



Edition

12/2022

OPERATING INSTRUCTIONS

SIMATIC

Gateways

PN/BACnet LINK

SIMATIC

Gateways PN/BACnet LINK

Operating Instructions

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

1.1 Preface

Purpose of this documentation

These operating instructions contain all the information required for configuring, installing, commissioning and operating the PN/BACnet LINK.

These operating instructions are intended for qualified personnel in the following target groups:

- Commissioning engineers
- Operating and service personnel
- System integrator

Knowledge required

The following knowledge is required in order to understand the operating instructions:

- Knowledge of programming a SIMATIC S7 controller
- Knowledge in the application of the TIA configuration environment
- Knowledge of working with the PROFINET fieldbus
- Sound knowledge of the BACnet/IP communication protocol
- General knowledge in the field of automation technology
- General knowledge of communication networks

Trademarks

SIMATIC® is a registered trademark of Siemens AG.

History

Edition	Remarks
10/2017	First edition

Naming conventions

The following terms are also used in this documentation instead of the full product name "SIMATIC PN/BACnet LINK":

- "PN/BACnet LINK"
- "Device"

1.2 Documentation guide

Below you will find a list of documents which supplement these operating instructions for the PN/BACnet LINK and which are available on the Internet.

Additional documentation

Subject	Documentation	Most important contents
Designing interference-free controllers	Function Manual Designing interference-free controllers (https://support.industry.siemens.com/cs/ww/de/view/59193566)	• Basics • Electromagnetic compatibility • Lightning protection
PROFINET	SIMATIC PROFINET System Description (https://support.industry.siemens.com/cs/ww/de/view/19292127)	• Basics • Installation • Functions • Configuration examples

The latest manuals for SIMATIC products are available for download free of charge from the Internet (<https://support.industry.siemens.com/cs/ww/de/ps/man>).

The information system of the TIA Portal also helps you configure and program your automation system and the PN/BACnet LINK.

Safety instructions

2.1 Safety instructions

CAUTION
--

Observe the safety instructions on the inside front cover of this documentation.
--

SIMATIC PN//BACnet LINK devices correspond to the approvals printed on the type plate. If you have questions about whether it is permissible to install the device in the planned environment, please contact your service representative.

NOTICE

Alterations to the devices are not permitted.

Failure to observe this requirement shall constitute a revocation of the CE approval and manufacturer's warranty.

Intended use

NOTICE

The PN/BACnet LINK may only be used for the applications described in the catalog and in the associated technical documentation. If the device is used in a manner other than the one specified by Siemens, the protection offered by the device might be impaired.

See also the section "Legal notices" at the beginning of this manual.

Repairs

WARNING
--

The device contains no user-serviceable parts.

May cause death or serious injury
--

Unauthorized opening or improperly performed repairs can cause considerable damage to property and/or danger to users. Contact Siemens Support (http://support.automation.siemens.com) in case of error.
--

Safety information

 WARNING
Connection only over safety extra-low voltage / protective extra-low voltage May cause death or serious injury The device is designed for operation using directly connectable safety extra-low voltage (SELV) with safe electrical separation according to IEC 60950-1 / EN 60950-1 / VDE 0805-1 or IEC 61131-2 / EN 61131-2 / DIN EN 61131-2. To maintain the safety property of the low voltage circuits of the PN/BACnet LINK, the 24 V rated power supply as well as external connections to communication ports must be supplied from reliable sources that meet the requirements for SELV / PELV limited voltage sources according to different standards. Therefore only connect safety extra-low voltages (SELV) with safe electrical separation according to IEC 60950-1 / EN 60950-1 / VDE 0805-1 to the supply voltage connections and the communications interfaces.

Working on the device or on connected components

 WARNING
Risk of electric shock May cause death or serious injury • Voltages > 60 V DC or 30 V AC may be present in the control cabinet. Therefore appropriate safety precautions must be taken to prevent contact during commissioning and maintenance work. • Before carrying out any work on the device or on connected components, make sure that the installation is in a zero-voltage state. • Use cable types with UL approval for UL-approved systems.

2.2 Security information

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 only form one element of such a concept.

Customer is responsible to prevent unauthorized access to its plants, systems, machines and networks. Systems, machines and components should only be connected to the enterprise network or the internet if and to the extent necessary and with appropriate security measures (e.g. use of firewalls and network segmentation) in place.

Additionally, Siemens' guidance on appropriate security measures should be taken into account. For more information about industrial security, please visit (<http://www.siemens.com/industrialsecurity>).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends to apply product updates as soon as available and to always use the latest product versions. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under (<http://www.siemens.com/industrialsecurity>).

2.3 IT security

Protective measures for SIMATIC PN/BACnet LINK

NOTICE
Only authorized personnel are permitted to access the system and carry out modifications.

System overview

3.1 Field of application



Figure 3-1 SIMATIC PN/BACnet LINK

The PN/BACnet LINK is a communication gateway and enables the connection of SIMATIC controllers to the BACnet/IP fieldbus over PROFINET. This connection enables the exchange of information and data between PROFINET and BACnet/IP.

3.2 Features

General features

- 1 BACnet port (Fast Ethernet, RJ45). The maximum transmission rate is 100 Mbps.
- The PN/BACnet LINK supports BACnet/IP according to DIN EN ISO16484-5 and Addendum ANSI/ASHRAE Standard 135-2012.
- BACnet/IP profile: B-GW (BACnet gateway)
- 2 PROFINET interfaces (integrated switch) enable PROFINET line operation according to Conformance Class B (CC-B).
- A PN/BACnet LINK can be both a BACnet client and a BACnet server. The actual functionality of the PN/BACnet LINK is defined when it is configured. A mixed mode of Client and Server functionality is possible.
- The PN/BACnet LINK is configured via the corresponding HSP in the TIA Portal.
- The following options are available for creating BACnet object references:
 - Manual input of the required object addresses
 - Scanning the network with takeover of the selected objects
 - Import a network description (EDE file) and select the desired objects
- The BACnet server located in the PN/BACnet LINK can handle up to 1000 subscribers.
- The BACnet client located in the PN/BACnet LINK can establish communication relationships with up to 126 BACnet devices.

BACnet characteristics

Supported BACnet object types:

- DEVICE
- BINARY INPUT
- BINARY OUTPUT
- ANALOG INPUT
- ANALOG OUTPUT

Supported BACnet services:

- Change of Value COV-A/B
- ReadProperty RP-A/B
- WriteProperty WP-A/B

Monitoring of BACnet devices:

- Cyclic query of the status properties in the device object
- Set the status in the device object of the PN/BACnet LINK

Number of BACnet objects configurable in PN/BACnet LINK

The number of BACnet objects that can be configured in PN/BACnet LINK is limited by several conditions. Which condition is effective depends on the particular configuration. It is important to consider all boundary conditions during application planning.

Limits specified by the PN/BACnet LINK

- Maximum of 126 BACnet client devices.
- The number of BACnet server objects is limited by the size of the configuration data. The size of the data is checked during the compilation. If the maximum size is exceeded, an error is displayed. You can calculate the data size manually for application planning. The maximum size of the configuration data is 32766 bytes.

The size of the configuration data is calculated as follows:

- Add 74 bytes for each binary object (input or output).
- Add 82 bytes for each analog object (input or output).

PROFINET data transfer limits

- Maximum of 1024 input bytes (PII) for a single BACnet client device (object references)
- Maximum of 1024 output bytes (PIQ) for a single BACnet client device (object references)
- Maximum of 1024 input bytes (PII) for a server (server objects)
- Maximum of 1024 output bytes (PIQ) for a server (server objects)
- The sum of all inputs (PII for server and client) must not exceed 1278 bytes and the sum of all outputs (PIQ for server and client) must not exceed 1278 bytes in a PN/BACnet LINK.

Table 3- 1 The amount of I/O data bytes required by BACnet objects.

Object type	Server		Client (object reference)	
	PII	PIQ	PII	PIQ
Binary input (BI)	--	1	1	--
Binary output (BO)	1	1	1	1
Analog input (AI)	--	5	5	--
Analog output (AO)	4	1	1	4

When using the PN/BACnet LINK with an S7-1200 controller, there is an additional limitation given by the size of the process image of the CPU which is 1024 bytes.

Example

The PN/BACnet LINK has defined server objects and a client device with several objects. The number of objects and the corresponding occupied I/O and memory bytes are listed in the following tables.

Table 3- 2 Checking for server objects

Objects	PII data	PIQ data	Configuration memory
35 Binary Inputs	0	35	2590
40 Binary Outputs	40	40	2960
97 Analog Outputs	388	97	7954
Total	428	172	13504
Limit	1024	1024	32766

Table 3- 3 Checking for objects of a client device

Objects	PII data	PIQ data
90 Binary Inputs	90	0
30 Binary Outputs	150	0
45 Analog Outputs	45	180
Total	285	180
Limit	1024	1024

Table 3- 4 Check for the entire PN/BACnet LINK

Objects	PII data	PIQ data
Server	428	172
Client device	285	180
Total	713	352
Limit	1278	1278

Note: You can define more client devices

3.3 System configuration

System configuration

The following figure shows a basic system configuration with a PN/BACnet LINK as a communication gateway between a PROFINET network and a BACnet/IP network.

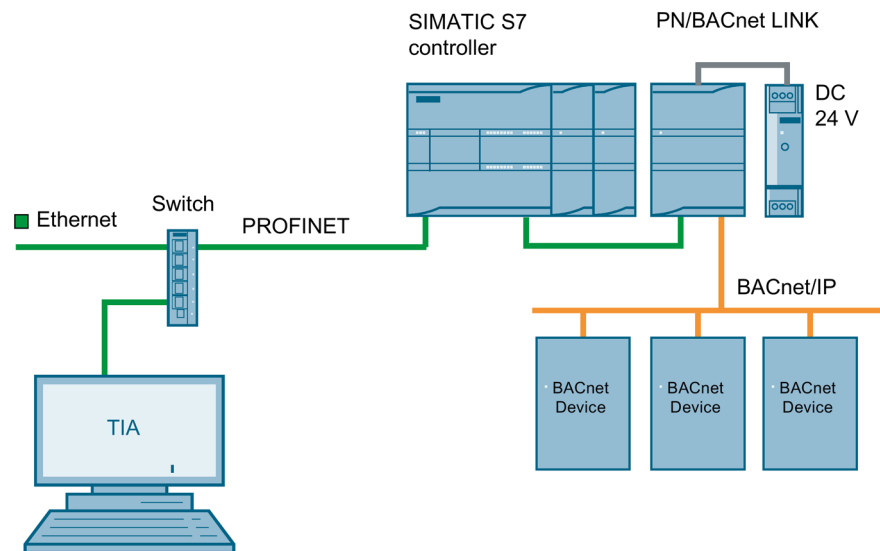


Figure 3-2 System configuration with PN/BACnet LINK

Purpose and function of the system components

The PN/BACnet LINK enables the connection of PROFINET to BACnet/IP.

The communication of the PN/BACnet LINK with the CPU of the S7 controller takes place exclusively over the PROFINET interface.

From the PROFINET view, the PN/BACnet LINK is an IO device according to Conformance Class B (CC-B).

The cyclic data exchange between the PN/BACnet LINK and the connected SIMATIC CPUs is based on updating the IO image. Acyclic communication takes place by means of "Read data record" and "Write data record" services.

Power is supplied to the PN/BACnet LINK either via an external 24 V DC power supply or via the 24 V power supply of the SIMATIC S7 system.

The TIA Portal is used for configuring. A corresponding HSP is available for this purpose.

3.4 System requirements

System requirements

- PN/BACnet LINK
- Controller: Supported are SIMATIC S7-1200, SIMATIC S7-1500, SIMATIC ET 200SP, SIMATIC OpenController
- 24 V power supply
- BACnet/IP bus
- PROFINET bus
- Windows PC (for configuring, commissioning and diagnostics)
- TIA Portal V14 SP1 (at least with Update 2)
- We recommend a switch for configuring, commissioning and diagnostics.

3.5 Design

PN/BACnet LINK design

The figure below shows the arrangement of the connection and display elements on the PN/BACnet LINK. The figure shows the device without a top and bottom enclosure cover.

Design

PN/BACnet LINK design

①	24 V DC + functional grounding
②	Status LEDs device operating state + PROFINET
③	MAC addresses X1: Address that the device uses on PROFINET X10: Address that the device uses on BACnet
④	Status LEDs Ethernet interface for BACnet
⑤	Status LEDs Ethernet interface for PROFINET
⑥	Ethernet connections for PROFINET
⑦	Ethernet connection for BACnet
⑧	Status LEDs BACnet operating state
⑨	Rating plate

See also

- 24 V DC power supply (Page 55)
- Connecting PROFINET (Page 57)
- Connecting BACnet bus (Page 58)
- Status LEDs (Page 79)

Functions

4.1 BACnet objects

4.1.1 Overview

The PN/BACnet LINK can be used both as a BACnet client and as a BACnet server. As a client, PN/BACnet LINK is the active communication partner, that is, it requests data from other communication partners (BACnet servers). As a server, PN/BACnet LINK provides data that is used by other communication users (BACnet clients). A mixed mode of Client and Server functionality is possible.

Server objects and Client object references

When describing objects, a distinction is made between Server objects and Client object references. Server objects are full BACnet objects which the PN/BACnet LINK makes available for other BACnet devices (Clients). Client object references are references to Server objects which are located in other BACnet devices (Servers).

Communication paths of BACnet server

BACnet objects of the type "Binary input (BI) and "Analog input" (AI) are inputs on the BACnet side. The values are written from the S7 side to the "Present_Value" property of the corresponding input object.

BACnet objects of the type "Binary output (BO) and "Analog output" (AO) are outputs on the BACnet side. The "Present_Value" properties of the output objects are read from the S7 side.

