a certificate's expiration date has to be updated. When a new certificate is needed, the signing also takes place using a CSR.

DC

Direct current

Duty cycle

The duty cycle specifies the ratio of pulse duration to cycle duration for a periodic pulse sequence.

EIM

External identification means, payment process using external identification (e.g. via RFID card reader).

EMAID

An EMAID (e-Mobility Account Identifier) is a unique identifier for providers of charging current contracts.
It is structured as follows:

Country code (e.g. DE)
Provider ID: (3-digit, alphanumeric)
eMA instance: (9-digit, alphanumeric)
Check digit: optional, calculated from the first 14 digits of the EMAID

EMC

Electromagnetic compatibility

EMP

E-mobility provider

EMV

see EMC Pertains to the immunity or interference of devices in electrical engineering.

EV

Electric vehicle

EVSE

Electric vehicle supply equipment

EVSEID

An electric vehicle supply equipment ID (EVSEID) is a unique identifier for charge point operators, i.e. they need one ID per dealer business.

It is structured as follows:

Country code
EVSE Operator ID: (3-digit, alphanumeric)
ID type to prevent it from being confused with the EMAID (predefined: E)
Power Outlet ID: specifies the EMP itself (up to 30 digits, alphanumeric, including separator "*" if necessary)

EXI format

Efficient XML Interchange (EXI) is a format for binary representation of XML information sets.

FB

Abbreviation for function block

FW

Abbreviation for firmware

HMI

User interface. The human machine interface (HMI) describes the place or action that a human uses to interact with a machine (e.g. a touch screen).

HPGP

HomePlug Green PHY, digital communication based on power line communication (→ PLC)

HSP

Hardware support packages (HSP) enable you to configure modules that are not included in the hardware catalog of your TIA Portal installation.

MMC (card)

The multimedia card is a flash storage medium

OCPP

The Open Charge Point Protocol (OCPP) is a universal application protocol that standardizes the communication between electric vehicle supply equipment (EVSE) and a central management system. Stations of different manufactures can be activated and billed and a set of standard commands can be exchanged between the backend and station via the OCPP interface.

OCSP

The Online Certificate Status Protocol (OCSP) enables a validation service to check whether a certificate has been revoked or blocked. The responses of the OCSP responder are digitally signed and can thus be checked for authenticity.

PKI

Public key infrastructure (PKI) refers to a system that can issue, distribute and verify digital certificates.

PLC

Power line communication (PLC) enables a local data network to be established using existing electrical cables without the need for additional cabling.

PnC

Plug and Charge (PnC) is a payment process based on automatic identification using an existing charging contract in the vehicle

PP

Plug Present, proximity pin of charging plug, relevant for Type 1 plug in accordance with SAE-J1772

PWM

Pulse-width modulation (PWM) is a type of modulation in which, for example, the electrical voltage alternates between two values. With constant-frequency PWM, the duty cycle of a rectangular pulse and, thus, the duration of the pulses forming it is modulated.

RFID

Radio-frequency identification (RFID) is the automatic and contactless identification using radio waves.

Shunt

Electrical measurement resistance

TIA

Totally Integrated Automation (TIA) is a concept that defines the interaction of diverse automation components, software tools and associated services (spare part service, etc.) to form an integrated automation solution.

TLS

Transport Layer Security, encryption protocol for secure data transmission

TM

Abbreviation for technology module

TRIP

Trip function. It ensures that a charging cable carries no dangerous voltage in unplugged state.

UDT

User-defined data types (UDT) are special data structures that you create yourself and can use according to their definition throughout the S7 program.

WEEE

EU Waste Electrical and Electronic Equipment (WEEE) Directive Its purpose is to prevent electrical and electronic equipment waste and to reduce this waste through reuse and other forms of recycling.

XML

Extensible Markup Language (XML) is used to represent hierarchically structured data in the format of a text file that can be read by humans and machines.

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