PROFIenergy "Wake on LAN" block

WinCC V15.1 / PROFIenergy

https://support.industry.siemens.com/cs/ww/en/view/109768643

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1 Introduction

1.1 Overview

Climate change and global warming have long been the subject of controversial discussions. Politicians all over the world are trying to find answers to the question of how this process can be slowed down or stopped. Due to the latest scientific findings, which outline the dramatic effects on the earth in the future, the pressure to act is greater than ever.

This pressure is also noticeable in industry, which is forced by ever new standards and laws to make its energy consumption more efficient. A rarely used possibility is to switch off devices during unproductive phases, e.g. during lunch break. However, the availability of the device is still the most important factor, as an unplanned plant shutdown can cause high costs.

PROFIenergy as a way to save energy during downtimes

In order to be able to save energy during downtimes or during maintenance periods, some PROFINET-capable devices offer the option of putting them into an energy-saving mode by means of a special telegram. This technology is called PROFIenergy. The energy saving modes are generally characterized by their specific energy consumption or time to reactivation. Full PROFINET communication during pauses allows these devices to be reactivated at any time. This ensures the availability of the devices.

1.2 Basics of PROFIenergy

PROFIenergy-enabled devices

There are generally three types of PROFIenergy-enabled devices:

- **Entity class 1:** Devices that support so-called standby management and can therefore be put into energy-saving modes.
- **Entity class 2:** Devices that exclusively provide measured values.
- **Entity class 3:** Devices that both support standby management and provide measured values.

This application example deals exclusively with devices of entity class 1 and supports you in the use of PROFIenergy technology with a function block for the S7-1500 control series and a picture block for convenient use with a Comfort Panel.

Command transfer

Instructions are written to the PROFIenergy-enabled device via a defined data record. After a short waiting time (a few milliseconds), the result can be read out again by means of a data record.

The assignment of command and response is made by a sequential consecutive number, which is transmitted to the device with the command and must be specified again in its response.

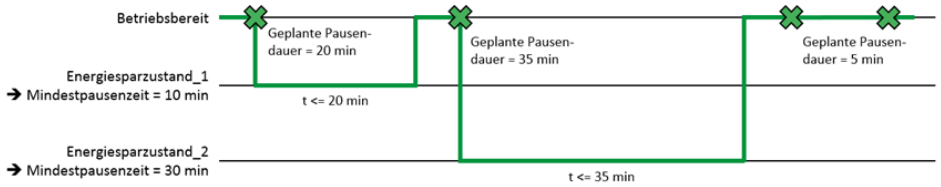
The following commands are used by the application example:

- **Start_Pause** (ID = 16#01): Sets the machine to power save mode.
- **End_Pause** (ID = 16#02): Ends the power save mode and starts the machine.
- **PE_Status** (ID = 16#04): Determines the current PROFIenergy status of the device.
- **PE_Identify** (ID = 16#05): Returns a list of devices supported by the device.
- **Query_Version** (ID = 16#06): Since there are two versions of PROFIenergy (V1.0 and V1.1) which differ, among other things, in the structure of some commands, this command determines the PE version supported by the device.
- **Info_WOL** (ID = 16#20): Queries the telegram that is necessary to wake up the device.
- **Go_WOL** (ID = 16#21): Sets the device to "Wake on LAN" mode.

Starting and termination downtimes

When using PROFIenergy, devices cannot be put directly into a specific energy-saving mode. The device determines which pause mode it takes based on the planned pause time transmitted with the command. The longer the pause duration, the more components of the device will be shut down if necessary (if several energy saving modes are supported). The pause duration does not correspond to one hundred percent exact information, it is the planned length at this time.

Figure 1-1



A paused device can be reactivated at any time, even if the pause time has not yet expired. The time it takes for the device to be fully functional again usually depends on the pause duration. The longer the pause, the longer the devices need to be ready for operation again.

Example:
A temperature dependent process needs a longer time to be operational again than a process that can be put back into operation without special precautions.

Wake on LAN mode

The "WOL mode" has a special status. "WOL" is activated by a separate command. Whether the energy saving mode can be activated by "WOL" instead of the normal "PE energy saving mode" depends on the minimum pause duration for the activation and must be determined in advance with the command "Info_WOL".

If the scheduled duration is longer than the minimum pause required, the "Go_WOL" command must be executed instead of the "Start Pass" command.

The device then switches off and can no longer be reached via PROFINET communication. To reactivate it, the wake-up data determined previously must be sent via broadcast. Since this Ethernet frame only explicitly addresses the switched-off device, no other devices are affected by this broadcast.

The "WOL mode" achieves the greatest energy savings. This is only used for longer non-production times. The WOL mode with PROFIenergy is most widely used with industrial robots (e.g. KUKA).

1.3 Components used

The following hardware and software components were used to create this application example:

Table 1-1

Components	Quantity	Article number	Note
CPU S7-1513-1PN	1	6ES7 513-1AL01-0AB0	S7-1500 CPU ab FW V2.5
Memory Card 4 MB	1	6ES7 954-8LC02-0AA0	
SIMATIC TP900 Comfort Panel	1	6AV2 124-0JC01-0AX0	All Comfort Panels from 15.1 compatible.
IM155-6 PN ST	1	6ES7 155-6AU00-0BN0	Any PROFIenergy-capable device as an alternative
TIA Portal V15.1 STEP 7 PROFESSIONAL	1	6ES7 810-5C..-0Y..	Or later version.
TIA PORTAL V15.1 WINCC PROFESSIONAL	1	6AV210.-0….-0…	From WinCC comfort.

This application example consists of the following components:

Table 1-2

Components	File name	Note
Project	109768643_PROFIenergy_Device_Control.zip	TIA V15.1 Project
Library	109768643_PROFIenergy_Device_Control_Library.zip	TIA V15.1 Portal library
Documentation	109768643_PROFIenergyBaustein.pdf	

2 Engineering

2.1 Interface description

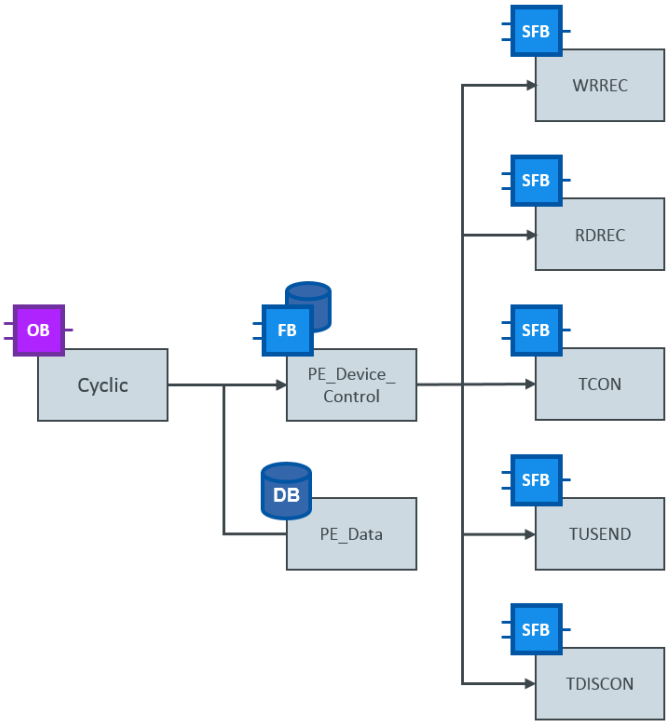
2.1.1 Function block "PROFIenergy_Device_Control"

The block "PE_WOL_Device_Control" controls the PROFIenergy functionality for a device. The FB initially determines the network configuration of the device by reading the data set 16#8080 required for all PROFINET devices. Subsequently, the PROFIenergy commands
are then transmitted to the device using the SFB "RDREC" and "WRREC" blocks. The data set 16#80A0 is described and read in return.

In addition, the system modules "TCON", "TUSEND" and "TDISCON" are used for establishing the connection, sending the wake-up data and terminating the connection. The block must be called in a cyclic organizational block.