With server objects, the PN/BACnet LINK writes the status information transferred by the S7 controller to the property "Status_Flags" of the corresponding objects.

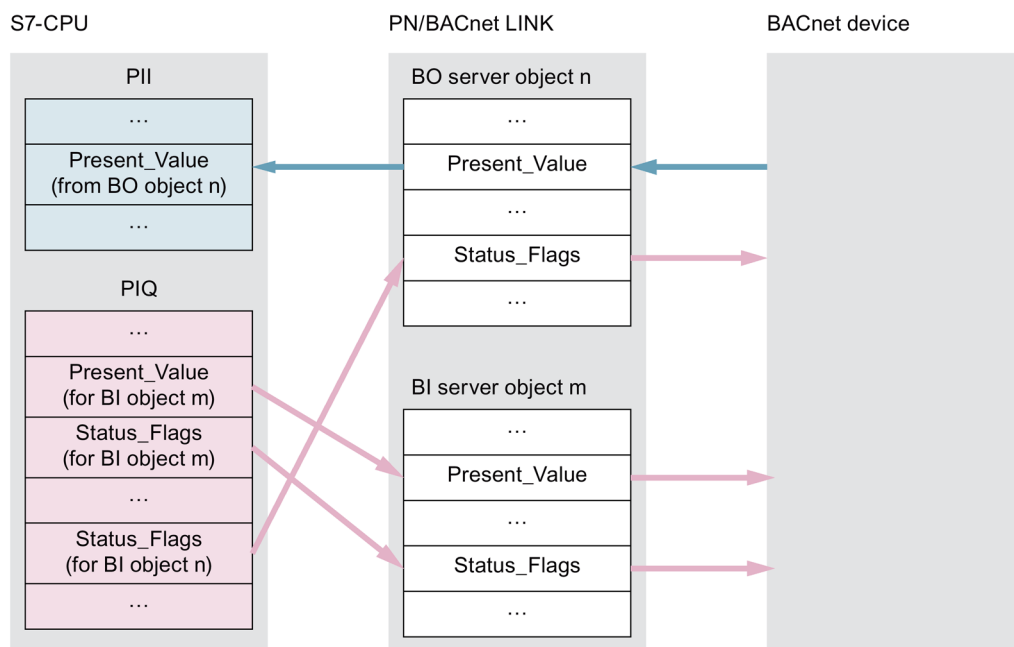


Figure 4-1 Communication paths of BACnet server

Communication paths of BACnet client

The PN/BACnet LINK reads the values of the corresponding "Present_Value" properties and transfers them to the S7 controller via references to input objects. The PN/BACnet LINK writes values which come from the S7 controller to the associated "Present_Value" properties of the corresponding objects via references to output objects.

The "Status_Flags" are transferred to the S7 controller as input data. With "Status_Flags", transmission is always from the object to which the reference is pointing, to the S7 controller, independent of the type of object.

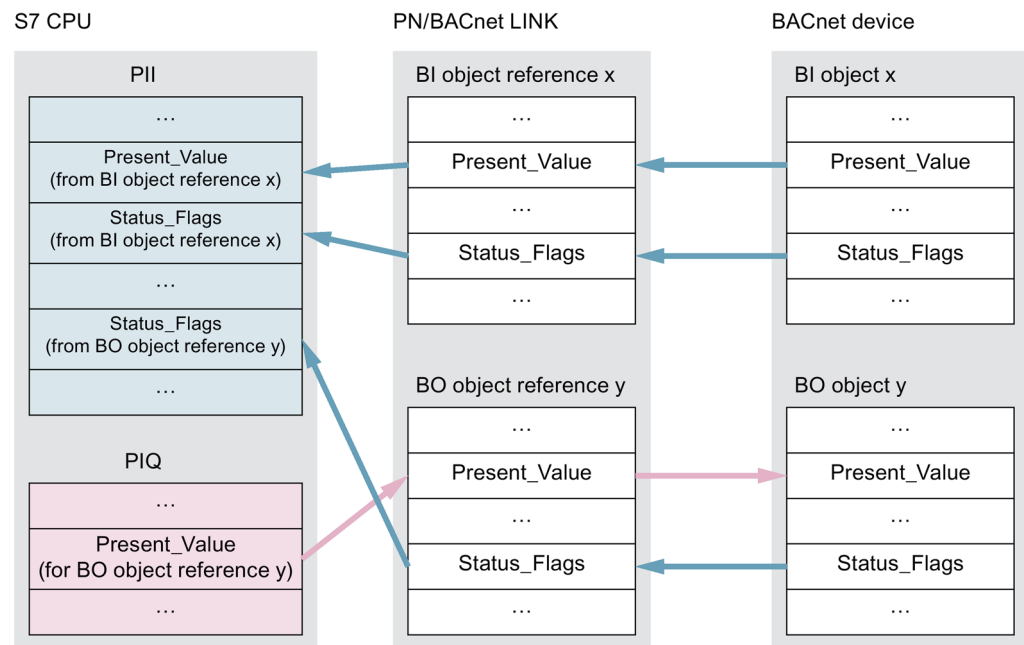


Figure 4-2 Communication paths of BACnet client

4.1.2 Server objects

Server objects are BACnet objects which the PN/BACnet LINK contains itself. When they are configured, full BACnet objects are written with the required properties.

The PN/BACnet LINK supports the following Server objects:

- Device
- Binary input
- Binary output
- Analog input
- Analog output

The following describes which of the associated properties are implemented in the individual server objects. The entries in the corresponding tables have the following meaning:

- All values which are filled from the data source "Configuration" are defined by the user or the HSP as part of configuring.
- For "fixed" values, the corresponding fixed assignments are found in the tables. These values cannot be changed.
- The entry "Dynamic" means: The Property value results from current operating conditions. The value can change dynamically.
- The "Access" column indicates whether read (R) and/or write access (W) to properties of the BACnet object is possible.

4.1 BACnet objects

4.1.2.1 Device object

Device object properties

Every BACnet device object and also therefore the PN/BACnet LINK has a device object as logical representation of the device. This object specifies the basic properties of a BACnet device. Devices in the BACnet network can read out the properties of a BACnet device. For example, as a BACnet client, the PN/BACnet LINK is able to read the device object from other devices in the BACnet network.

The following table shows which properties are supported for the device object of the PN/BACnet LINK and from which source the associated values originate.

Property	Data source	Value	Access
Object_Identifier	Configuration	--	R
Object_Name	Configuration	--	R
Object_Type	Fixed	8	R
System_Status	Dynamic	--	R
Vendor_Name	Fixed	Siemens AG	R
Vendor_Identifier	Fixed	7	R
Model_Name	Fixed	PN/BACnet LINK	R
Firmware_Revision	Fixed	e.g. V1.0.0-xxxx xxxx = 4-digit build number	R
Application_Software_Version	Configuration	--	R
Protocol_Version	Fixed	1	R
Protocol_Revision	Fixed	13	R
Protocol_Services_Supported	Dynamic	--	R
Protocol_Object_Types_Supported	Dynamic	--	R
Object_List	Dynamic	--	R
Max_APDU_Length_Accepted	Fixed	1476	R
Segmentation_Supported	Fixed	0 = SEGMENTED_BOTH	R
APDU_Timeout	Fixed	6000 (= 6 s)	R
Number_Of_APDU_Retries	Fixed	3	R
Device_Address_Binding	Dynamic	--	R
Database_Revision	Configuration	--	R
Description	Configuration	--	R
Active_COV_Subscriptions	Dynamic	--	R
Apdu segment timeout	Fixed	5000 (= 5 s)	R
Max_Segments_Accepted	Fixed	32	R

R: Read

All the properties listed in the table can only be read from the BACnet side. Writing of these properties from the BACnet side is not possible.

Note

The device object must be configured even if only client object references are required, since this object must be present in every BACnet device.

4.1.2.2 Binary input

The PN/BACnet LINK supports the object type "Binary input" as server. BACnet objects of the type "Binary input" are inputs on the BACnet side. They are written from the S7 side.

Binary input properties

The following table shows which properties are supported for this object type of the PN/BACnet LINK and from which data source the associated values are filled.

Property	Data source	Value	Access
Object_Identifier	Configuration		R
Object_Name	Configuration		R
Object_Type	Fixed	always "3"	R
Present_Value	Dynamic		R(W)
Status_Flags	Dynamic		R
Event_State	Fixed	always NORMAL	R
Out_Of_Service	Dynamic		R/W
Polarity	Fixed	always NORMAL	R
Description	Configuration		R

R: Read

W: Write

To write the "Present_Value" property, the "Out_of_Service" property must be set to TRUE. When the "Out_of_Service" property is set to TRUE, the BACnet object property "Present_Value" is disconnected from the value of the PLC tag. This means when the "Out_Of_Service" property is TRUE, a value change of the PLC tag does not cause a value change of the BACnet object property "Present_Value".

The property "Out_Of_Service" can be read and written from the BACnet side.

All the other properties listed in the table can only be read from the BACnet side.

4.1.2.3 Binary output

The PN/BACnet LINK supports the object type "Binary output" as server. BACnet objects of the type "Binary output" are outputs on the BACnet side. They are read from the S7 side.

Binary output properties

The following table shows which properties are supported for the object type "Binary output" of the PN/BACnet LINK and from which data source the associated values are filled.

Property	Data source	Value	Access
Object_Identifier	Configuration		R
Object_Name	Configuration		R
Object_Type	Fixed	always "4"	R
Present_Value	Dynamic		R/W
Status_Flags	Dynamic		R
Event_State	Fixed	always NORMAL	R
Out_Of_Service	Dynamic		R/W
Polarity	Fixed	always NORMAL	R
Priority_Array	Dynamic		R
Relinquish_Default	Configuration		R
Description	Configuration		R

R: Read

W: Write

The "Present_Value" and "Out_Of_Service" properties can be read from the BACnet page and also written to it.

All the other properties listed in the table can only be read from the BACnet side.

4.1.2.4 Analog input

The PN/BACnet LINK supports the object type "Analog input" as server. BACnet objects of the type "Analog input" are inputs on the BACnet side. They are written from the S7 side.

Analog input properties

The following table shows which properties are supported for this object type of the PN/BACnet LINK and from which source the associated values are filled.

Property	Data source	Value	Access
Object_Identifier	Configuration		R
Object_Name	Configuration		R
Object_Type	Fixed	always "0"	R
Present_Value	Dynamic		R(W)
Status_Flags	Dynamic		R
Event_State	Fixed	always NORMAL	R
Out_Of_Service	Dynamic		R/W
Units	Configuration		R
COV_Increment	Configuration		R
Description	Configuration		R

R: Read

W: Write

To write the "Present_Value" property, the "Out_of_Service" property must be set to TRUE. When the "Out_of_Service" property is set to TRUE, the BACnet object property "Present_Value" is disconnected from the value of the PLC tag. This means when the "Out_Of_Service" property is TRUE, a value change of the PLC tag does not cause a value change of the BACnet object property "Present_Value".

The property "Out_Of_Service" can be read and written from the BACnet side.

All the other properties listed in the table can only be read from the BACnet side.

Note

With a COV increment of 0, the value of "Present_Value" is constantly transmitted even if it does not change.

4.1 BACnet objects

4.1.2.5 Analog output

The PN/BACnet LINK supports the object type "Analog output" as server. BACnet objects of the type "Analog output" are outputs on the BACnet side. They are read from the S7 side.

Analog output properties

The following table shows which properties are supported for this object type of the PN/BACnet LINK and from which source the associated values are filled.

Property	Data source	Value	Access
Object_Identifier	Configuration		R
Object_Name	Configuration		R
Object_Type	Fixed	always "1"	R
Present_Value	Dynamic		R/W
Status_Flags	Dynamic		R
Event_State	Fixed	always NORMAL	R
Out_Of_Service	Dynamic		R/W
Units	Configuration		R
Priority_Array	Dynamic		R
Relinquish_Default	Configuration		R
COV_Increment	Configuration		R
Description	Configuration		R

R: Read

W: Write

The properties "Present_Value" and "Out_Of_Service" can be read and also written from the BACnet side. All the other properties listed in the table can only be read from the BACnet side.

Note

With a COV increment of 0, the value of "Present_Value" is constantly transmitted even if it does not change.

4.1.3 Client object references

Client object references are references to BACnet objects which are located in other BACnet devices.

If the PN/BACnet LINK does not require any server objects, which means only client object references are configured, the device object must still be configured.

Supported object references

The PN/BACnet LINK supports object references to the following BACnet objects:

- Binary input
- Binary output
- Analog input
- Analog output

The supported object references are defined on configuration of the PN/BACnet LINK.

When configuring, the following should be specified:

- To which BACnet object on which BACnet device the client object reference in the PN/BACnet LINK is referring to.
- How access to this object is handled

4.1.4 Supported BACnet services (BIBB)

Supported BIBB

BIBB	Description
DS-COV-A	The PN/BACnet LINK works as a Client and is able to register with other objects for notification when a value changes. The service "SubscribeCOV" is used for this.
DS-COV-B	The PN/BACnet LINK works as a Server and responds to "SubscribeCOV" packages which are received from other BACnet devices in the PN/BACnet LINK. Notification of these devices if a value changes is performed via the service "ConfirmedCOVNotification" or "UnconfirmedCOVNotification". The service used depends on the parameters contained in the received "SubscribeCOV" package. Note: The server functionality of the PN/BACnet LINK does not support an infinite lifetime for a COV subscription.
DM-DDB-A	The PN/BACnet LINK works as a Client and is able to request the identification of other BACnet devices via the service "Who-Is". This service is used for scanning a BACnet network.
DM-DDB-B	The PN/BACnet LINK works as a Server and responds to "Who-Is" requests which are received from other BACnet devices in the PN/BACnet LINK with an "I-Am" answer.
DM-DOB-B	The PN/BACnet LINK works as a Server and responds to "Who-Has" requests which are received from other BACnet devices in the PN/BACnet LINK with an "I-Have" answer.
DS-RP-A	With configured Client object references to input objects (BI, AI), the PN/BACnet LINK requires this BIBB to be able to read properties from these objects.
DS-RP-B	The PN/BACnet LINK works as a Server and responds to "ReadProperty" requests which are received from other BACnet devices in the PN/BACnet LINK.
DS-WP-A	With configured Client object references to output objects (BO, AO), the PN/BACnet LINK requires this BIBB to be able to write properties to these objects.
DS-WP-B	The PN/BACnet LINK works as a Server and responds to "WriteProperty" requests which are received from other BACnet devices in the PN/BACnet LINK.
GW-EO-B	The PN/BACnet LINK assumes the representation of the S7 controller in the BACnet network. The object types listed in the section Server objects (Page 23) are supported.

