SIEMENS

Configuration manual "Shared Device"

SIMATIC S7-1500 / ET 200SP

https://support.industry.siemens.com/cs/ww/de/view/109741600

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1 Task and Solution

1.1 Task description

Description

For bigger or widely dispersed plants, multiple IO controllers are frequently used. Every peripheral module of an IO device is assigned to a particular IO controller. If sensors spatially close to one another must send data to different IO controllers, multiple IO devices are required.

In this configuration description, an IO device shall be assigned to multiple IO controllers.

Requirements

The following requirements have to be considered:

- Reduction of the required network and system components
- Sustained reduction of engineering costs and commissioning time
- Easy communication between multiple IO controllers and an IO device.

1.2 Possible solutions

Description

The function "Shared Device" allows splitting up the modules of an IO device between different IO controllers. This distribution allows flexible automation concepts. You have the possibility, for example, to summarize peripheral modules spatially close to one another into one IO device.

Diagrammatic representation

The following figure schematically shows the function "Shared Device":

Figure 1-1
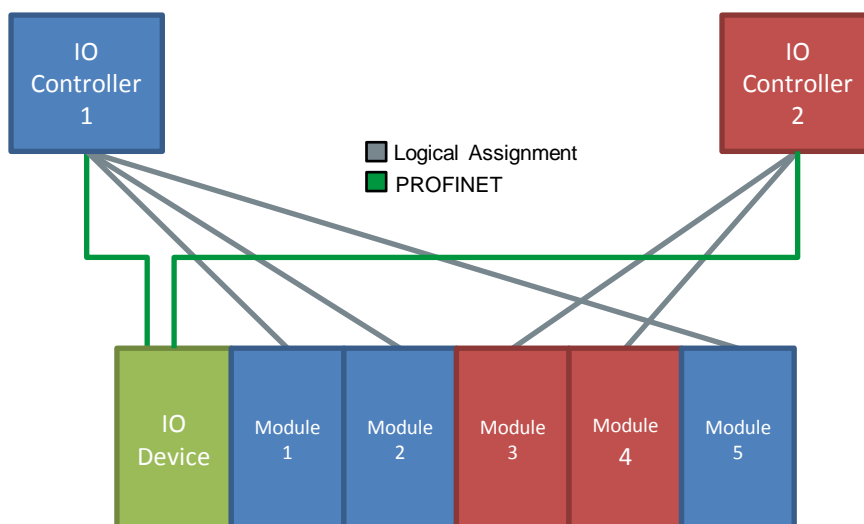
Shared Device allows a shared use of IO devices via multiple IO controllers without additional CPU-CPU communication.

Advantages

The solution presented here offers you the following advantages:

- Lower costs through the reduction of additional IO devices and modules.
- Real time capture in several CPUs.
- Lower space requirements through the reduction of additional IO devices and modules.
- Lower communications burden through the suspension of CPU-CPU communication.
- No additional programming work for CPU-CPU communication.

Prerequisite

The following prerequisites must be met in order to use the "Shared Device" function:

- STEP 7 V12 SP 1 or higher
- CPU as of FW 1.1 or higher as IO controller
- IO device supports the "Shared Device" function

Note	IO controllers that use the "Shared Device" function, are created in different projects. In every project, you must ensure that the "Shared Device" is configured the same at every station.

Characteristics with I-Device

If you use "I-Device" and the "Shared Device" function in parallel, please bear the following conditions in mind:

- A S7-1500-CPU configured as I-Device supports the "Shared Device" function from firmware V1.5 or higher. The I-Device needs to be integrated into the IO controller's IO system via a GSD import.
- A S7-300-CPU or a S7-400-CPU configured as I-Device supports the "Shared Device" function. You need to export the PROFINET-GSD file for the I-Device from STEP 7 (from V5.5 or higher) and then import it in STEP 7 (TIA Portal).
- A ET 200SP-CPU configured as I-Device supports the "Shared Device" function from firmware V1.6 or higher. The I-Device needs to be integrated into the IO controller's IO system via a GSD import.

2 Fundamentals on "Shared Device"

Explanation of terms

An IO device whose modules are used by different IO controllers is referred to as "Shared Device".