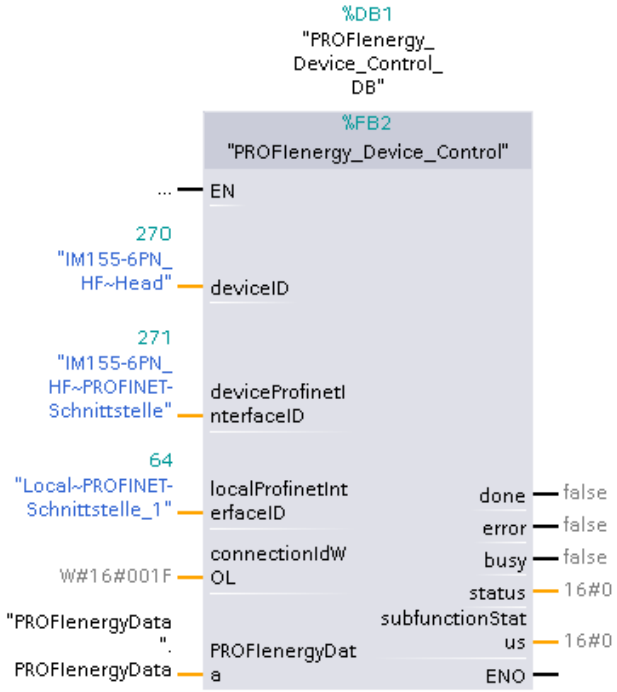
Block call

Figure 2-1



Interface

Figure 2-2



Parameter of PROFIenergy_Device_Control_8080

Table 2-1

Name	Data type	Data type	Comment
deviceID	IN	HW_ANY	The Hardware identifier of the PROFIenergy Devices. Used to transmit the PROFIenergy commands.
deviceProfinetInterfaceID	IN	HW_INTERFACE	The hardware identifier of the communication interface of the PROFIenergy device. Used to determine the network configuration.
localProfinetInterfaceID	IN	HW_INTERFACE	The hardware identifier of the local PROFINET interface of the CPU. Default value for 1500 CPUs = 64.
connectionIdWOL	IN	Word	Unique connection ID for sending wake-up data. Used only on devices that support WOL.
done	OUT	Bool	TRUE = start or end of a pause successful
Error	OUT	Bool	TRUE = Error when processing the block
busy	OUT	Bool	TRUE = Command is currently being transmitted
status	OUT	Word	Status of the block
subfunctionStatus	OUT	DWord	In the event of an error, the return value of the sub-function used in the FB is returned.
PROFIenergyData	IN_OUT	"typePEdata"	User-defined data type with the PROFIenergy information of the device.

Block sequence

Before the block can be used for switching off or switching on via PROFIenergy, some information must be collected during initialization. For this purpose, the data set 16#8080, which is standardized for PROFINET devices and contains the network configuration, is initially read.

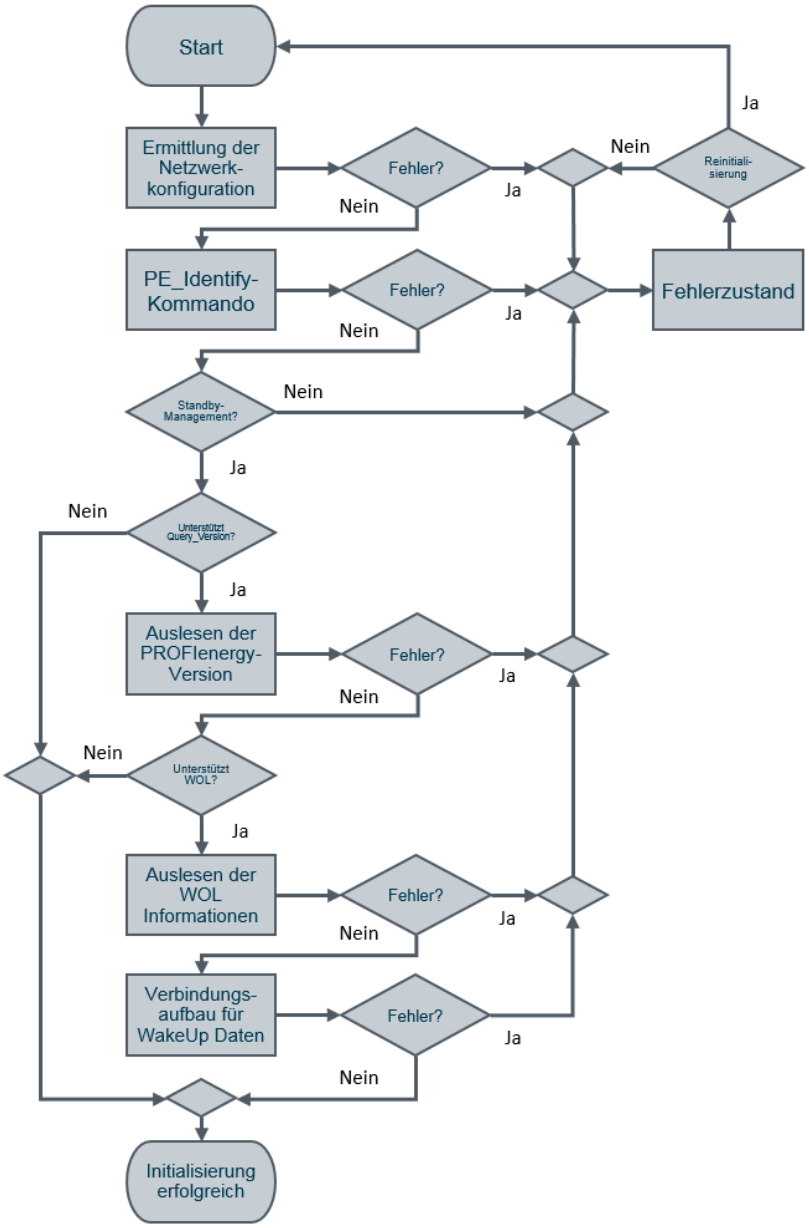
This data is primarily intended to provide the user with a clear overview. This makes it easier for the user to assign the instances of the blocks or the visualization to the devices.

The data determined includes:

- IP address
- Subnet mask
- MAC address
- PROFINET device name

The system then checks whether the device supports PROFIenergy. This attempts to execute the command "PE_Identify" on the device. This command must be supported by every PROFIenergy device and returns the possible commands. This also determines whether the device supports pause management and Wake on LAN mode. Finally, the PROFIenergy version used on the device and, if applicable, the WOL data are queried and a connection prepared for sending the WakeUp data.

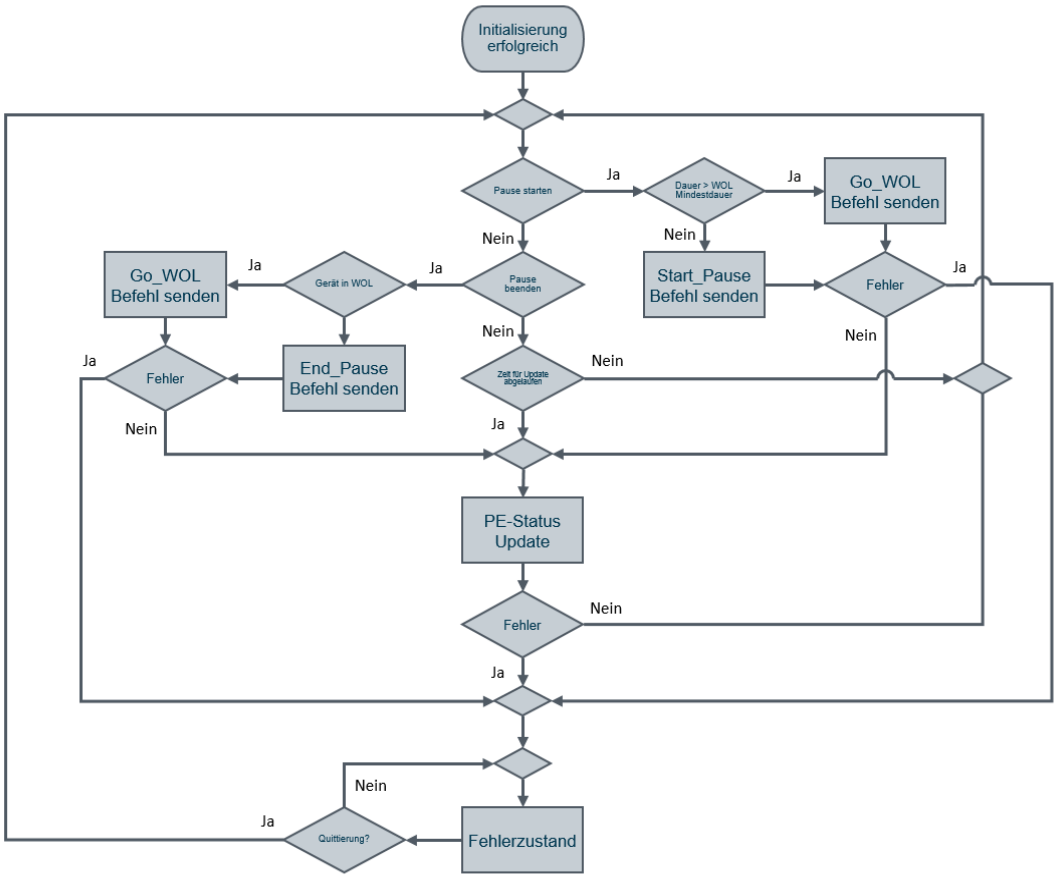
Figure 2-3



In the initialized state, the device can be put into an energy-saving state using PROFIenergy or reactivated from this state.
To start a pause, the planned duration of the pause must be specified. If the selected device supports WOL, the block decides whether the "Start_Pause" or the "Go_WOL" command is sent to the device from the previously determined information (minimum pause time for WOL). Depending on the selected mode, the "End_Pause" command or the WakeUp data are sent to reactivate the device. In

addition, the PROFIenergy status of the device is queried cyclically every 30 seconds.