4.2 State model

The configuration made in HSP is transmitted to the PN/BACnet LINK in the startup phase of the S7 controller. This configuration information is stored in the S7 controller and not in the PN/BACnet LINK.

Controlling the server and client status

Client functionality

The data transfer is controlled via a control byte (Page 33) which is transmitted cyclically by the S7 controller to the PN/BACnet LINK as part of the I/O data.

If the bit for controlling the client functionality is set to OFF, the I/O data is not transmitted between the PN/BACnet LINK and the BACnet network. Transmission is only activated when the control bit is set to ON.

Server functionality

The system status in the device object is controlled via a control byte (Page 33). The S7 controller also transmits this control byte cyclically as part of the I/O data to the PN/BACnet LINK.

The control byte can contain the following values:

Value of control byte	Reaction
OPERATIONAL	• "Out_Of_Service" flags of all server objects are updated. • "Out_of_Service" property can be written from outside in this state.
NON_OPERATIONAL	• "Out_Of_Service" flags of all server objects are set to TRUE. • "SubscribeCOV", "WriteProperty", "ReadProperty" on server objects are rejected. • Subscribers using the SubscribeCOV service are notified (Notification).
OPERATIONAL_READ_ONLY	• "WriteProperty" is rejected. • "ReadProperty"/"SubscribeCOV" are accepted. • "Out_Of_Service" flags of all server objects are still updated.

PN/BACnet LINK states

The status of the PN/BACnet LINK is influenced by the status of the PROFINET connection and the status of the S7 controller.

The following table shows the dependency of the PN/BACnet LINK state from the status of the PROFINET connection and from the state of the S7 controller.

Scenario PN state	Reaction
PN/BACnet LINK was never connected to the S7 controller or has not yet been configured since startup.	The PN/BACnet LINK is not visible in the network.
S7 controller connected / PN/BACnet LINK not yet configured	The PN/BACnet LINK state is CONFIGURATION. - The PN/BACnet LINK receives the necessary configuration data from the S7 controller. - The PN/BACnet LINK applies the configuration data from the S7 controller and creates the server objects as well as configured BACnet object references. - If configured as third-party device: PN/BACnet LINK registers at the specified BBMD and waits for the end of the registration.
S7 controller connected / PN/BACnet LINK configured / no cyclic PROFINET data exchange or data from the S7 controller have the IO provider status "BAD"	The PN/BACnet LINK state changes to STOP mode (NON_OPERATIONAL). - All BACnet Server objects are set to "Out_Of_Service" = TRUE. "System_Status" property in the device object is set to NON_OPERATIONAL. - The device object is visible in the BACnet network. All requests directed to other server objects are rejected with an error. - BACnet client: When object references are configured and the client control bit is set to "ON" BACnet communication starts.
Cyclic PROFINET data exchange is active and data from the S7 controller has IO provider status "GOOD"	The PN/BACnet LINK state changes to RUN (OPERATIONAL). - Status of "Out_Of_Service" is according to the process image of the S7 controller "System_Status" property in the device object is set to OPERATIONAL or according to the server control byte. - BACnet server: Requests are processed according to their system status. - BACnet client: When object references are configured and the client control bit is set to "ON" communication with the BACnet devices starts.

S7 controller goes into STOP operating state.	The PN/BACnet LINK state changes to STOP (NON_OPERATIONAL). • All BACnet Server objects are set to "Out_Of_Service" = TRUE. • "System_Status" property in the device object is set to NON_OPERATIONAL. • BACnet server: The device object is visible in the BACnet network. All requests directed to other server objects are rejected with an error. • BACnet client: All requests to BACnet devices are still being sent.
SIMATIC S7 goes into RUN operating state	The PN/BACnet LINK state changes according to a status according to the server control byte. Possible states are: OPERATIONAL/NON-OPERATIONAL or OPERATIONAL-READ-ONLY. • "Out_Of_Service" of all BACnet server objects updated according to the process image • If the client control bit is set to "ON", the BACnet client starts the BACnet communication. • "System_Status" property in the device object is set to according to the server control byte in the process image of the S7 controller.
Termination of the S7 connection (after the PN/BACnet LINK has been configured once by the S7 controller)	The PN/BACnet LINK state changes to STOP (NON_OPERATIONAL). • All BACnet Server objects are set to "Out_Of_Service" = TRUE. • "System_Status" property in the device object is set to NON_OPERATIONAL. • BACnet server: The device object is visible in the BACnet network. All requests directed to other server objects are rejected with an error. • BACnet client: No requests are sent to BACnet devices any longer. Existing subscriptions are canceled.
Reconfiguration by S7 controller	The PN/BACnet LINK state changes to CONFIGURATION. • Existing custom BACnet client subscriptions and BACnet server objects are deleted. • The PN/BACnet LINK receives the necessary configuration data from the S7 controller. • When configuration is complete, the PN/BACnet LINK begins with the BACnet communication.

The configured read and write functions are still executed in the STOP state. This means that PN/BACnet LINK still communicates on the BACnet side. Only cyclic communication with the S7 controller is interrupted. With write accesses, this means that the PN/BACnet LINK is sending obsolete values to the configured BACnet devices in STOP mode.

4.3 Cyclic data exchange between controller and PN/BACnet LINK

4.3.1 Data exchange between controller and PN/BACnet LINK

Cyclic data exchange

The cyclic data exchange between S7 controller and the PN/BACnet LINK is performed via PROFINET IO.

The data to be transferred belong to the IO process image of the S7 controller. This data is written to the "Present_Value" property of the BACnet objects defined during configuration or read from there. With a read operation, in addition to the actual value, the status of this value is also transmitted in the cyclic process image. This status results from the "Status_Flags" property of the associated object.

With write operations, in addition to the value to be transmitted, its status must also be set by the S7 program. This status is then transferred to the "Status_Flags" property of the corresponding BACnet object.

With PROFINET IO, a maximum of 1440 bytes of data (user data and associated data) can be exchanged in each cycle for each transmission direction.

Data formats

The values of "Binary input" and "Binary output" objects are transferred as bytes in each case. The actual value of these objects is transmitted in the least significant bit.

The values of "Analog input" and "Analog output" objects are each transferred as float32 values. For 32-bit floating-point values, a format conversion is performed between the format used in the S7 controller and the format used for the REAL data type in the BACnet network (endianness correction).

Status and control information of BACnet server

The PN/BACnet LINK cyclically transmits the following status information to the S7 controller:

Table 4- 1 Current status of the server in the PN/BACnet LINK (1 byte input address)

Bit	Meaning	Value		Remarks
7	Status of the connection from the PN/BACnet LINK to the S7 controller	0	S7 controller has no connection with the PN/BACnet LINK	If the connection between the S7 controller and the PN/BACnet LINK is interrupted, this bit is automatically set to 0 by the S7 controller.
		1	Cyclic data exchange takes place	
5 ... 6	Not assigned	--	--	--
4	Error bit for feedback on control action	0	No error, control information taken over	A feedback message to a performed control action is output via bit 4. In the event of an error (bit 4 = 1), the current control information is not applied. The current system status remains unchanged.
		1	Error, control information not applied	
0 ... 3	"System_Status" of server	0	OPERATIONAL	The S7 controller can read out the current system status of the Server function on the PN/BACnet LINK via the value in bits 0 to 3.
		1	OPERATIONAL_READ_ONLY	
		4	NON_OPERATIONAL	

The S7 controller cyclically transmits the following control information to the PN/BACnet LINK:

Table 4- 2 Control byte for the server functionality in the PN/BACnet LINK (1 byte output address)

Bit	Meaning	Value		Remarks
4 ... 7	Not used	--	--	--
0 ... 3	Controlling the "System_Status"	0	OPERATIONAL	The S7 controller can control the current system status of the server function via the value in bits 0 to 3. This control byte also influences the "Status_Flags" properties.
		1	OPERATIONAL_READ_ONLY	
		4	NON_OPERATIONAL	

Status and control information of BACnet client

The PN/BACnet LINK cyclically transmits the following status information to the S7 controller:

Table 4- 3 Status of the client functionality (1 byte input address)

Bit	Meaning	Value		Remarks
1 ... 7	Not used	--	--	--
0	Current status of the client functionality	0	Client function OFF	The S7 controller can read the current status of the Client functionality of the PN/BACnet LINK via bit 0. The read status indicates whether the transmission of the I/O data between the S7 controller and BACnet is switched on or off.
		1	Client function ON	

The S7 controller cyclically transmits the following control information to the PN/BACnet LINK:

Table 4- 4 Control byte for the client functionality in the PN/BACnet LINK (1 byte output address)

Bit	Meaning	Value		Remarks
1 ... 7	Not used	--	--	--
0	Control the client functionality	0	Switch off client function	The client functionality of the PN/BACnet LINK can be switched on or off by the S7 controller via bit 0. The transmission of the I/O data between the S7 controller and BACnet is switched on or off by this.
		1	Switch on client function	

Note

Several seconds can pass after switching the client functionality on or off using the control byte before the corresponding actions are completed in the PN/BACnet LINK. The time required for this process depends, among other things, on the size of the configuration and the response times of the addressed BACnet devices. The PN/BACnet LINK indicates completion of these actions by updating the corresponding status information in the status byte.

Status information on BACnet objects

The status information of the BACnet objects on the PN/BACnet LINK is exchanged with the S7 controller via the process image.

Server objects

With server objects, the PN/BACnet LINK writes the status information transferred by the S7 controller to the property "Status_Flags" of the corresponding objects.

Client object references

The status information from the property "Status_Flags" of the affected objects is transmitted as input data to the S7 controller.

Note

The flags for client object references do not have a valid value until the corresponding object has been accessed from the PN/BACnet LINK at least once. As long as such access has not taken place, the corresponding "Out_Of_Service" status flag has the value "TRUE" (default). Until the first access this has the meaning "Status not defined". The following applies after the first access: The flags always reflect the status on the last access. The current status of a value may vary from the the status on the last access.

Transmission of status information

With "Binary input" objects, this status information is transmitted in accordance with the table below in the four most significant bits of the byte to be transmitted. With objects of the type "Binary output", "Analog input" and "Analog output" the status information is transmitted in an additional byte.

Bit	Meaning
7	OUT_OF_SERVICE
6	OVERRIDDEN
5	FAULT
4	IN_ALARM
3	Not assigned
2	Not assigned
1	Not assigned
0	Present_Value

Effect of the S7 communication state on the status information of server objects

For server objects, the S7 controller can only affect the OUT_OF_SERVICE status flag. The other status flags are set completely by the PN/BACnet LINK. The state of the OUT_OF_SERVICE status flag which is specified by the S7 controller can be overwritten by internal states of the PN/BACnet LINK.

State of S7 communication	Status information of objects
S7-CPU in RUN mode	The OUT_OF_SERVICE bit is set in the "Status_Flags" Property in all objects based on the S7 status information. The "Out_Of_Service" property represents the "Out_Of_Service" bit from the "Status_Flags". When the bit is updated, the property is also updated accordingly.
S7-CPU in STOP mode	"Out_Of_Service" property of all objects is set to TRUE (1).
Error in PROFINET communication	

4.4 Data exchange between PN/BACnet LINK and other BACnet devices

4.4.1 Data transfer as client

Transmission types

Possible transmission types:

- Transmission on change
- Cyclic transfer

Writing values

For values that are written from the S7 controller to BACnet objects, the user can configure in the HSP whether this write operation is only to be performed in the event of a change of value or cyclically. With cyclic sending, the user can assign parameters for the cycle times.

The cycles start with each activation of the client function by the client control bit. The data is transmitted for the first time at the start of a cycle.

For write operations, the user can set priorities from 1 (highest) to 16 (lowest). The set priority applies globally to all devices and is used for the corresponding "WriteProperty" call.

With the transmission mode "Send if value has changed", the user can specify for each analog value how big a change of value is required to trigger transmission. If "0.0" is specified as the value change, the corresponding analog value is transmitted in the shortest possible cycle.

Reading values

For read values, you can determine whether they are read cyclically or if a registration for a message is to take place in case of value change (COV).

If "Registration for value change" is activated in the configuration, the following procedure applies:

The PN/BACnet LINK checks whether the device supports COV. If the device does not support COV, it is read cyclically automatically. Cyclic reading uses the time set by the user for the update cycle.

If the device supports COV, the PN/BACnet LINK attempts to register for the time interval configured by the user. Once the time interval elapses, the PN/BACnet LINK attempts to register itself again.

If the registration attempt fails, the system automatically reads cyclically.

Causes for a failure of the registration can be, for example, a configured time interval for new registration that is not supported or too many COV subscriptions.