The access to the modules of the "Shared Device" is split up between the different IO controllers. Every module of the "Shared Device" is exclusively assigned to a particular IO controller.

Functionality "Shared Device"

The function "Shared Device" allows splitting up the modules of an IO device between different IO controllers. Thereby, several IO controllers can access the same IO device without CPU-CPU communication. You have the possibility, for example, to summarize peripheral modules spatially close to one another into one IO device.

Note	The "Shared Device" allows you to build up an IO device from F- and default modules and assign each module according to the F-CPU or default CPU. Thus, the F-CPU can control a safe F-Power module for a failsafe F-shutdown and a robot can use the default inputs/outputs in the same station.

Access of IO controllers to "Shared Device"

In the Engineering Tool via the "Shared Device" parameter of the interface module, it can be determined to which modules the IO controller has access to:

- If the local IO controller has access to the configured module, select the IO controller's name from the list.
- If not the local IO controller but the IO controller from another project shall have access to the configured module, select the entry "---". If every module in just one project is assigned to one IO controller, then access-wise, the configuration is consistent.

If an IO controller does not have access to a module (entry "--"), the following consequences apply:

- A data exchange with the module is not possible.
- Alarms and diagnostics cannot be received, meaning that in the online view, the diagnostic status will not be displayed.
- Configuring the module is not possible.

Setting the real-time properties

STEP 7 calculates the communications burden and the resulting update times. In order to allow a calculation for "Shared Device" configurations, you need to enter the number of project-external IO controllers into the project where the PROFINET interface of the "Shared Device" is assigned to the IO controller. The maximum possible number of IO controllers for the "Shared Device" is device-dependent. This number is stored in the GSD file of the "Shared Device". If the IO controller is a CPU, you can set a very short send clock. The send clock can be shorter than the shortest sending rate supported by the "Shared Device". In this case, the "Shared Device" will be operated by the IO controller with a send clock that it supports (send clock adaption).

Example:
A CPU supports send clocks of 0.25 ms or higher. A configured IO device also supports send clocks of 0.25 ms or higher, another supports send clocks of 1 ms or higher. In this case, you have the possibility to set a short send clock of 0.25 ms for the CPU. The CPU operates the "slow" IO device with a send clock of 1 ms, for example.

Rules for the configuration

For the use of the "Shared Device" function, the following rules apply:

- IO controllers that use the "Shared Device", are created in different projects. In every project, you must ensure that the "Shared Device" is configured the same at every station. Only one IO controller at a time may have access to a module. Inconsistencies within the configuration lead to a failure of the "Shared Device".

- I/O addresses of a module are editable only when it is assigned to the IO controller in the same project.

- The "Shared Device" must have the same IP parameters and the same device name in every project.

- The send clock must be the same for all IO controllers that have access to the "Shared Device".

- The S7 subnet ID of the subnet to which the "Shared Device" is connected must be the same in all projects.

- The following functions are enabled only when the PROFINET interface of the "Shared Device" is assigned to the local IO controller:
  - IRT operation
  - Prioritized initialization
  - Configuring the port properties

Boundary conditions

Because a shared device configuration is distributed over several projects, the following boundary conditions apply:

- In the address overview of every IO controller that has access to a "Shared Device", the addresses of modules that are not assigned to this IO controller are missing.

- During the consistency check, the unassigned modules are not included into the quantity structure calculation for the "Shared Device". Therefore, you must ensure that the maximum number of modules or the maximum number of cyclic IO data for the "Shared Device" is not exceeded. Information on the maximum quantity structures can be found in the documentation of the devices used.

- Configuration errors like assigning a module to several IO controllers will not be recognized by STEP 7.

- CPUs that are loaded with a "Shared Device" configuration are unable to detect that the IO device is a "Shared Device". Modules that are assigned to other IO controllers and therefore other CPUs, are missing in the loaded configuration. Therefore, these modules are neither displayed in the CPU web server, nor in the CPU display.