Figure 2-4



Error codes

The output "Status" contains a code for the cause of the error. The block continues to work after the error has been acknowledged or is reinitialized.

The status word is divided into two bytes, the high byte indicating the program area in which the error occurred and the low byte indicating the cause of the error.

The following table shows the possible values of the high byte.

Table 2-2

Value	Description
16#60	Block in the initialization or error in the initialization.
16#70	Block initialized and ready for starting or ending a pause.
16#80	Error during communication with the device.
16#90	PROFIenergy-specific error after sending a command.

The following table shows the possible error causes of the low byte.
If an error occurs while processing a system module, its error code is specified in the output "subfunctionStatus".

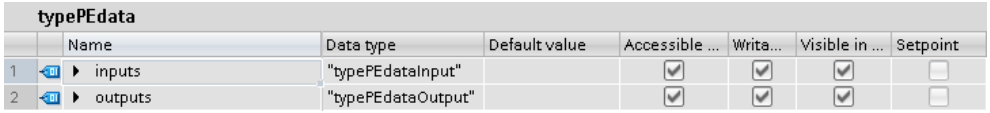
Table 2-3

Value	Description
16#01	PROFIenergy error: Wrong header read back from device
16#02	PROFIenergy error: Command is not supported by the device
16#03	PROFIenergy error: Request Reference in command and response of the device do not fit together
16#04	PROFIenergy error: The response from the device is not complete
16#05	PROFIenergy error: The command failed on the device.
16#06	PROFIenergy error: Incorrect Data Structure Identifier returned by device
16#07	PROFIenergy error: WakeUp data for the device is too long to store completely in the device (>150 bytes)
16#08	The specified device does not support PROFIenergy pause management.
16#10	Error when sending the command to the device or when processing the SFB WRREC.
16#11	Error when reading the response of the device or when processing the SFB RDREC.
16#12	Device not ready despite multiple attempts
16#30	The connection to send the WakeUp data could not be opened. Error when processing the SFB TCON
16#31	The WakeUp data cannot be sent. Error while processing the SFB TUSEND
16#40	Device information could not be read. Error cause could be wrong hardware identifier for PROFINET interface devices.
16#50	PROFIenergy error: No suitable power saving mode on the device for the selected pause duration.
16#51	PROFIenergy error: The scheduled pause time is too short for the unit to switch to a pause mode.
16#53	PROFIenergy error: The unit cannot enter a power save mode because it is operating.
16#54	PROFIenergy error: Function currently not available.

2.1.2 User data type "typePEdata"

The "typePEdata" data structure is configured as an "InOut" variable on the "PROFIenergy_Device_Control" block. Thus an instance of this data type must be created in a data block for each configured device. If necessary, this can also be done with an array of this data type.

Figure 2-5

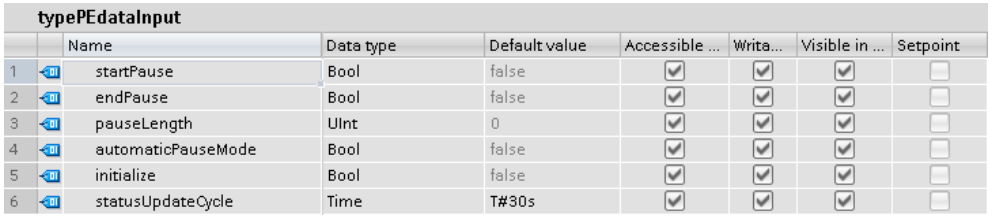


The data type "typePEdata" contains both the input data for controlling the device and the output data with information about the PROFIenergy device status. Both structures are configured as user-defined data types.

Data structure "typePEdataInput"

The data structure "typePEdataInput" is passed to the function module as an InOut variable. This structure is used to start and end pauses and to pass the pause length.

Figure 2-6



typePEdataInput

	Name	Data type	Default value	Accessible ...	Writa...	Visible in ...	Setpoint
1	startPause	Bool	false	☑	☑	☑	☐
2	endPause	Bool	false	☑	☑	☑	☐
3	pauseLength	UInt	0	☑	☑	☑	☐
4	automaticPauseMode	Bool	false	☑	☑	☑	☐
5	initialize	Bool	false	☑	☑	☑	☐
6	statusUpdateCycle	Time	T#30s	☑	☑	☑	☐

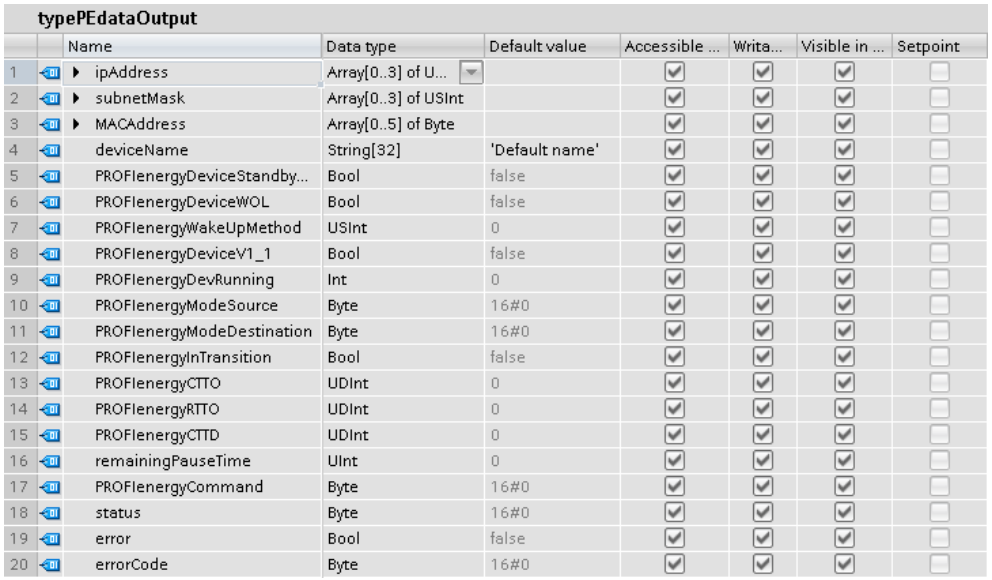
Table 2-4

Name	Data type	Description
startPause	Bool	TRUE = Starts a pause in the device. Depending on the pause length, either a PE pause or the WOL mode is started. Automatically reset by the FB.
endPause	Bool	TRUE = Ends a pause in the device. Depending on the pause mode, either the PE command or the Magic Packet is sent. Automatically reset by the FB.
pauseLength	UInt	Planned pause length in seconds
automaticPauseMode	Bool	TRUE = Pause is automatically terminated after the scheduled pause duration has elapsed.
initialize	Bool	TRUE = In case of an error, the block is initialized and the error is reset.
statusUpdateCycle	Time	Time period in which the PROFIenergy status is updated and queried cyclically.

Data structure "typePEdataInput"

The data structure "typePEdataOutput" displays all available information about the device and its PROFIenergy status.