4.4.2 Data transfer as server

Transmission types

Possible transmission types:

- Direct write or read accesses from other BACnet devices
- Sending values if the value changes

Sending values

The maximum lifetime accepted by the PN/BACnet LINK for incoming registration requests is 8 hours. All registration requests with a longer lifetime are rejected by PN/BACnet LINK.

The maximum number of COV subscriptions is 1000. The PN/BACnet LINK rejects any additional registration requests.

4.5 Acyclic data exchange

4.5.1 Acyclic reading and writing of properties of BACnet objects from the S7 user program

Using the acyclic PROFINET IO services RDREC (write data record) and WRREC (write data record), individual "ReadProperty" and "WriteProperty" accesses can be triggered on any BACnet properties.

The corresponding data records are made available by the PN/BACnet LINK on the client module.

The S7 user program can perform 16 property accesses in parallel.

A total of 16 data records are available for the two services "ReadProperty" and "WriteProperty".

The data record indices in use are 0x401 to 0x410.

Note

A data record for a (sub)module in PROFINET is uniquely defined by an "index" that specifies the data record number. The index is a 32-bit integer. Different data records differ in their index.

The user can assign priorities to the acyclic "WriteProperty" calls from the S7 user program. The PN/BACnet LINK supports 16 priority levels.

Note

With property access via the data record mechanism, the PN/BACnet LINK does not adapt the data format. The conversion of the S7 format (Big Endian) to the data format used on the BACnet side (Little Endian) must be coded by the user for the property content in the S7 program.

The parameters contained in the following data record structures are also to be specified in the Big Endian format.

ReadProperty

For a "ReadProperty", the data record must contain the corresponding parameters for the service. The result is located in a data record, which must then be read.

Table 4- 5 WRREC (write data record) - data record structure for "ReadProperty" service

Element	Type	Meaning
PNreq	UINT8	PROFINET service: Property access = 1
BNreq	UINT8	BACnet service: "ReadProperty" = 0x0C = 12
DNET	UINT32	Network number
Device ID	UINT32	BACnet device instance number
ObjectID	UINT32	BACnet ObjectID (type and instance)
PropertyID	UINT32	PropertyID
ArrayIndex	INT32	Property index (-1 = no index)

4.5 Acyclic data exchange

Table 4- 6 RDREC (record read) - data record structure for "ReadProperty" result

Element	Type	Meaning
PNresp	UINT8	PROFINET error number (0 == no error)
BNresp	UINT8	BACnet error number (0 == no error)
DNET/ErrorClass	UINT32	Network number (BNresp == 0)/BACnet error class (BNresp != 0)
Device/ErrorCode	UINT32	BACnet device instance (BNresp == 0)/BACnet error code (BNresp != 0)
ObjectID	UINT32	BACnet ObjectID (type and instance)
PropertyID	UINT32	PropertyID
ArrayIndex	INT32	Property index (-1 = no index)
empty1	UINT16	Not assigned
empty2	UINT16	Not assigned
Len	UINT16	Length of value in bytes
Value	Array	BACnet property value in ASN.1 format (BNresp == 0)

WriteProperty

For a "WriteProperty", in addition to the parameters required for "ReadProperty", the data record must also contain the property value and the priority of the write job.

Table 4- 7 WRREC (Write data record) - RecordWrite data record structure for WriteProperty service

Element	Type	Meaning
PNreq	UINT8	PROFINET service: Property access = 1
BNreq	UINT8	BACnet service: "WriteProperty" = 0x0F = 15
DNET	UINT32	Network number
Device ID	UINT32	BACnet device instance number
ObjectID	UINT32	BACnet ObjectID (type and instance)
PropertyID	UINT32	PropertyID
ArrayIndex	INT32	Property index (-1 = no index)
Priority	UINT16	BACnet priority (1 ... 16)
Data type	UINT16	BACnet data type of the property (according to BACnet specification)
Len	UINT16	Length of value in bytes
Value	Array	BACnet property value in ASN.1 format

The result is located in a data record, which must then be read.

Table 4- 8 RDREC (Read data record) - data record structure for WriteProperty result

Element	Type	Meaning
PNresp	UINT8	PROFINET error number (0 == no error)
BNresp	UINT8	BACnet error number (0 == no error)
DNET/ErrorClass	UINT32	Network number (BNresp == 0)/BACnet error class (BNresp != 0)
Device/ErrorCode	UINT32	BACnet device instance (BNresp == 0)/BACnet error code (BNresp != 0)
ObjectID	UINT32	BACnet ObjectID (type and instance)
PropertyID	UINT32	PropertyID
ArrayIndex	INT32	Property index (-1 = no index)

Error messages

If an error occurs in the PROFINET connection during an acyclic property access triggered by a data record, then the element "PNresp" of the associated reply data record contains the cause of the error.

Table 4- 9 PROFINET error numbers (PNresp)

Error ID	Meaning
0	No error
1	Job buffer already assigned
2	Length (Len) not sufficient for job/result
3	Incorrect data record number
4	Job buffer does not contain a result
5	Job not yet complete

In addition to the above-mentioned error messages, other errors may be reported when data records are accessed, for example, that the specified data record is not present. These causes of error are described in the SIMATIC S7 documentation.

If the reason for a defective property access lies on the BACnet side, then the element "BNresp" of the associated reply data record contains a value not equal to 0. The actual cause of the error is then described in the two elements "ErrorClass" and "ErrorCode". The meaning of these two elements can be found in the BACnet standard.

Table 4- 10 BACnet error numbers (BNresp)

Error ID	Meaning
0	No error
!= 0	Error

4.6 Monitoring functions

Diagnostics with activated device monitoring

For monitoring of configured BACnet devices, the PN/BACnet LINK cyclically requests the property "System_Status" of the devices in question.

The cycle time with which the PN/BACnet LINK reads out the property "System_Status" from other devices can be configured. The configured cycle time applies globally for all devices.

If data is to be written to a device, then all "System_Status" values not equal to OPERATIONAL are classified as an error state.

If data is only to be read from a device, then all the values not equal to OPERATIONAL_READ_ONLY and OPERATIONAL are interpreted as error states.

The PN/BACnet LINK sends diagnostics information to the S7 controller in the following cases:

- An error condition is detected in a configured device.
- The device does not respond to the reading out of the "System_Status" properties.

Note

With activated monitoring, the set monitoring time may act as a delay when a failed device starts working again.

Diagnostics with deactivated device monitoring

When the monitoring of configured BACnet devices is deactivated for the BACnet client, the failure of BACnet devices is still recognized in the following cases and signaled to the S7 controller by means of diagnostics:

- Output references are configured for the BACnet device (references are written cyclically)
- Input references are configured for the BACnet device without COV (references are read cyclically)

This means device monitoring is only necessary when clients exclusively have COV input references.

Use of acyclic services for diagnostic messages

The S7 user can access any property of BACnet objects with "Read data record". This allows the S7 user to read additional information from the affected device if needed.

4.7 Response to errors

Diagnostic resource

The device provides various tools to isolate the cause. These tools are listed below:

Diagnostic resource	Description	Examples of possible causes of error
LED display	The PN/BACnet LINK signals its state with the LEDs on the front of the housing. The meaning of the LEDs is described in section Operating state of the PN/BACnet LINK / PROFINET diagnostics (Page 79).	• Device fault • Configuration error • Network error:
SIMATIC diagnostics	Information on the events that trigger a diagnostic message is available in the section Events that trigger a diagnostic message (Page 83). This section also includes a detailed description of the error that triggers the diagnostic message and possible measures.	• Fault in startup of firmware • Configuration error • Network error:
BACnet status bit OUT_OF_SERVICE	See section Data exchange between controller and PN/BACnet LINK (Page 33)	• Configuration error • Network error: • Error in the control program
BACnet system state	See section Data exchange between controller and PN/BACnet LINK (Page 33)	• Configuration error • Network error: • Error in the control program

Below you will find a list of possible error situations and the corresponding response of the PN/BACnet LINK.

Configuration error

During configuration, defective inputs and parameters are largely detected and reported through compilation of the TIA Portal project. If the configuration does not correspond to the associated system, error situations arise such as configuration errors (see following section).

Configuration error

If there is a configuration error, the configuration does not match the corresponding system, or the system configuration changes in runtime. For example, BACnet objects are no longer accessible or devices have been removed. The PN/BACnet LINK supports locating the cause of the error as follows:

- If a configured BACnet object does not exist, the PN/BACnet LINK runs SIMATIC diagnostics and sets the OUT_OF_SERVICE status bit for the S7 controller.
- If a configured BACnet device does not exist, the PN/BACnet LINK runs SIMATIC diagnostics and sets the OUT_OF_SERVICE status bits for all objects of this device for the S7 controller.

PROFINET network error

If the PN/BACnet LINK loses the PROFINET connection, the PN/BACnet LINK performs the following actions:

- The PN/BACnet LINK sets the OUT_OF_SERVICE status bits of all server objects.
- The PN/BACnet LINK allocates the system state in the device object with NON_OPERATIONAL.

This happens, for example, if the S7 controller is switched off or the network connection on the PROFINET side is interrupted.

Once the PROFINET connection is available again, the device behaves as after a reboot. This means, among other things, that all subscriptions from other devices are lost on the server. Data exchange only resumes again after a renewed logon call of the affected devices.

Network error BACnet

If the PN/BACnet LINK loses the BACnet network connection, the PN/BACnet LINK runs corresponding SIMATIC diagnostics.

Error in the control program

If the desired device functions (server, client) are not activated by the user program, the associated functionalities are not available to the network interfaces.

For example, no data should be transferred between the PROFINET side and the BACnet side.

Device fault

Device errors are indicated by the status LEDs. If necessary, corresponding diagnostic messages are also issued. These can then be taken from the diagnostic buffer of the S7 controller either immediately or during the next start-up.

Note

An Ethernet switch is integrated in the PN/BACnet LINK. This switch is also operational in an error state so that the PROFINET network continues to run.

Application planning

5.1 Installation guidelines

General installation guidelines

The following guidelines must be observed when installing and connecting the PN/BACnet LINK:

- When connecting the PN/BACnet LINK, make sure that you observe all applicable and legally binding standards. Adhere to the relevant national and regional regulations when installing and operating the device. Check with the local authorities regarding the standards and rules to be followed in your particular case.
- Ensure a zero-voltage state during assembly and connection work.
- Adhere to the installation and wiring guidelines of your automation system and the BACnet system.

Guidelines for installation of PN/BACnet LINK devices

- The PN/BACnet LINK is classified as open equipment based on standards for electrical devices.
- You must install the PN/BACnet LINK in an enclosure, control cabinet or in a control center. The enclosure, control panel or control center may be located in residential areas, business and commercial areas or in a small business.
- Only authorized personnel must have access to the enclosure, control cabinet or control center.
- Installation and operation of the PN/BACnet LINK is only permitted in a dry environment.
- Only one connection to SELV circuits is permitted. Only SELV circuits offer protection from electric shock in a dry environment.
- The installation must offer the required mechanical protection and environmental protection for open equipment in your specific location category according to the applicable electrical regulations and building code.
- Proper grounding and wiring of the PN/BACnet LINK is important for optimal operation and for sufficient immunity of your system and your application.

5.2 Installation location

Selection of the installation site / installation

You can install the PN/BACnet LINK either in a control panel or on a standard mounting rail:

Installation in control cabinet / device connection box

NOTICE

The device is intended for installation in a control cabinet or in a device connection box.

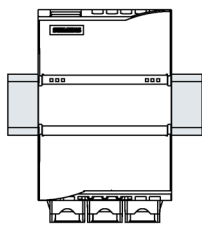
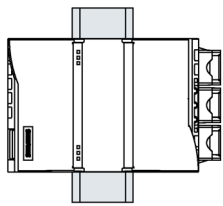
It is important to note that installation in a control cabinet or device connection box is essential for compliance with the UL regulations.

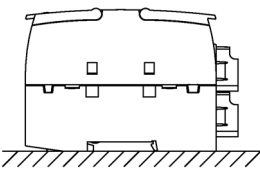
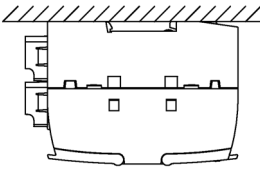
The control cabinet / device connection box must satisfy the regulations regarding fire-protection housing.

Ensure that all cables and leads that protrude externally are equipped with adequate strain relief.

Permitted mounting positions and permitted ambient temperature

The table below show the permitted temperature range for the different mounting positions.

Mounting position		Permitted ambient temperature
Horizontal		-25 ... +60 °C
Vertical		-25 ... +55 °C

Mounting position		Permitted ambient temperature
Lying		-25 ... +45 °C
Hanging		-25 ... +45 °C

NOTICE

Damage due to overheating

You must comply with all the instructions regarding the installation site and mounting position. Otherwise, the device may malfunction or incur permanent damage as a result of overheating.

Minimum spacing

The PN/BACnet LINK is designed for natural heat dissipation through convection. Therefore observe sufficient clearances:

- For horizontal mounting position: At least 35 mm above and below the PN/BACnet LINK
- For vertical mounting position: At least 35 mm to the left and right of the PN/BACnet LINK

Provide sufficient space for the connection of supply voltage, Ethernet and BACnet bus.

Also make sure that a depth of at least 25 mm remains clear between the module front and the inside of the enclosure / control panel.

Table 5- 1 Device dimensions

PN/BACnet LINK dimensions	
Width	70 mm
Height	111.5 mm (including overhangs)
Depth	75 mm (including overhangs)

The dimension drawing of the PN/BACnet LINK is available in the section Dimension drawing (Page 92).

Humidity and atmospheric pressure

Ensure that there is no condensation at a relative humidity between 10% and 95%.

Ensure that the atmospheric pressure is between 795 hPa and 1080 hPa. This corresponds to an installation height of -1000 m to +2000 m.