3 Configuration

3.1 Infrastructure information

Required components

For the use of the "Shared Device" function, the following components are required:

- A CPU 1516-3 PN/DP (Project 1)
- A CPU 1511-1 PN (Project 2)
- Two SIMATIC MEMORY CARDs
- AN ET 200SP station as IO device with "Shared Device" function with the IM 155-6PN ST interface module and any modules (DI, DO, AI, AO, ...)
- A 24V power supply with cable connector and terminal block plug (the modules can also be operated with a shared power supply)
- DIN rail with mounting accessories for the S7-1500
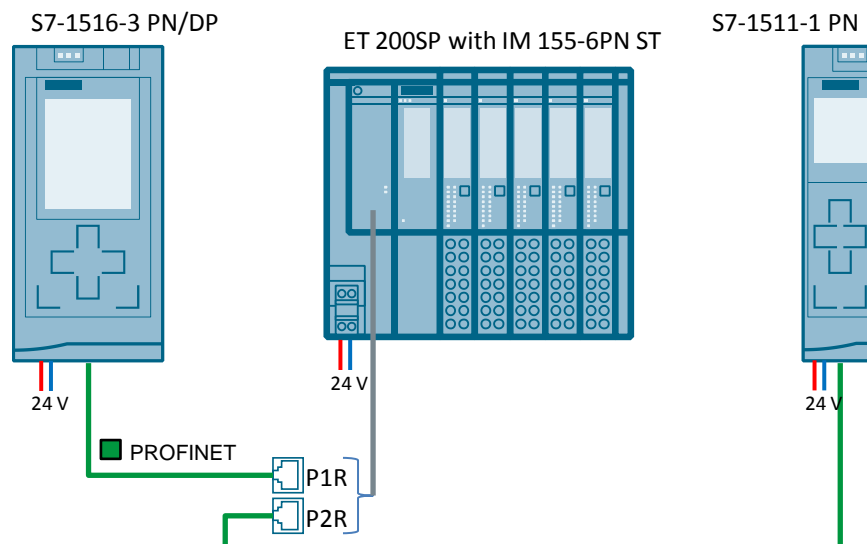- A PG/PC with the configuration tool "STEP 7 V13 SP1" installed

Software package

Install STEP 7 V13 SP1 on your PC/PG.

Setting up the infrastructure

Connect all the components involved in this solution via the integrated PROFINET interface.

Figure SharedDeviceKonfig-109741600

3.2 Configuring a "Shared Device"

The following describes how a decentralized peripheral device is configured as "Shared Device" with STEP 7 from version V13 SP1 or higher.

The description is limited to two IO controllers from the S7-1500 family sharing a "Shared Device"

Two projects are created (Shared-Device-1 and Shared-Device-2), each with one IO controller ("PLC_1" and "PLC_2"). You need to create the "Shared Device" in both projects, although physically speaking, it is one and the same IO device.

Note	Make sure that the IO device is configured the same in all projects. If you make changes: Make the changes in every project in the "Shared Device".

3.2.1 Configuration of project 1

Preparation

Open the TIA Portal configuration software and create a new project.

Implementing the devices

Via the project navigation, insert a S7-1500 CPU (here CPU 1516-3 PN/DP). It gets the name "PLC_1".

In the "Devices & networks" overview, add a PROFINET interface module here IM 155-6 PN ST) and equip the interface module with the desired modules (here 2 DI modules and 2 DO modules) and a server module.

Networking the devices

To set up an automation system, the individual hardware components must be configured, parameterized and connected to each other. Use the device and network view to do this.

Proceed as follows:

1. Select CPU 1516-3 PN/DP in the project tree and open its folder.
2. Open the device view of the CPU by double clicking "Device configuration".
3. In the graphical view, select the CPU interface to be networked. The properties of the selected interface are displayed in the inspector window.