Figure 2-7



typePEdataOutput

	Name	Data type	Default value	Accessible ...	Writa...	Visible in ...	Setpoint
1	ipAddress	Array[0..3] of U...		☑	☑	☑	☐
2	subnetMask	Array[0..3] of USInt		☑	☑	☑	☐
3	MACAddress	Array[0..5] of Byte		☑	☑	☑	☐
4	deviceName	String[32]	'Default name'	☑	☑	☑	☐
5	PROFIenergyDeviceStandby...	Bool	false	☑	☑	☑	☐
6	PROFIenergyDeviceWOL	Bool	false	☑	☑	☑	☐
7	PROFIenergyWakeUpMethod	USInt	0	☑	☑	☑	☐
8	PROFIenergyDeviceV1_1	Bool	false	☑	☑	☑	☐
9	PROFIenergyDevRunning	Int	0	☑	☑	☑	☐
10	PROFIenergyModeSource	Byte	16#0	☑	☑	☑	☐
11	PROFIenergyModeDestination	Byte	16#0	☑	☑	☑	☐
12	PROFIenergyInTransition	Bool	false	☑	☑	☑	☐
13	PROFIenergyCTTO	UDInt	0	☑	☑	☑	☐
14	PROFIenergyRTTO	UDInt	0	☑	☑	☑	☐
15	PROFIenergyCTTD	UDInt	0	☑	☑	☑	☐
16	remainingPauseTime	UInt	0	☑	☑	☑	☐
17	PROFIenergyCommand	Byte	16#0	☑	☑	☑	☐
18	status	Byte	16#0	☑	☑	☑	☐
19	error	Bool	false	☑	☑	☑	☐
20	errorCode	Byte	16#0	☑	☑	☑	☐

Table 2-5

Name	Data type	Description
ipAddress	Array[0..3] of USInt	The IP address of the device
subnetMask	Array[0..3] of USInt	The subnet mask of the device
MACAddress	Array[0..5] of Byte	The MAC address of the device
deviceName	String[32]	PROFINET device name
PROFIenergyDeviceStandbyMgmt	Bool	TRUE = Device supports PE Standby Management
PROFIenergyDeviceWOL	Bool	TRUE = Device supports WOL
PROFIenergyWakeUpMethod	USInt	WakeUp method of the device: 1 = MAC Address 2 = Ethernet Frame
PROFIenergyDeviceV1_1	Bool	TRUE = device supports PROFIenergy Version 1.1
PROFIenergyDevRunning		Used for visualization
PROFIenergyModeSource	Byte	Current PE mode: FF = Operating device FE = WOL mode F0 = During operation 01 – 1F = Pause mode 00 = Off
PROFIenergyModeDestination	Byte	During the transition to a new PE mode, the target mode. Description see above.

Name	Data type	Description
PROFIenergyInTransition	Bool	TRUE = device currently in a PROFIenergy transition
PROFIenergyCTTO	UDInt	Current time to operational readiness in seconds.
PROFIenergyRTTO	UDINT	During a transition, remaining time to operational readiness in seconds. (not supported by every device).
PROFIenergyCTTD	UDINT	During a transition into a pause mode, time until this is reached. (Not supported by every device).
remainaingPauseTime	UInt	Remaining time, the pause time in seconds previously started.
PROFIenergyCommand	Byte	Last PE command sent: 1 = Start pause 2 = End pause 4 = PE status 5 = PE Identify 6 = Query Version 32 = Info WOL 33 = Go WOL
Status	Byte	Current status of the block. See error code (link)
Error	Bool	TRUE = Error is currently present.
errorCode	Byte	In the event of an error, the status of the block. See error code (link)

2.2 Integration into the user project

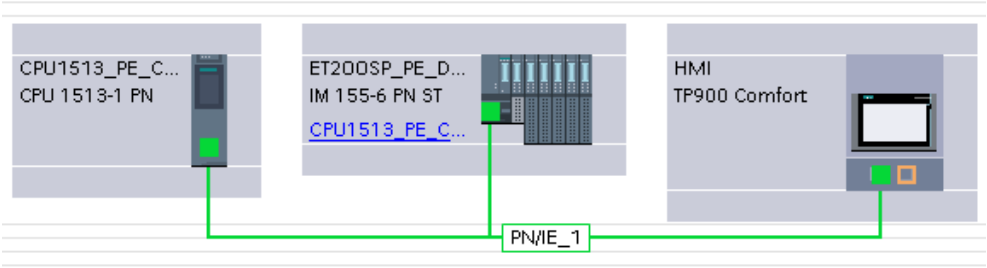
2.2.1 Requirement

It is assumed that at least one PROFIenergy-capable device is configured in the hardware configuration of your user project.
It is recommended to use a Comfort Panel to operate the application example.

2.2.2 Hardware setup

The hardware structure is shown as an example in the network view.

Figure 2-8



The structure consists of a CPU 1513-1PN that is connected via PROFINET to a decentralized peripheral ET 200SP IM 155-6PN ST and a TP900 Comfort Panel. The CPU is used as PROFIenergy controller and the ET 200SP as PROFIenergy device.

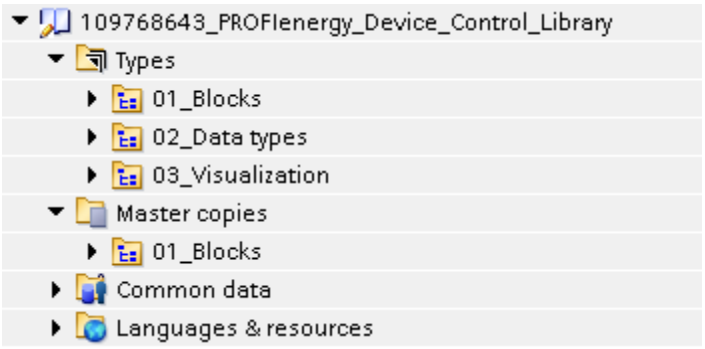
Note Instead of the CPU 1513-1PN you can use any further CPU 1500 controller.

The standard template for the Comfort Panel is taken from the application example "HMI Template Suite for User Interfaces" (see article ID: https://support.industry.siemens.com/cs/ww/en/view/91174767) which also contains a detailed description of how to operate the HMI template.

2.2.3 Structure of the library

The following figure shows the structure of the library.

Figure 2-9



The library contains the folder "Types" and the folder "Copy template".
Under the folder "Types" you will find

- the "PLC data types"
- the function block "PROFIenergy_Device_Control" and
- the image block "FP_PROFIenergyDeviceControl"

All types have version 1.0.0.

Note The block "PROFIenergy_Device_Control" is executable on any CPU 15xx.

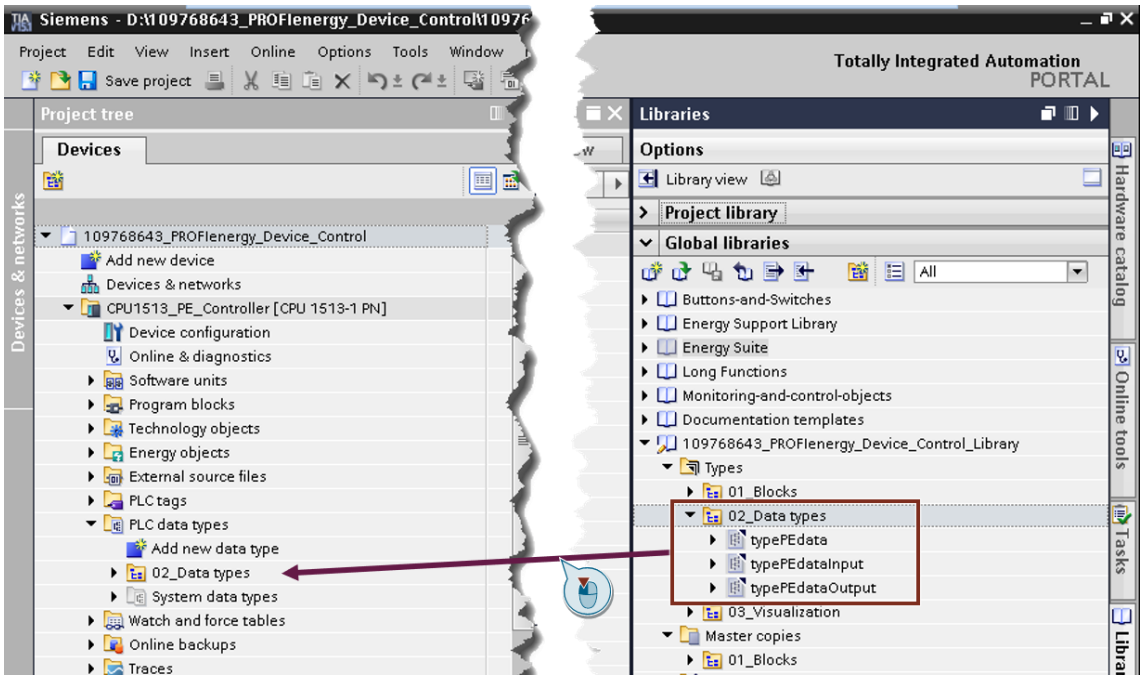
The folder "Copy templates" also contains the data block "PROFIenergy_Device_Data". This contains a variable of the user defined data type "typePEdata", which is described in section User data type (2.1.2). The data block serves as interface between the function block "PROFIenergy_Device_Control" in the CPU and the image block "FP_PROFIenergyDeviceControl" on the Comfort Panel.