Pollution degree

The PN/BACnet LINK is designed for pollution degree 2. Pollution degree 2 according to the EN 50178 standard is non-conductive contamination in the normal case which can briefly become conductive as a result of condensation when the device is not in operation.

Pollution of conductive parts through dust, humidity and air pollution can result in fault conditions and electrical faults in the PN/BACnet LINK.

Degree of protection

The housing of the PN/BACnet LINK has IP20 degree of protection according to IEC 60529.

The PN/BACnet LINK is also rated as "open type" or "open equipment" according to UL 61010-2-201 or IEC 61010-2-201.

If the PN/BACnet LINK is located in an area in which pollution of conductive parts can occur, the PN/BACnet LINK must be protected by an enclosure with the corresponding degree of protection. IP54 is a protection class that is generally used for electronic systems in heavily polluted environments and may be suitable for your application.

Electromagnetic compatibility (EMC) / overvoltage protection

NOTICE
Damage to the device
Inadequately dimensioned overvoltage protection can result in severe damage to the device. Always ensure, therefore, that the overvoltage protection is adequate (see Chapter 24 V DC power supply (Page 55)).

5.3 Transportation

The devices must be transported in a clean and dry state, preferably in their original packaging. The transport temperature must be between -40 °C and +70 °C. Temperature fluctuations greater than 20 K per hour are not permitted.

5.4 Storage

The devices must be stored in clean and dry rooms, preferably in their original packaging. The storage temperature must be between 40 °C and +70 °C.

5.5 Scope of delivery

- PN/BACnet LINK
- 3 retaining collar for the Ethernet connections (plugged into the device when delivered)
- Insert
- DVD with license terms

Unpacking and checking the delivery

1. Unpack the device.
2. Check the delivery for completeness.
3. Check the device for transport damage by visual inspection.

NOTICE
Damage to the system Damaged parts can result in damage to the system. Do not use devices that show evidence of damage!

Mounting/Extending

6.1 Installing the device

The PN/BACnet LINK can be mounted to a 35 mm standard mounting rail according to DIN EN 60715 or installed on a control panel.

Information on the selection of the location of use as well as reliable mounting positions and minimum clearances is available in the section Installation location (Page 46).

Mounting on a standard mounting rail

Follow these steps:

1. Mount the PN/BACnet LINK on the mounting rail.
2. Swivel the PN/BACnet LINK backwards until it engages audibly.



Figure 6-1 PN/BACnet LINK rail mounting

NOTICE

If the device is not installed on a control panel, the mounting sliders (see figure Control panel mounting item ①) must always be in the default positions set at the factory. Otherwise, the mounting slides can deform if they are exposed to hot and moist ambient conditions for long periods.

Mounting to a control panel

Preparations

- Drill holes (M4). The dimensions for the drill holes are available in the figure below.
- Remove the retaining collar on the BACnet connection. This is required so that you can screw in the fixing screw later.

Mounting

Proceed as follows:

1. Move the sliders ① to the outside until they latch in place.
2. Fasten the PN/BACnet LINK. Use a cylinder head screw M4 as well as a spring lock washer and a flat washer for this.

NOTICE

Do not use a countersunk head screw.

The type of screw required depends on the type of material on which the module is mounted. Fasten the screw with the corresponding torque until the spring lock washer is pressed flat.

Do not fasten the screws with excessive torque.

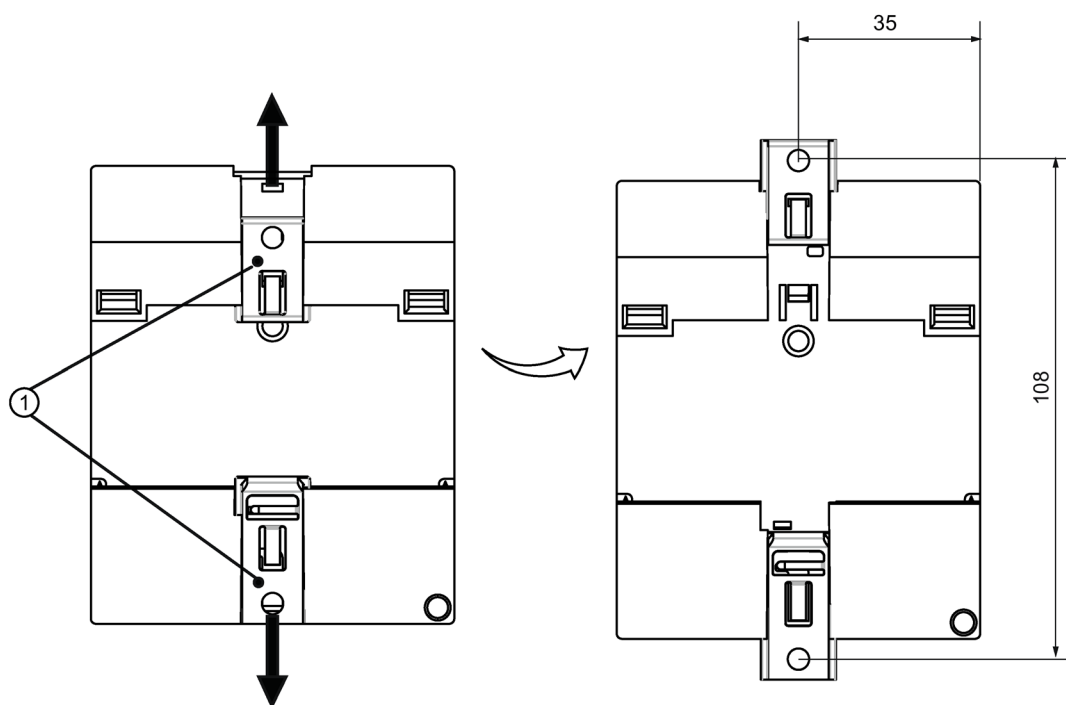


Figure 6-2 Control panel mounting of PN/BACnet LINK

Connecting

7.1 Safety instructions and guidelines

Safety information

 WARNING
Connection only over safety extra-low voltage / protective extra-low voltage May cause death or serious injury The device is designed for operation using directly connectable safety extra-low voltage (SELV) with safe electrical separation according to IEC 60950-1 / EN 60950-1 / VDE 0805-1 or IEC 61131-2 / EN 61131-2 / DIN EN 61131-2. To maintain the safety property of the low voltage circuits of the PN/BACnet LINK, the 24 V rated power supply as well as external connections to communication ports must be supplied from reliable sources that meet the requirements for SELV / PELV limited voltage sources according to different standards. Therefore only connect safety extra-low voltages (SELV) with safe electrical separation according to IEC 60950-1 / EN 60950-1 / VDE 0805-1 to the supply voltage connections and the communications interfaces.

Working on the device or on connected components

 WARNING
Risk of electric shock May cause death or serious injury • Voltages > 60 V DC or 30 V AC are present in the control cabinet. Therefore appropriate safety precautions must be taken to prevent contact during commissioning and maintenance work. • Before carrying out any work on the PN/BACnet LINK or on connected components, make sure that the installation is in a zero-voltage state.

Wiring guidelines

When wiring the PN/BACnet LINK, observe the wiring guidelines of your automation system (e.g. SIMATIC S7-1200, SIMATIC S7-1500, SIMATIC ET 200SP).

Also observe the installation instructions and configuration guidelines for routing of the PROFINET cables.

Cable routing and grounding

Note**Electromagnetic interference**

Ensure that adequate equipotential bonding is implemented for all plants or systems in which the PN/BACnet LINK is installed, for example, using a low-impedance connection to a ground potential.

Note**Strain relief**

Ensure that all cables and leads that protrude externally are equipped with adequate strain relief.

Other requirements

NOTICE
Damaged cables • The cables must be suitably dimensioned to ensure that they cannot be damaged. Make sure that the cables are suitable for the individual application. • Observe the bending radii.
CAUTION
For system for UL approval: The cables must be specified for an ambient temperature of at least +75 °C.

7.2 Potential ratios

Electrical isolation

Electrical isolation for the PN/BACnet LINK exists between the following switching components:

- The signals of the PROFINET interfaces are galvanically isolated from each other, from the electronics or 24 V supply voltage and from the fieldbus interfaces.
- The BACnet interface is galvanically isolated from the power supply.

Shielding

The shields of the PROFINET interface are galvanically connected.

NOTICE

Sufficient interference immunity is only achieved through EMC compliant application of the cable shields of the PROFINET and BACnet cables to a shield rail.

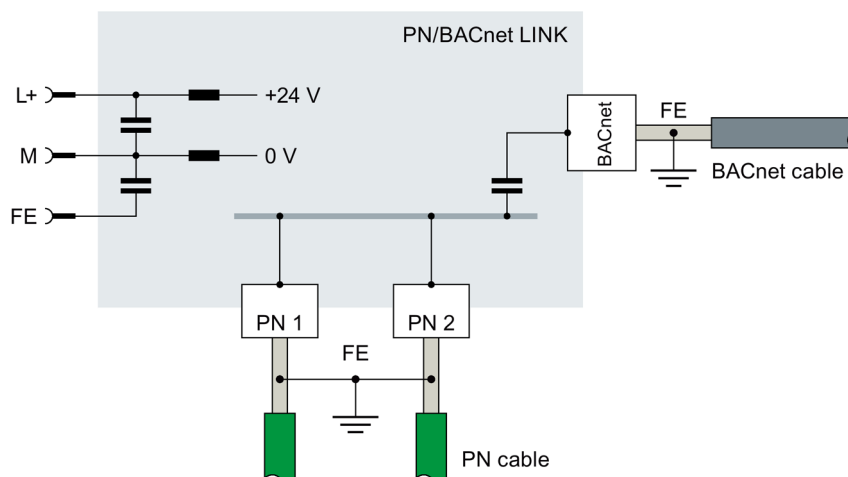


Figure 7-1 Block diagram shielding

7.3 24 V DC power supply

24 V DC power supply

The connection of the external 24 V power supply and the functional earth connection takes place via a 3-pin screw-type terminal. It is located below the top housing cover (see Design (Page 19)).

A suitable power supply is, for example, SIMATIC S7-1200 Power Supply PM1207 (6EP1332-1SH71).

Safety information

WARNING

Connection only over safety extra-low voltage / protective extra-low voltage

May cause death or serious injury

The device is designed for operation using directly connectable safety extra-low voltage (SELV) with safe electrical separation according to IEC 60950-1 / EN 60950-1 / VDE 0805-1 or IEC 61131-2 / EN 61131-2 / DIN EN 61131-2.

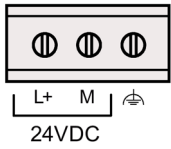
To maintain the safety property of the low voltage circuits of the PN/BACnet LINK, the 24 V rated power supply as well as external connections to communication ports must be supplied from reliable sources that meet the requirements for SELV / PELV limited voltage sources according to different standards.

Therefore only connect safety extra-low voltages (SELV) with safe electrical separation according to IEC 60950-1 / EN 60950-1 / VDE 0805-1 to the supply voltage connections and the communications interfaces.

Connector pin assignment

The figure below shows the assignment of the terminal for the 24 DC power supply.

Table 7- 1 Terminal assignment for the 24 DC power supply

	L+	24 V supply for PN/BACnet LINK (+)
	M	24 V supply for PN/BACnet LINK (-)
		Functional ground

Permissible torques for screw terminal:

- Minimum tightening torque: 0.5 Nm
- Maximum tightening torque: 0.6 Nm

External lightning protector

An external lightning protector can be installed in the 24 V DC supply line to protect against powerful pulses on the supply lines:

We recommend the Dehn Blitzductor BXT ML2 BD 180, article number 920 247 (on basis BXT BAS) or an equivalent protection element.

Manufacturer:

DEHN+SOEHNE GmbH+Co.KG, Hans-Dehn-Str.1, Postfach 1640, D-92306 Neumarkt, Germany The lightning protection module must be installed and used in accordance with the manufacturer's specifications.

7.4 Connecting the functional ground

Connect the ground (e.g. from mounting rail) for discharge of EMI, such as bursts or surges, to the FE terminal (see 24 V DC power supply (Page 55)).

Permissible conductor cross-section:

- 0.5 - 6 mm², AWG 26 - AWG 12

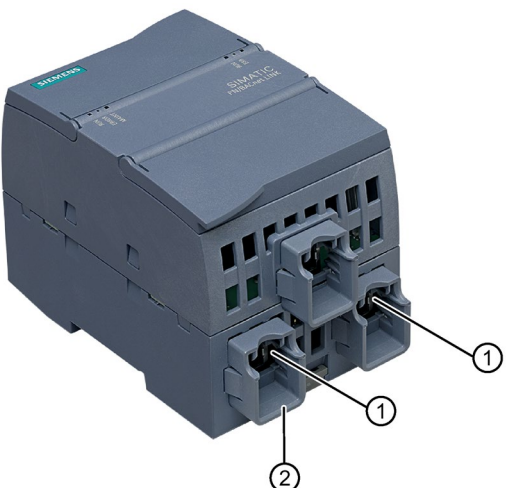
Note

EMC-compliant functional grounding

- Use as short a stranded-wire conductor as possible with a large cross section.
- Compliance with the technical specifications of the device is only assured with a correct functional ground connection.

7.5 Connecting PROFINET

Connecting PROFINET

PROFINET connection	
 Connecting PROFINET	Connect Ethernet cable according to PROFINET specification to higher-level controller and / or the next PROFINET node ①. Use a shielded Ethernet cable with shielded connector for the connection. We recommend RJ45 connectors from the Siemens FastConnect system as connectors for the Ethernet cabling. Always apply the shields of the PROFINET Ethernet cable at both ends.