4. Select the parameter group "Ethernet addresses" and, under "Interface networked with", click "Add new subnet".
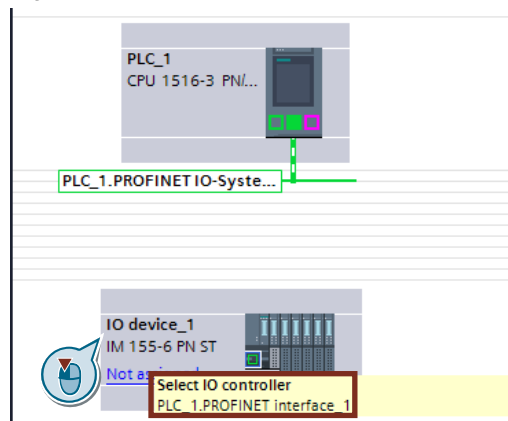
Figure 3-1
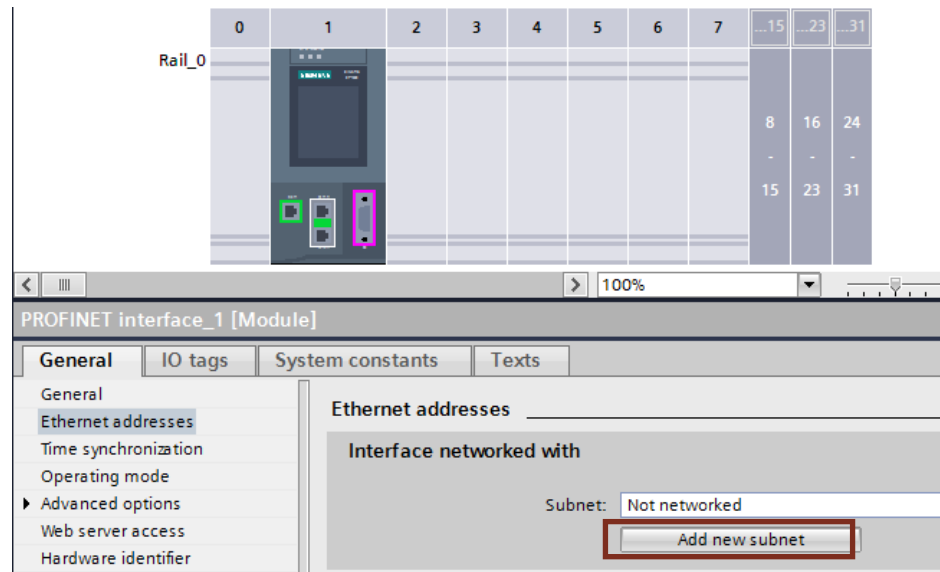
Result

The interface is now connected to a new subnet of the suitable subnet type. When this is done, the address parameters of the interface are set consistently automatically.

Then, add the interface module (here IM 155-6 PN ST) to the newly created network.

Proceed as follows:

1. Open "Devices & Networks" in the overview.
2. Click on "Not assigned" in the interface module and select the IO controller ("PLC_1") to which this IO device is assigned to.

Figure 3-2

Result

The interface and the selected subnet are now connected. When this is done, the address parameters of the interface are set consistently automatically.

Configuring the access to the "Shared Device"

The previously implemented and networked ET 200SP station shall now be configured as "Shared Device".

Proceed as follows:

1. In the graphical view, select the ET 200SP station and perform a double click. Mark the head module to display the properties of the interface module in the inspector window.

2. In the "modules parameters" menu, select "Shared Device". Here, you can determine which IO controller can access the different modules.

   Except for the modules "DI 8x24VDC ST_2" and "DQ 8x24VDC/0.5A ST_2", all modules are assigned to "PLC_1". For those that are not assigned, select the settings "---" in the "Access" column.

   Figure 3-3
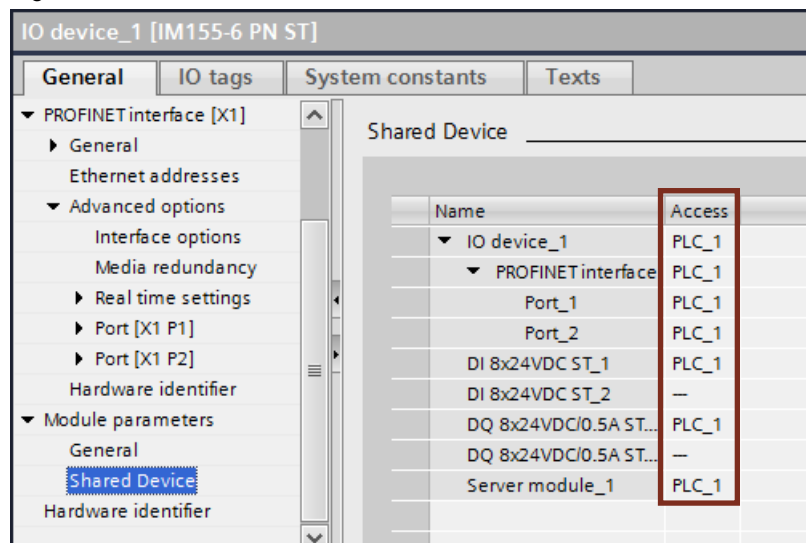
Result
The CPU 1516-3 PN/DP has now access to the modules assigned to it.