2.2.4 Procedure for integrations

Integration in the PLC

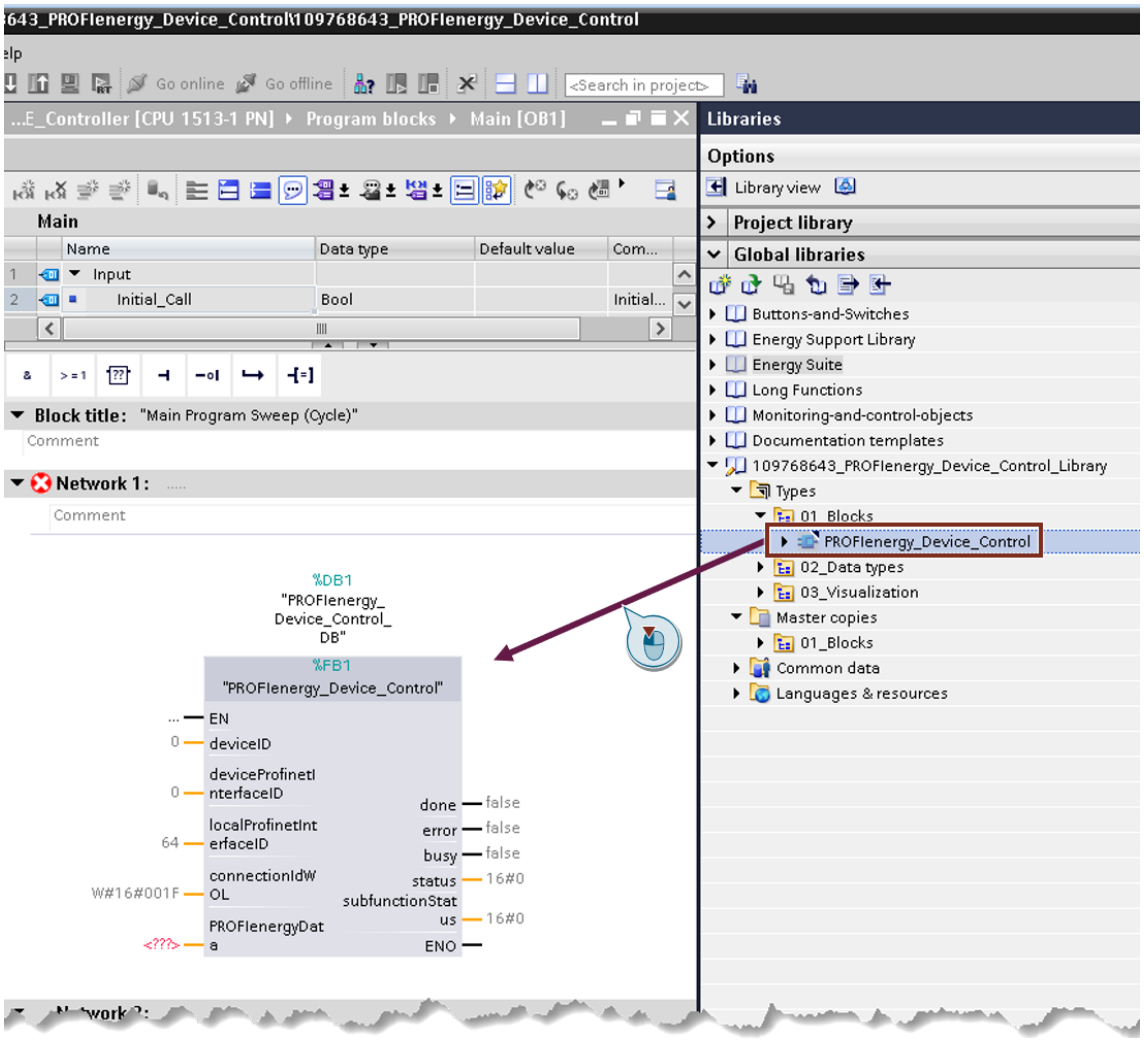
1. Open the library "109768643_PROFIenergy_Device_Control_Library" in the global libraries tab.
2. Open the Types folder of the library. Copy the folder "02_Data types" by Drag & Drop into the "PLC data types".

Figure 2-10



3. Open a cyclic OB (e.g. Main OB1) and place the FB "PROFIenergy_Device_Control" contained in the folder "01_Blocks" in an empty network by drag & drop and create a new IDB for this block.

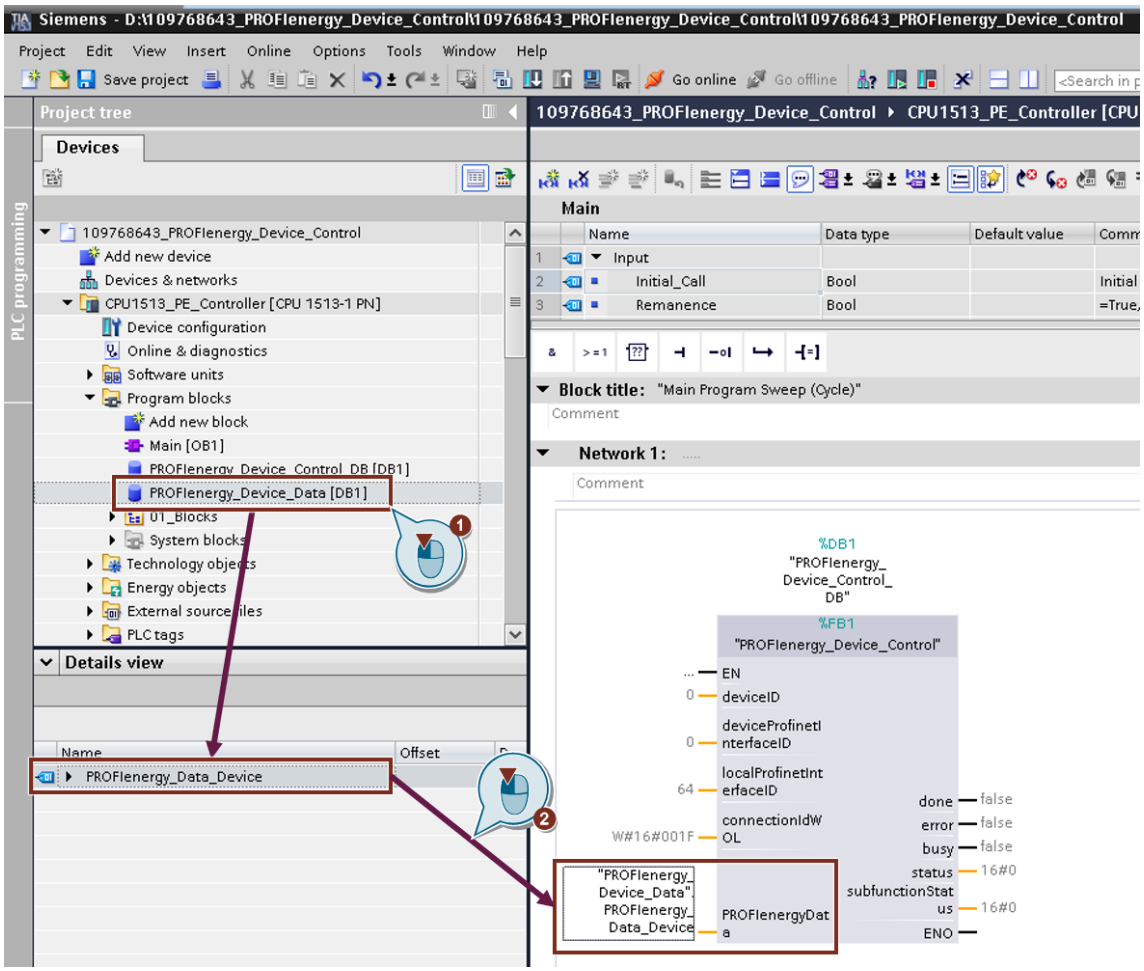
Figure 2-11



4. Open the "Master copies" folder of the library. Copy the data block "PROFIenergy_Device_Data" from the folder "01_Blocks" into the program blocks of your CPU.

5. Select the DB "PROFIenergy_Device_Data" in the program blocks of the CPU (1). Then connect the variable "PROFIenergy_Data_Device", in the detailed view of the DB, by Drag & Drop with the InOut variable "PROFIenergyData" of the FB (2).