Note

To increase the mechanical stability, optimized retaining collars ② for the two Ethernet connectors are installed on the bottom part of the housing of the PN/BACnet LINK in the delivery state. These retaining collars are intended for the Siemens FastConnect connectors.

NOTICE

Make sure you observe the minimum bending radius of the Ethernet cable; otherwise the shield effect of the cable shield may be impaired. There is also the risk that the cable shield breaks.

NOTICE

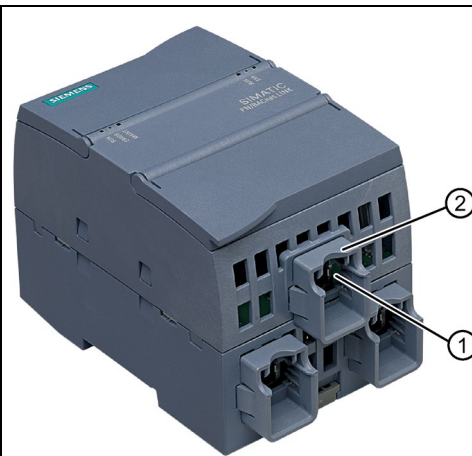
EMC stability is only guaranteed with shielded PROFINET cables.

**CAUTION****Critical plant state**

The Ethernet switch installed in the PN/BACnet LINK is only in operation after run-up of the PN/BACnet LINK. A restart of the PN/BACnet LINK interrupts the Ethernet switch function.

Existing Ethernet connections over the switch are interrupted for the duration of the PN/BACnet LINK startup. This can result in critical plant states.

7.6 Connecting BACnet bus



Connecting BACnet

The PN/BACnet LINK is connected to the BACnet bus using an Ethernet cable with an RJ45 connector ①. Use a shielded Ethernet cable (CAT5e) with a shielded connector.

Note

To increase the mechanical stability, a retaining collar ② for the BACnet connector is installed on the bottom part of the housing of the PN/BACnet LINK in the delivery state. This retaining collar is intended for the Siemens FastConnect connectors.

Commissioning

8.1 Commissioning the PN/BACnet LINK

Prerequisites

- The PN/BACnet LINK is installed and connected to a SIMATIC S7 CPU via PROFINET.
- The BACnet-Bus is connected to the PN/BACnet LINK.
- The PN/BACnet LINK and all other components are wired and connected.

Basic commissioning procedure

After commissioning of the hardware perform the additional steps required for commissioning in the TIA Portal.

TIA Portal

1. Checking in the TIA Portal whether the "PN/BACnet LINK" module exists in the hardware catalog.
If necessary, download and install the HSP "HSP0214 PN/BACnet LINK" from Siemens Service&Support (<http://support.automation.siemens.com>).
2. Assign a PROFINET device name and an IP address for the PN/BACnet LINK.
3. Creating a project
4. Configuration using HSP in the TIA Portal (see also Configuring / Programming (Page 61)).
5. Download project to the S7 CPU
6. Set the SIMATIC-CPU to RUN mode. The corresponding configuration data is automatically downloaded from the S7-CPU to the PN/BACnet LINK.
7. Set this to the "OPERATIONAL" state from the S7 program via the control word for the sever. If client functionality is required, also activate the client functionality in the control byte (Page 33)for the client.
If the RUN LED is lit, this indicates that the device is in error-free operating state. Illumination of the right RUN LED indicates that BACnet communication is running without problem.

Note

The complete startup of the PN/BACnet LINK (initialization of the firmware, transfer of the configuration data and run-up of the PROFINET and BACnet communication) takes several seconds, depending on the complexity of the configuration.

Result

Successful commissioning of the PN/BACnet LINK.

Configuring / Programming

9.1 Overview

The PN/BACnet LINK is configured in the TIA Portal. Configuration mainly comprises the following steps:

1. Dragging PN/BACnet LINK from the HW catalog to the project
2. S7 controller and PN/BACnet LINK via PROFINET
3. Setting the PROFINET-specific parameters
4. Setting the BACnet-specific communication parameters
5. For server functionality:
 - configure device object
 - Configure server objects
6. For client functionality:
 - Configure client
 - Import BACnet device modules or create them manually
 - Configure I/O object references
 - If not already done for server functionality, configure device object
7. Checking and compiling the configuration

The following section contains concise descriptions of the configuring steps for the PN/BACnet LINK:

The descriptions are not based on any specific example configurations. They are intended to illustrate the basic method for configuring the PN/BACnet LINK and to provide a fast introduction to configuring the PN/BACnet LINK.

The versions refer to the TIA Portal V14.

Note

TIA Portal Openness

The PN/BACnet LINK supports only mandatory attributes in TIA Portal Openness.

9.2 TIA Portal Devices & Networks

TIA Portal: Devices & networks

Follow these steps:

1. Select the PN/BACnet LINK with its specific article number from the HW catalog ①. The PN/BACnet LINK appears in the "Devices & networks" window.
2. Connect the CPU and PN/BACnet LINK with a PROFINET connection. CPU and PN/BACnet LINK are connected in the "Devices & networks" window with a green PN line ②.
3. Assign the parameters of the PROFINET interface of the PN/BACnet LINK ③ according to the configuration of your PROFINET network.

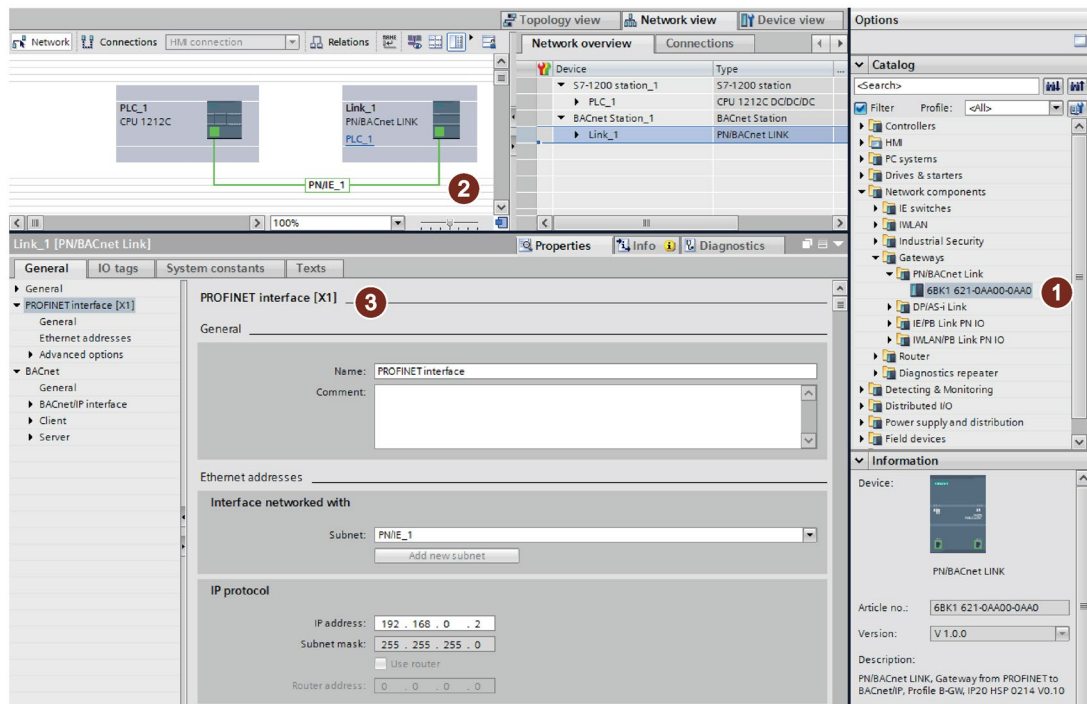


Figure 9-1 TIA Portal Devices & Networks

9.3 Configuring the BACnet/IP interface

Communication settings for the BACnet/IP interface

1. Enter the communication settings for the BACnet/IP protocol ①.
Specify the standard gateway of the BACnet subnet in which the PN/BACnet LINK is located as the default gateway. Network ID is the ID of the BACnet network in which the PN/BACnet LINK is located.
Server and client always use the same port number.
2. If you are required by your system environment, activate the foreign device registration by setting the check mark ②. The IP address to be specified refers to the BACnet/IP Broadcast Management Device (BBMD) that manages the foreign device registration.

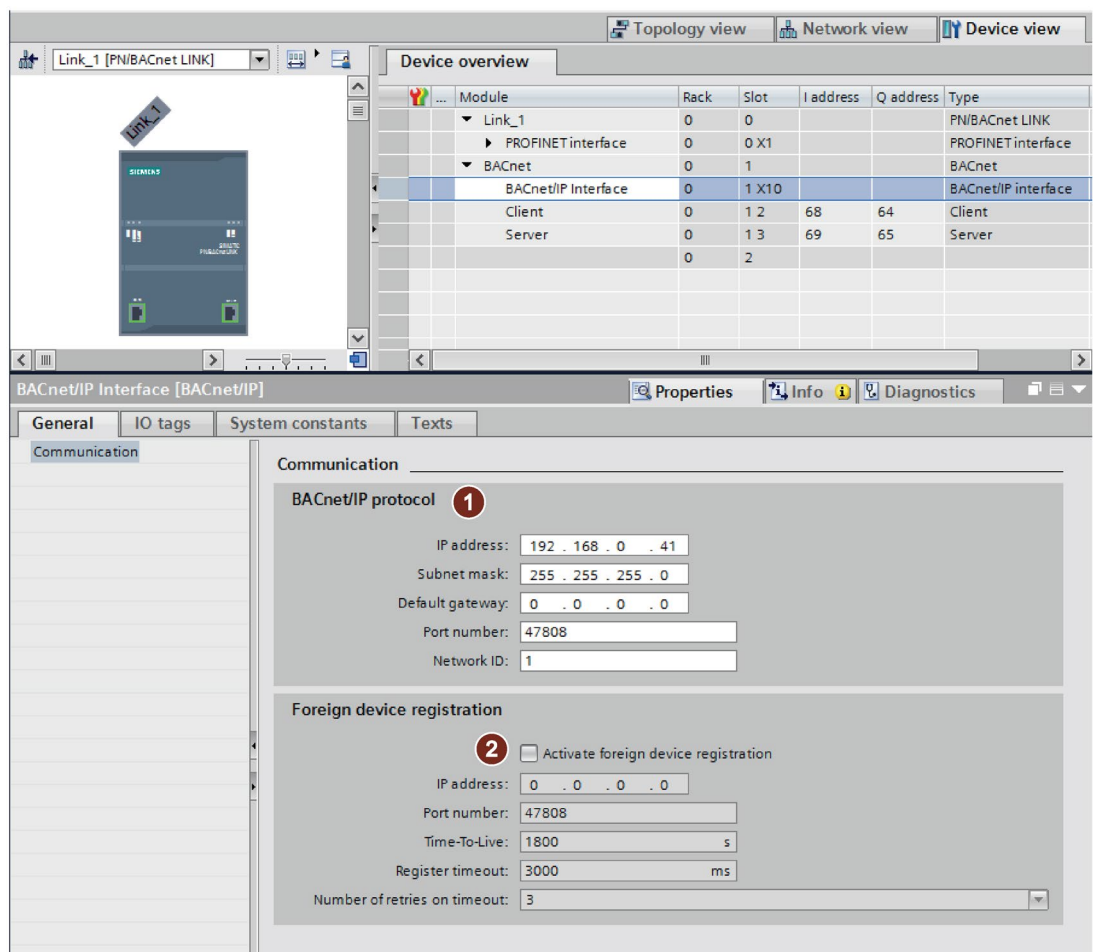


Figure 9-2 Communication settings for the BACnet/IP interface

Note

If the foreign device registration fails with the configured BBMD after the specified number of retries, the PN/BACnet LINK cannot exchange data via BACnet. Possible causes of a registry failure may be, for example: Connection interruption, BBMD out of service, BBMD rejects the registration.

The PN/BACnet LINK does not have automatic restart. If this happens, you must therefore first switch off PN/BACnet LINK and then switch it on again.

If you expect network problems when using the foreign device registration, set the connection parameters so that the duration available for registration bridges these network problems.

9.4 Configuring a BACnet server

When configuring the BACnet server, you define the device object for PN/BACnet LINK as well as the BACnet I/O objects to be created in PN/BACnet LINK.

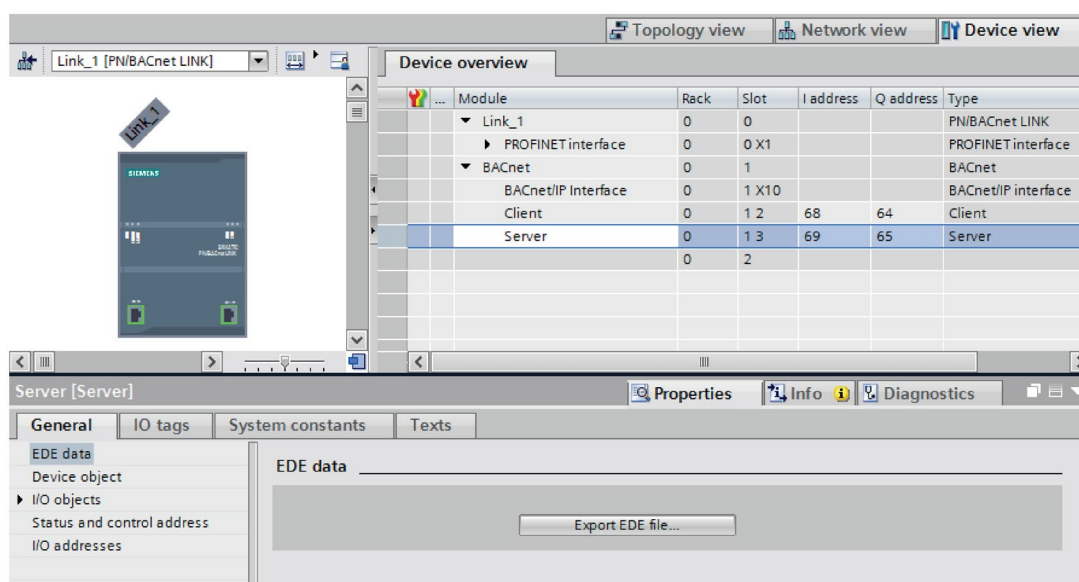


Figure 9-3 BACnet server

Configuring a device object

The device object represents the PN/BACnet LINK as a device on the BACnet side. Vendor_Name and Model are fixed and cannot be changed.