Note	Make sure that only one IO controller at a time has access to a module.

3.2.2 Configuration of project 2

Preparation

Open another instance of the TIA Portal configuration software and create a new project.

Implementing the devices

Via the project navigation, insert a S7-1500 CPU (here CPU 1511-1 PN). It gets the name "PLC_2".

Again, in the "Devices & networks" overview, add a PROFINET interface module (here IM 155-6 PN ST). In terms of structure and configuration (IP address and device name), this peripheral station is identical to that in Chapter 3.2.1. Also, you can copy the already configured ET 200SP from project 1. Thus, you can avoid the configuration of the peripheral station.

Linking the devices

To set up an automation system, the individual hardware components must be configured, parameterized and connected to each other. Use the device and network view to do this.

Proceed as follows:

1. Select CPU 1511-1 PN in the project tree and open its folder.

2. Open the device view of the CPU by double clicking "Device configuration".

3. In the graphical view, select the CPU interface to be networked. The properties of the selected interface are displayed in the inspector window.

4. Select the parameter group "Ethernet addresses" and, under "Interface networked with", click "Add new subnet".
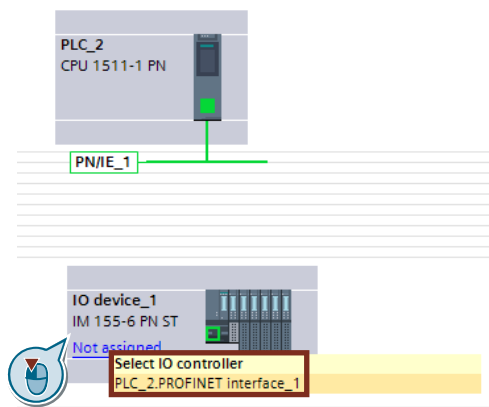
Figure 3-4
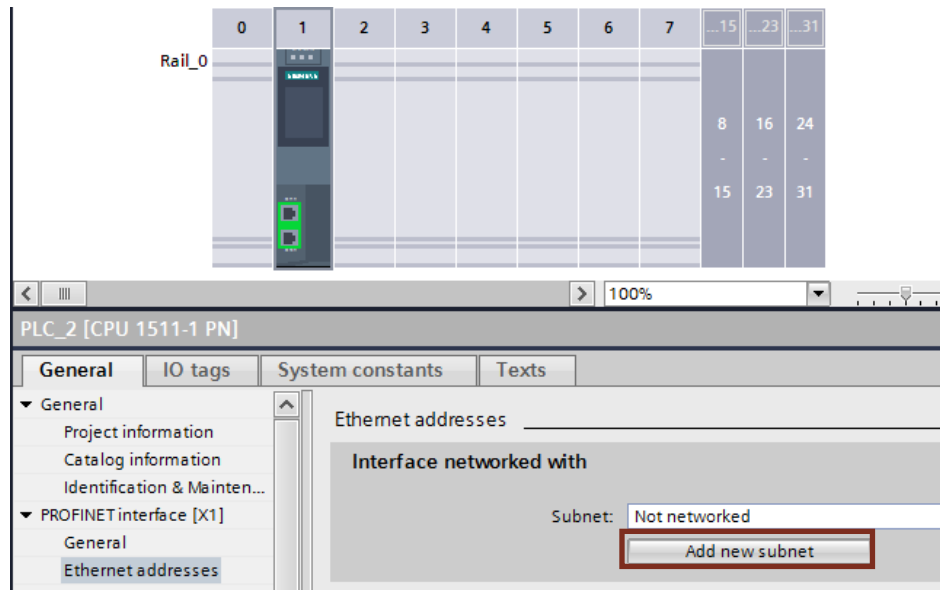
Result

The interface is now connected to a new subnet of the suitable subnet type. When this is done, the address parameters of the interface are set consistently automatically.