Figure 2-12

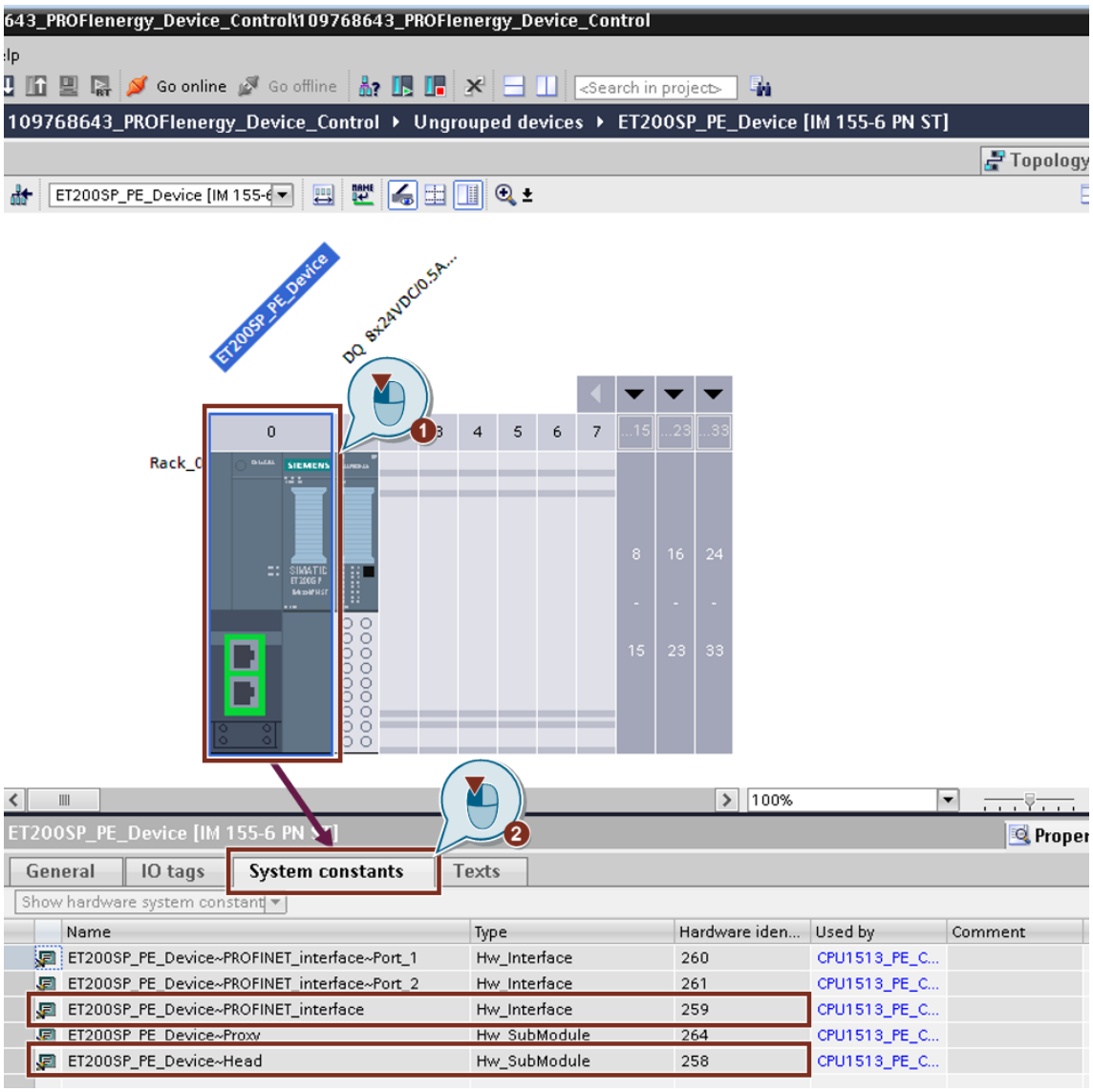


6. Change to the hardware configuration and open the device configuration of the ET 200SP. Select the header assembly (1) and select the "System constants" tab (2) in the properties.

   In order to communicate with the ET 200SP, the function block requires the hardware identifier of the header module and its PROFINET interface. The hardware identifiers can be recognized by the following nomenclature:

   - Head component group = …~Head
   - PROFINET interface = …~PROFINET_interface

Figure 2-13

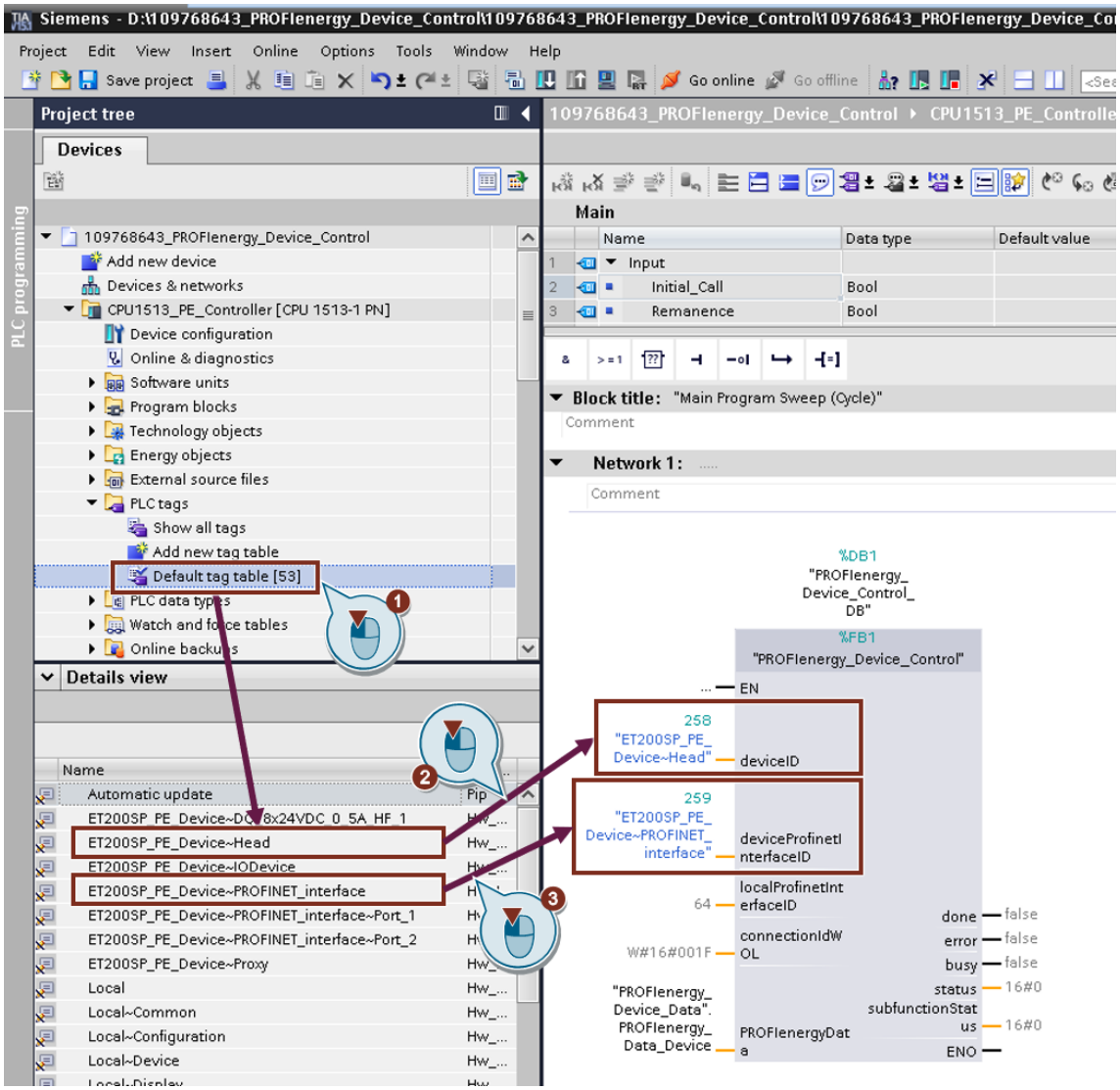


7. Switch back to the OB to call the FB "PROFIenergy_Device_Control" and select the standard variable table (1) in the folder "PLC Tags".

   Now connect the newly selected hardware identifiers to the inputs of the FB via Drag & Drop.