The screenshot shows a software interface with a left-hand tree view and a main configuration area. The tree view includes 'EDE data', 'Device object' (highlighted), 'I/O objects', 'Status and control address', and 'I/O addresses'. The main area is titled 'Device object' and contains several input fields: 'Vendor' (Siemens AG), 'Model' (PN/BACnet LINK), 'Instance' (10), 'Name' (Link1), 'Description' (empty), 'Application software version' (empty), and 'Database revision' (1).

Figure 9-4 Device object

Defining I/O objects

In this dialog, you create new I/O objects, namely BACnet objects and can edit or delete existing I/O objects.

1. To create a new I/O object, click the "New" button.
2. Select the type of I/O object. Possible options are: Binary input, binary output, analog input, analog output
3. Define the parameter values for the selected object type. Different parameters are displayed depending on the selected type of the I/O object.

Define the I/O object - binary input example

The screenshot shows a software interface with a left-hand tree view and a main configuration area. The tree view includes 'EDE data', 'Device object', 'I/O objects' (expanded), 'Overview', 'Define I/O object' (highlighted), 'Status and control address', and 'I/O addresses'. The main area is titled 'Define I/O object' and contains: a dropdown for 'I/O object' (2: Binary input (Instance: 0)), 'New' and 'Delete' buttons, a 'Type' dropdown (Binary input), 'Name' (I/O object2), 'Instance' (0), 'Description' (empty), 'Polarity' dropdown (normal), and 'Initial value input' dropdown (0).

Figure 9-5 Binary input

Define I/O object - analog input example

The screenshot shows the 'Define I/O object' dialog box. On the left is a tree view with the following items: 'EDE data', 'Device object', 'I/O objects' (expanded), 'Overview', 'Define I/O object' (selected), 'Status and control address', and 'I/O addresses'. The main area of the dialog is titled 'Define I/O object' and contains the following fields and buttons:

- 'I/O object': A dropdown menu showing '1: Analog input (Instance: 0)'. Below it are 'New' and 'Delete' buttons.
- 'Type': A dropdown menu showing 'Analog input'.
- 'Name': A text field containing 'I/O object1'.
- 'Instance': A text field containing '0'.
- 'Description': An empty text field.
- 'Unit': A dropdown menu showing 'NO_UNITS (95)'.
- 'Initial value input': A text field containing '0.0000'.
- 'Change of value increment': A text field containing '1.0000'.

Figure 9-6 Analog input

Note

If you specify the value "0" as the change of value increment, the value of "Present_Value" is constantly transmitted to non-existing COV subscribers even when it has not changed.

Exporting EDE data

You can export the description of the I/O objects defined in PN/BACnet LINK and the device object as an .EDE file in *.csv format.

By clicking on the "Export EDE file" button, the corresponding file selection dialog opens.

The screenshot shows the 'EDE data' dialog box. On the left is a tree view with the following items: 'EDE data' (selected), 'Device object', 'I/O objects', 'Status and control address', and 'I/O addresses'. The main area of the dialog is titled 'EDE data' and contains a single button labeled 'Export EDE file...'.

Figure 9-7 Exporting an EDE file

Check the status address and the control address

On the "Status and control address" page, you can see the addresses in the process image that contain the status byte and the control byte for the sever functionality. (See Data exchange between controller and PN/BACnet LINK (Page 33)).

The addresses are defined by the HSP and can be influenced by moving the start addresses of the BACnet server (see I/O addresses).

Adapting I/O addresses

The "I/O addresses" page allows you to set the start and end addresses of the input and output data of the BACnet server. In addition, the address range can be assigned to an organization block and a process image.

9.5 Configure BACnet client

9.5.1 Set client-specific parameters

With the client functionality, the PN/BACnet LINK can access objects in other BACnet devices. You define the data exchange with the various BACnet devices by "plugging" in BACnet devices and then configuring references to objects contained in them.

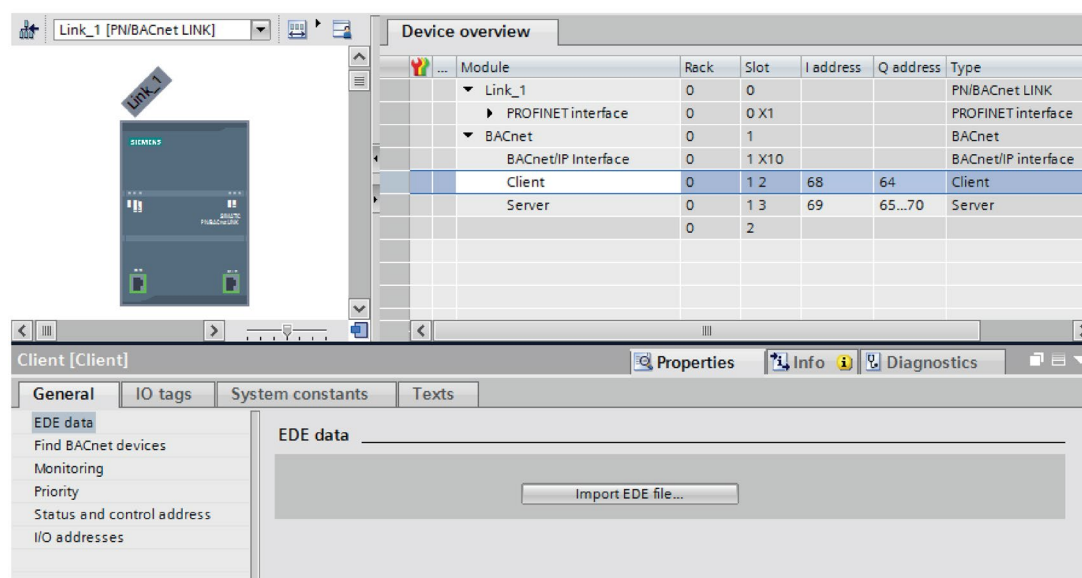


Figure 9-8 BACnet client

Configuring monitoring

You set client-specific monitoring parameters on this page.

1. You enable the monitoring of configured BACnet devices by setting a check mark.
2. Specify the desired monitoring interval. See section Monitoring functions (Page 41).

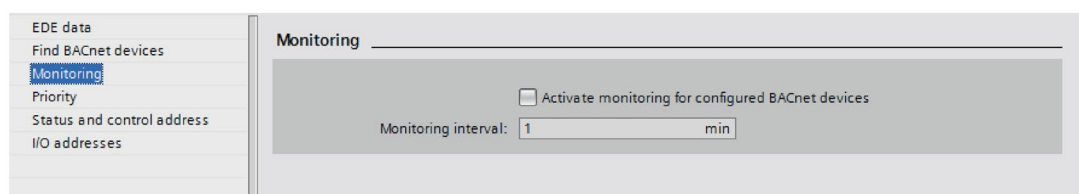


Figure 9-9 Monitoring

The monitoring interval set here applies globally for all BACnet devices, for which communication relationships are configured. If a device is not reached in the configured monitoring interval, the PN/BACnet LINK issues a corresponding diagnostic. This diagnostic result is cleared as soon as the device is accessible again (see section Monitoring functions (Page 41))

Setting the priority for write operations

On this page, you define the priority with which the BACnet client writes output objects (binary output or analog output) in referenced BACnet devices.

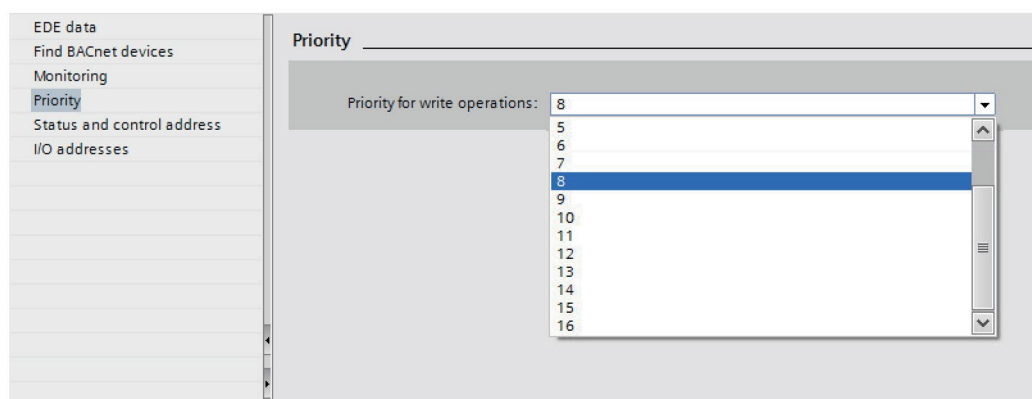


Figure 9-10 Priority for write operations

The priority set here applies globally to all configured write operations on objects in other BACnet devices. The highest priority is "1". The lowest priority is "16".

Check status and control address

On the "Status and control address" page, you can see the addresses in the process image that contain the status byte and the control byte for the client functionality.

Adapting I/O addresses

The start and end addresses of the input and output data of the BACnet Client can be set via the "I/O addresses" page. In addition, the address range can be assigned to an organization block and a process image.

9.5.2 Configuring references to BACnet devices

In the TIA Portal, you have three options for configuring references to objects that are located in other BACnet devices:

- Import of an EDE file
- Search for BACnet devices and the objects contained in them
- Manual

The possibilities mentioned are described below.

9.5.2.1 Import EDE file

An EDE file contains the devices available in a BACnet network along with their objects and services. After importing such a file, in the HSP you can specify which of the PN/BACnet LINK I/O objects contained therein should exchange data. BACnet objects which do not support the PN/BACnet LINK are not displayed here (see section BACnet objects (Page 21))

1. By clicking on the button "Import EDE file..." the corresponding file selection dialog opens.

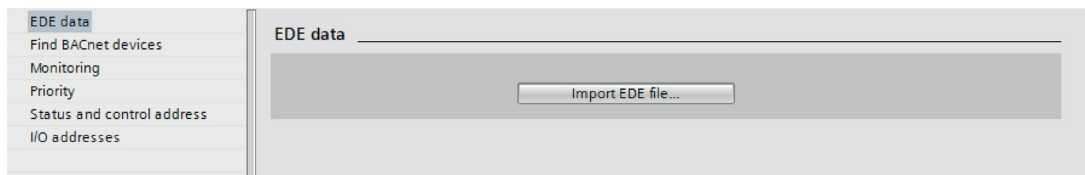


Figure 9-11 Import EDE file

2. Select the EDE file to import. Use the "Open" button to import the selected file. A dialog box appears displaying imported BACnet device objects.

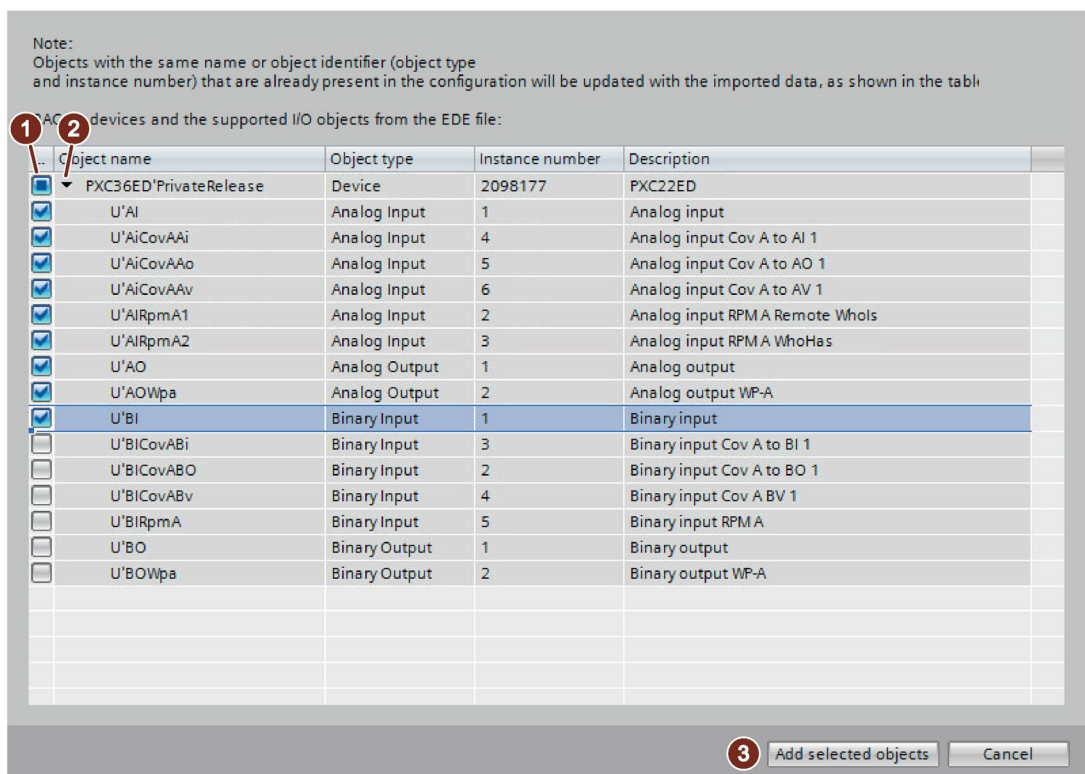


Figure 9-12 Example of EDE file Import

3. Use the check boxes ① to specify the device objects to be transferred. The hierarchy arrow ② indicates that I/O objects are contained in the BACnet device. By clicking on the arrow, you can display the assigned I/O objects and select or deselect individual I/O objects.