Then, you add the interface module to the newly created network.

Proceed as follows:

1. Open "Devices & Networks" in the overview.

2. Click on "not assigned" and select the IO controller ("PLC_2") to which this IO device is assigned to.

Figure 3-5

Result

The interface and the selected subnet are now connected. When this is done, the address parameters of the interface are set consistently automatically.

**Configuring the access to the "Shared Device"**

The previously implemented and networked ET 200SP station shall now be configured as "Shared Device".

Proceed as follows:

1. In the graphical view, select the ET 200SP station and perform a double click. Mark the head module to display the properties of the interface module in the inspector window.

2. At "Modules parameters", select "Shared Device". Here, you can determine which IO controller can access the different modules.

   In the following image, only the modules "DI 8x24VDC ST_2" and "DQ 8x24VDC/0.5A ST_2", are assigned to the IO controller "PLC_2". For this, select the setting "PLC_2" in the "Access" column.

   Figure 3-6
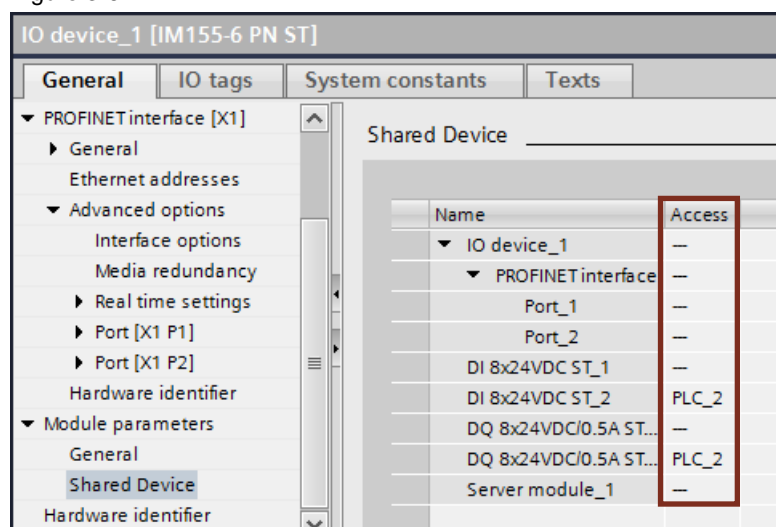
Result
The CPU 1511-1 PN has now access to the modules assigned to it.

| Note	Make sure that only one IO controller at a time has access to a module.

3.2.3 Adjusting the real time settings

To make sure that all IO controllers and "Shared Devices" are operated with the appropriate send clock and the update times are correctly calculated due to the communications burden, you need to adjust and check the following settings.

Proceed as follows:

1. In project 1 / project 2, mark the interface module of the "Shared Device" in the network view.

2. In the inspector window, navigate to:

   "PROFINET interface" > "Advanced options" > "Real time settings" > "IO cycle".

   In the "Shared Device" area, set the number of project-external IO controllers.

   Figure 3-7
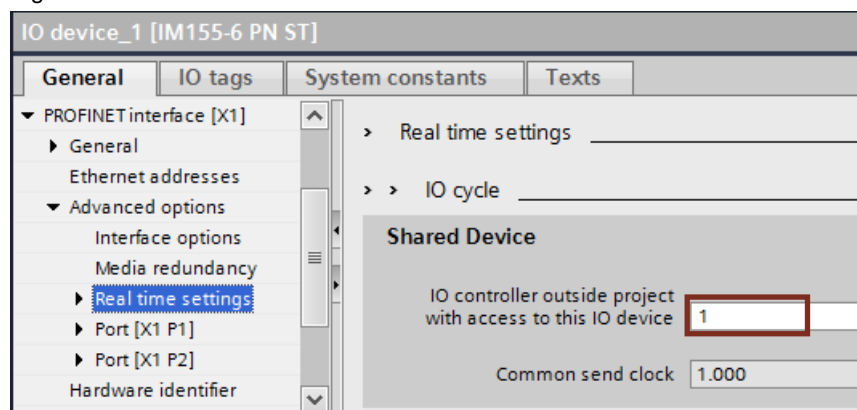
Note	The maximum possible number of IO controllers depends on the IO device and is store in the GSD file.