   - Hardware Identifier …~Head on the input "deviceID" (2)
   - Hardware Identifier …~PROFINET_interface on the input "deviceProfinetInterfaceID" (3)

Figure 2-14



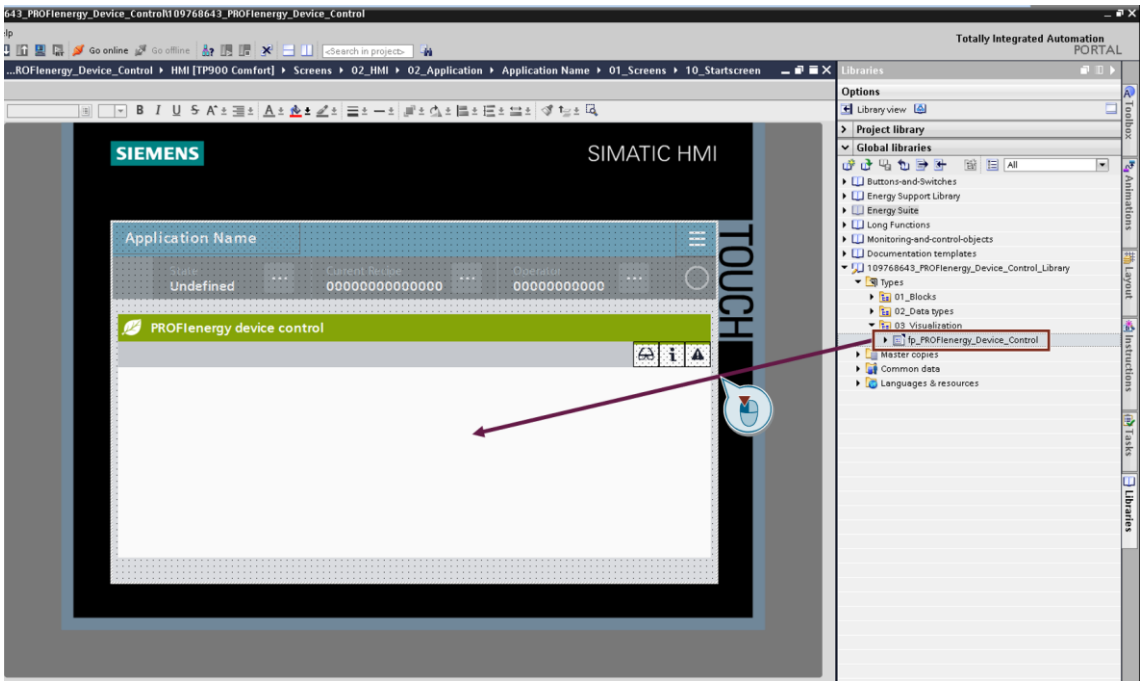
8. Load the program and the hardware configuration onto the CPU.

Integration into HMI

Open an empty image on your configured Comfort Panel.

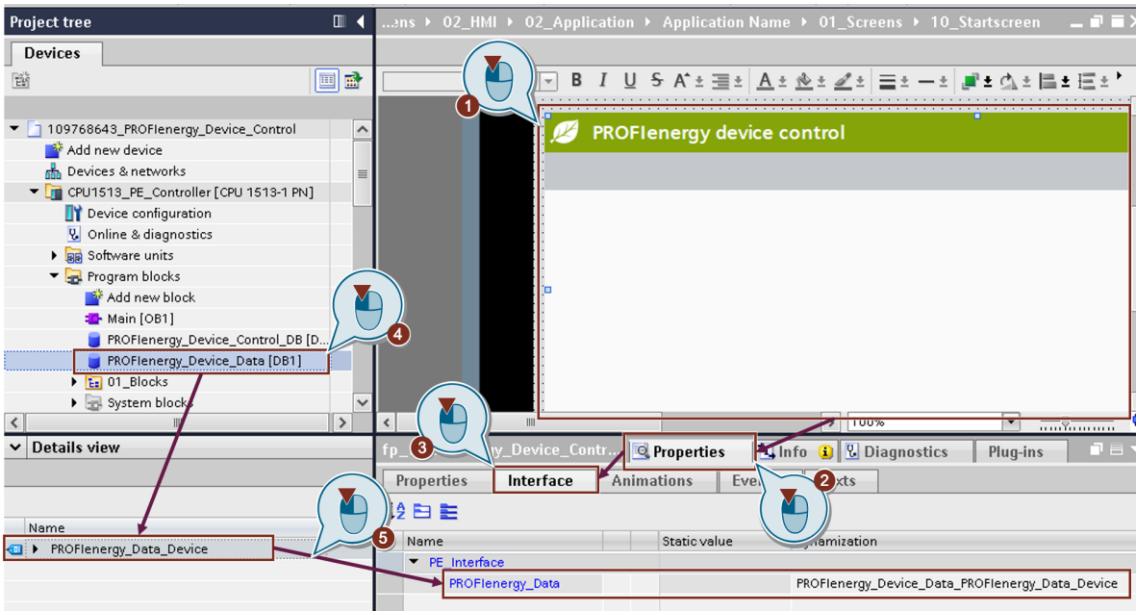
9. In the library, navigate to the "Types " folder - "03_Visualization". Place the image module "fp_PROFIenergy_Device_Control" via the Drag & Drop on the screen "10_Startscreen".

Figure 2-15



10. Now select the just placed picture block (1) in the picture and navigate in its properties (2) to the "Interface" tab (3). Then select the DB "PROFIenergy_Device_Data" (4) in the PLC in the folder "Program blocks". Now connect the variable "PROFIenergy_Data_Device" from the detail view of the DB via drag & drop with the variable "PROFIenergy_Data" in the interface of the faceplate (5).

Figure 2-16



11. Download the software to the Comfort Panel or start the panel simulation.

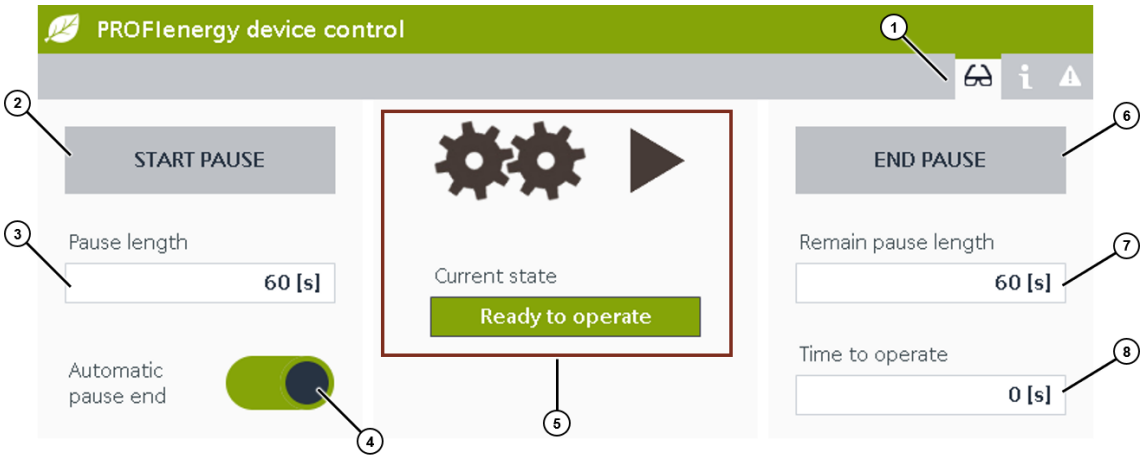
3 Operation of the application example

Note You can also operate the application example with a simulated Comfort Panel.

Control of PROFIenergy functionality

The following illustration shows the start screen of the screen block. With this overview you control the PROFIenergy functionality of the connected device. In addition, you will receive the current status regarding PROFIenergy.

Figure 3-1



(1) This allows you to navigate between the individual views of the screen block. You can choose between the following displays:
- Control of PROFIenergy functionality.
- Device information.
- Malfunction and reporting information.

(2) Button: Start the PROFIenergy Pause.

(3) Input field: Planned pause length.

(4) Slide switch: Select whether the device is to be restarted automatically after the scheduled pause time has elapsed.

(5) Status output: Displays the current PROFIenergy status of the device. In the figure no pause is active.

(6) Button: End an active pause. This also applies to waking up from WOL mode.

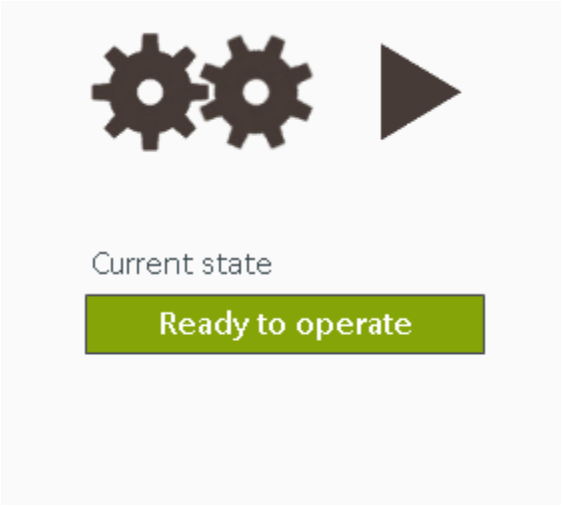
(7) Output field: Remaining pause duration of the planned pause.