3. For every IO controller that has access to modules of the "Shared Device", you need to set the same send clock:

a. In project 1 / project 2, mark the interface of the IO controller in the network view.

b. In the inspector window, navigate to:

"PROFINET interface" > "Advanced options" > "Real time settings" > "IO communication".

In the field "Send clock" of the IO controller, enter the shared send clock with the IO device (see Fig. 3-8).

Figure 3-8
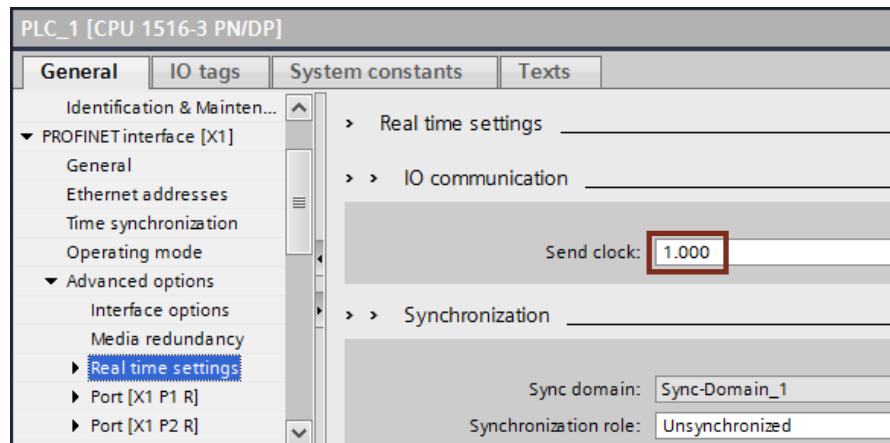
| Note | If you configure all IO controllers that have access to the "Shared Device" in STEP 7, then shorter send clocks than supported by the "Shared Device" can be set at the IO controller (send clock adaption). |

3.2.4 Compiling and loading

Save and compile the configurations for the different IO controllers.

To load the project data, select each controller in the project navigation and load the project into the respective module.

Further information on loading can also be found in the TIA Portal Online Help or in the system manual (\4\).

Consistency check during loading

Due to the distributed configuration with separate projects, STEP 7 does not output any consistency errors for a faulty access configuration. Examples for a faulty access configuration are:

- Multiple IO controllers have access to the same module
- IP address parameters or send clocks are not identical

These errors have an effect only during operation and are, for example, detected as configuration errors.

Note	After loading a configuration into the IO controller, unassigned modules keep their current configuration status in the IO device to remain independent from the configurations of other IO controllers.

3.3 Diagnostics with "Shared Device"

Description

If during an ongoing operation, a module of the "Shared Device" fails or is removed, the controllers react differently to the failure of the module. The reaction of the IO controller depends on its configured access to the module.

Note	If you remove more than one peripheral module or the server module, this results in a station stop. All peripheral modules of the ET 200SP fail (replacement value reaction) (\5\).

Reaction of IO controller with access to the module

If the IO controller has access to the missing module, it detects a missing module and the error LED flashes in operation mode "RUN".

The following figure shows the "Diagnostic buffer" of the IO controller with access to the module.
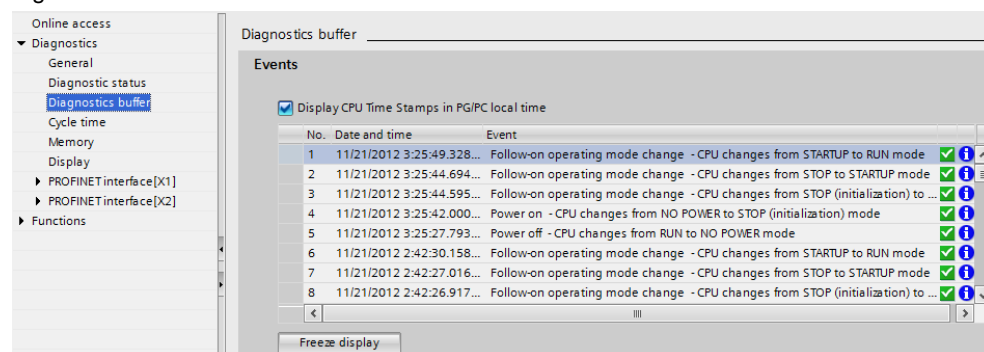
Figure 3-9
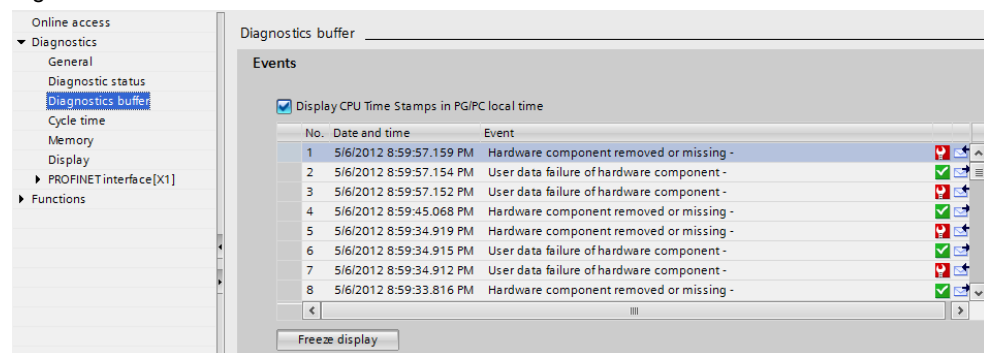
Reaction of IO controller without access to the module

If the IO controller does not have a configured access to the failed or missing module, it does not detect and remains in operation mode "RUN".

The following figure shows the "Diagnostic buffer" of the IO controller without access to the module.
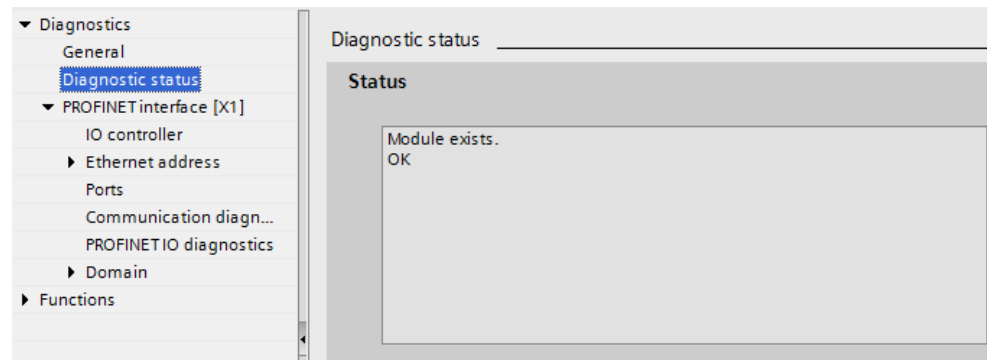
Figure 3-10

Reaction of "Shared Device"

The ET 200SP detects a missing module and the error LED flashes in operation mode "RUN".

The "Diagnostic status" of the "Shared Device" displays, that the module exists and is "OK", even if the module has in fact been removed or is faulty. The following illustration shows the "Diagnostic status" of the "Shared Device".

Figure 3-11

Note	The "Online & diagnostics" function can only be used in the project in which the IO controller has access to the PROFINET interface of the "Shared Device".

4 References

Table 11/2016-1

	Topic	Title
\1\	Siemens Industry Online Support	http://support.industry.siemens.com
\2\	Download page of the entry	https://support.industry.siemens.com/cs/ww/de/view/109741600
\3\	SIMATIC PROFINET with STEP 7 V13	https://support.industry.siemens.com/cs/de/de/view/49948856
\4\	STEP 7 Professional V13 SP1	https://support.industry.siemens.com/cs/de/de/view/109011420
\5\	ET 200SP Manual Collection	https://support.industry.siemens.com/cs/ww/de/view/84133942

5 History

Table 1-2

Version	Date	Modifications
V1.0	10/2016	First version