(8) Output field: Time it takes for the machine to switch from power save mode to standby mode. (the function is not supported by every connected device).

Visualization of the PROFIenergy status of the device

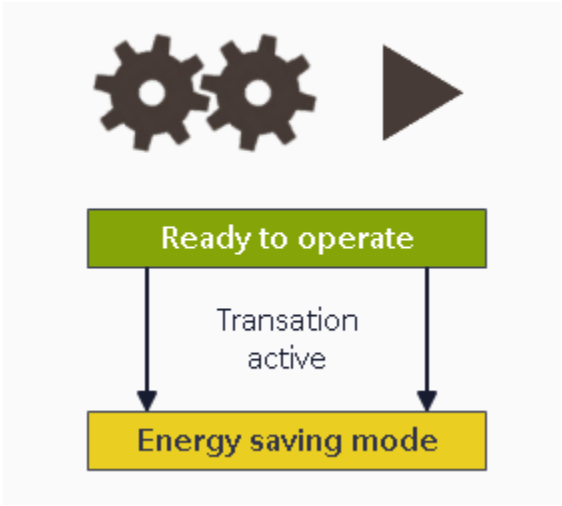
In the following, the PROFIenergy status of the device with regard to the visualization is shown in the screen module.

Figure 3-2



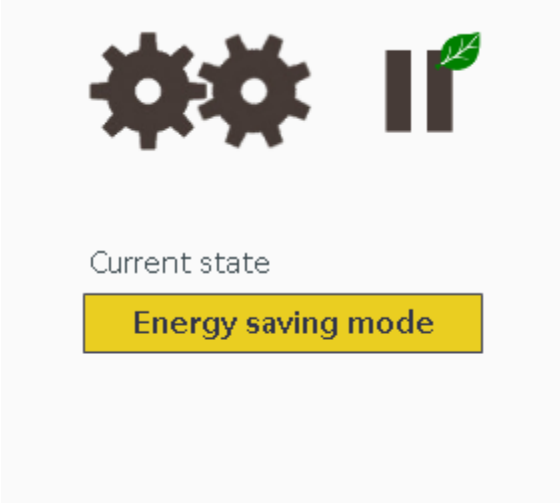
There is currently no PROFIenergy pause active in the device, which means it is in Ready mode. The gears rotate and a playback icon is visible.

Figure 3-3



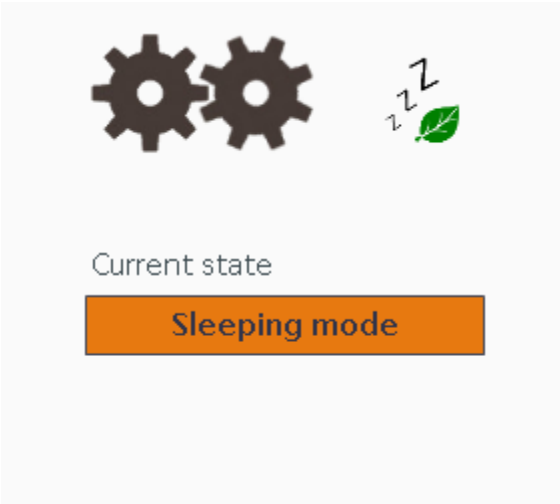
A status transition is currently active, in this case from Ready mode to a PROFIenergy energy-saving mode. The arrows and text flash for the duration of the transition.

Figure 3-4



A PROFIenergy pause is currently active in the device. The machine is in a power save mode. The gears stand still and the pause sign appears.

Figure 3-5

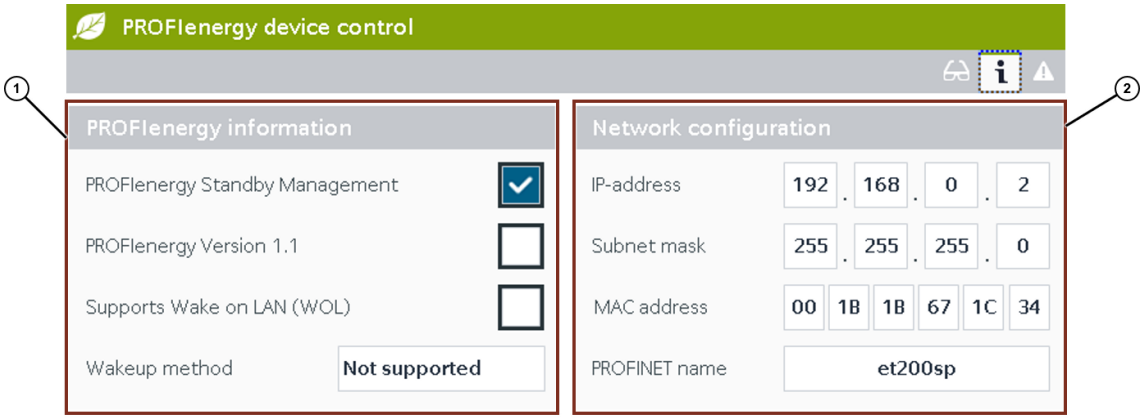


The device is currently in WOL mode. This mode is not available on all devices. The gears stand still and a sleep icon is displayed.

Visualizing the device information

The following figure shows the view of the device information in the screen block. You can get there via the navigation bar.

Figure 3-6



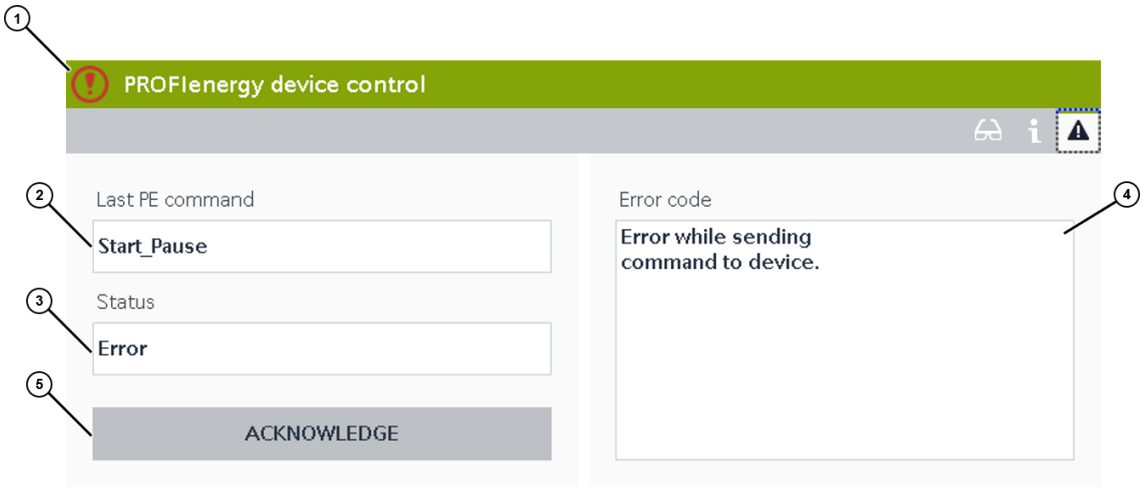
(1) Status output: In this section you will find information on the device with regard to its PROFIenergy functionality.

(2) Status output: In this section you will find information on the network configuration of the device.

Visualization of the block status

The following figure shows the view of the block diagnosis in the screen block. You can get there via the navigation bar. In case of an active error, the corresponding button in the navigation bar flashes orange.

Figure 3-7



(1) Status output: In case of an active error, this symbol appears in the upper left corner of the screen block.

(2) Output field: The last PROFIenergy command sent to the device. In the event of an error of the command that led to it.

(3) Status output: The current block status. An error is active in the representation.

(4)	Output field:	In case of an active error, a more detailed error description is given here.
(5)	Button:	With this button an active error can be acknowledged. The block is then reinitialized.

4 Appendix

4.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:
https://support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts. Please send queries to Technical Support via Web form:
www.siemens.com/industry/supportrequest

SITRAIN – Training for Industry

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:
www.siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:
https://support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone:
https://support.industry.siemens.com/cs/ww/en/sc/2067

4.2 Links and literature

Table 4-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the entry page of the application example https://support.industry.siemens.com/cs/ww/en/view/109768643

4.3 Change documentation

Table 4-2

Version	Date	Change
V1.0	07/2019	First version