Note

Only object types supported by the device (BI, BO, AI and AO) are imported.

4. To select the selected device objects or I/O objects, click the "Add selected objects" button ③. The imported BACnet devices are now automatically transferred to the configuration of the PN/BACnet LINK active in the project.
5. If needed, you can subsequently edit the I/O object references of the imported device objects. See Creating object references manually (Page 73).

9.5.2.2 Find BACnet device

1. By clicking on the "Find BACnet devices..." button, the corresponding dialog opens.

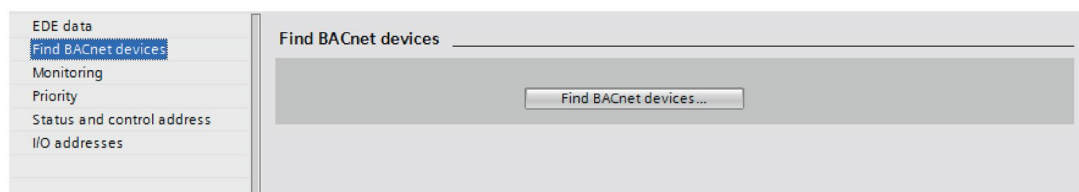


Figure 9-13 Find BACnet device

2. You can use a filter ① to limit and refine searches in the BACnet/IP network. You can specify a vendor ID and a value range in which the device instance IDs should lie.

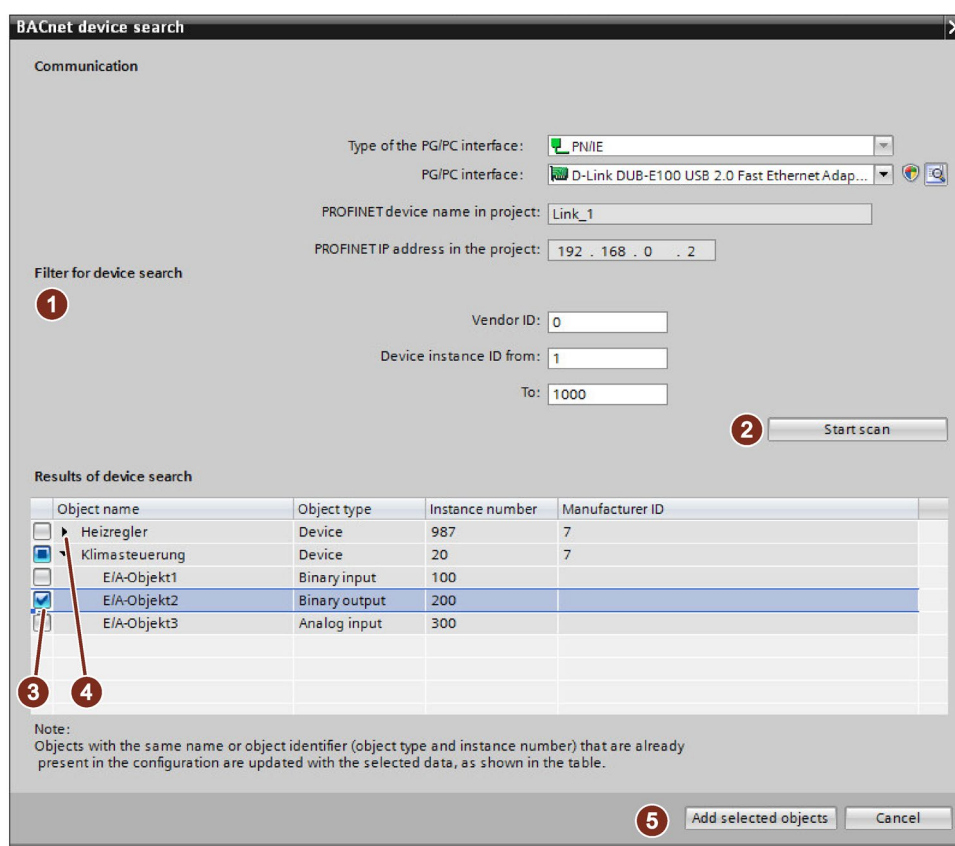


Figure 9-14 Find BACnet devices - filter and search result

3. To start the search, click on the "Start device search" button ②. While the search is running, the text "Find BACnet devices..." is displayed. The results of the search are shown in the "Result of the device search" table.

- Use the check boxes ③ to specify the BACnet device objects to be transferred. The hierarchy arrow ④ indicates that I/O objects are contained in the BACnet device. By clicking on the arrow, you can display the assigned I/O objects and select or deselect individual I/O objects.

Note

Only object types supported by PN/BACnet LINK (BI, BO, AI and AO) are displayed here.

- To transfer the selected objects to the configuration of the PN/BACnet LINK currently active in the project, click the "Add selected objects" button ⑤. The imported BACnet devices are now transferred and automatically inserted into the configuration.

9.5.2.3 Creating object references manually

Object references are created manually by inserting a generic BACnet device from the HW catalog into the PN/BACnet LINK. After setting the appropriate instance number for the associated device object, you can configure references to the I/O objects contained in this device object.

Insert BACnet device

- Double-click "BACnet device" ① in the HW catalog. This places a BACnet device as a submodule in PN/BACnet LINK.

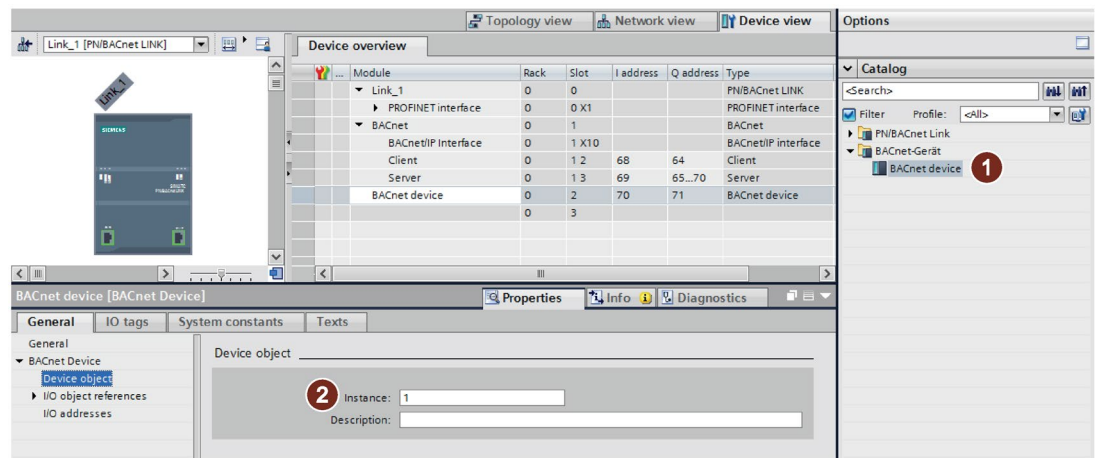


Figure 9-15 Insert BACnet device

- Enter the instance number ② for the device object. The specification of the instance number is used to uniquely identify the device. The instance numbers of all device objects in a BACnet network must be unique.

The instance number must correspond to the device that contains the objects to be read or written.

Defining I/O object references

You can now configure references to their I/O objects for each BACnet device that is created.

The configured references to I/O objects of the BACnet device are mapped as input and output data in the corresponding process images on the PROFINET side.

1. To create a new I/O object reference, click the "New" button.
2. Select the type of I/O object. Possible options are: Binary input, binary output, analog input, analog output.
3. Define the parameter values for the selected object type. Different parameters are displayed depending on the selected type of the I/O object.
4. Specify the update cycle to access the "Present_Value" property of the referenced I/O object.

Note

The specification of an update cycle is always required since BACnet devices may exist in the network that do not support COV (Change of Value). In this case, the value is queried by the BACnet client function via polling. The query is made within the time set in the update cycle.

If the cycle time is significantly exceeded while reading an I/O object, the PN/BACnet LINK sends diagnostics information to the S7 controller. The corresponding monitoring time is the duration of an additional update cycle but at least 300 ms.

The smallest cycle time for your application depends, among other things, on the following factors:

- Number and type of the data to be transmitted
- Reaction time of the addresses BACnet devices.

5. Subscription for change of value (COV): Here, you define whether the BACnet client is to register for a notification of changes in the value of the corresponding BACnet device (server) and specify the necessary parameters.

Defining I/O object references - binary input example

Figure 9-16 Defining I/O object references - binary input example

I/O object references for other devices

If needed, create references to objects in other BACnet devices.

Note

You can place a maximum of 126 BACnet device modules from the HW catalog.

Adapting I/O addresses

You can use the "I/O addresses" page to check and set the start and end addresses of the input and output data of the referenced I/O objects for the BACnet device. In addition, the address range can be assigned to an organization block and a process image. I/O addresses are preset by the system.

9.6 Checking and compiling the configuration

Checking / adapting I/O addresses

If necessary, you must adapt the I/O addresses assigned automatically by the TIA Portal. This is possible, for example, in the "Device overview" window. Here you can also find the I/O addresses used by the slots. The addresses assigned to slot 1, that is the BACnet module, are especially important because the control and status information is exchanged with the S7 program via these addresses. It is important for startup of the PN/BACnet LINK that the control information transmitted here from the S7 program is set correctly.

Checking data consistency

With a subsequent compilation, you can check the consistency of the assignments as well as the data types used.

PN/BACnet LINK via the S7 user program

To enable data transmission between the S7 controller and the PN/BACnet LINK, you need to set the control information for both the server and the client functionality via the S7 user program. This controller information is cyclically transmitted by the S7 controller to the PN/BACnet LINK. You can find detailed information on this in the section Data exchange between controller and PN/BACnet LINK (Page 33).

9.7 Programming

9.7.1 PLC tags

PLC tags are automatically created by the HSP when configuring the PN/BACnet LINK in the TIA Portal; you can use these PLC tags in the S7 program for accessing the cyclic I/O image. This means the parts of the I/O image allocated to the PN/BACnet LINK can be accessed from the S7 program using logical names. The use of explicit addresses is therefore not required in the S7 program.

Name diagram of the created PLC tags

Module/ Submodule	IO data	Name diagram	Data type	S7 address mnemonic
BACnet client	Prefix: <LinkName>.<ClientSubmoduleName>			
	ClientStatus	<Prefix>.ClientStatus	Bool	%I<ByteAdr>.0
	ClientControl	<Prefix>.ClientControl	Bool	%Q<ByteAdr>.0
BACnet server	Prefix: <LinkName>.<ServerSubmoduleName>			
	ServerStatus	<Prefix>.ServerStatus	Byte	%IB<ByteAdr>
	ServerControl	<Prefix>.ServerControl	Byte	%QB<ByteAdr>
	Binary input	<Prefix>.<IOObjectName>	Bool	%Q<ByteAdr>.0
		<Prefix>.<IOObjectName>.OUT_OF_SERVICE	Bool	%Q<ByteAdr>.7
	Binary output	<Prefix>.<IOObjectName>	Bool	%I<ByteAdr>.0
		<Prefix>.<IOObjectName>.OUT_OF_SERVICE	Bool	%Q<ByteAdr>.7
	Analog input	<Prefix>.<IOObjectName>	Real	%QD<ByteAdr>
		<Prefix>.<IOObjectName>.OUT_OF_SERVICE	Bool	%Q<ByteAdr>.7
	Analog output	<Prefix>.<IOObjectName>	Real	%ID<ByteAdr>
		<Prefix>.<IOObjectName>.OUT_OF_SERVICE	Bool	%Q<ByteAdr>.7
BACnet device	Prefix: <LinkName>.<BACnetDeviceModuleName>			
	Binary input	<Prefix>.<IOObjectRefName>	Bool	%I<ByteAdr>.0
		<Prefix>.<IOObjectRefName>.IN_ALARM	Bool	%I<ByteAdr>.4
		<Prefix>.<IOObjectRefName>.FAULT	Bool	%I<ByteAdr>.5
		<Prefix>.<IOObjectRefName>.OVERRIDDEN	Bool	%I<ByteAdr>.6
		<Prefix>.<IOObjectRefName>.OUT_OF_SERVICE	Bool	%I<ByteAdr>.7
	Binary output	<Prefix>.<IOObjectRefName>	Bool	%Q<ByteAdr>.0
		<Prefix>.<IOObjectRefName>.IN_ALARM	Bool	%I<ByteAdr>.4
		<Prefix>.<IOObjectRefName>.FAULT	Bool	%I<ByteAdr>.5
		<Prefix>.<IOObjectRefName>.OVERRIDDEN	Bool	%I<ByteAdr>.6
		<Prefix>.<IOObjectRefName>.OUT_OF_SERVICE	Bool	%I<ByteAdr>.7
	Analog input	<Prefix>.<IOObjectRefName>	Real	%ID<ByteAdr>
		<Prefix>.<IOObjectRefName>.IN_ALARM	Bool	%I<ByteAdr>.4
		<Prefix>.<IOObjectRefName>.FAULT	Bool	%I<ByteAdr>.5
		<Prefix>.<IOObjectRefName>.OVERRIDDEN	Bool	%I<ByteAdr>.6
		<Prefix>.<IOObjectRefName>.OUT_OF_SERVICE	Bool	%I<ByteAdr>.7
	Analog output	<Prefix>.<IOObjectRefName>	Real	%QD<ByteAdr>

Module/ Submodule	IO data	Name diagram	Data type	S7 address mnemonic
		<Prefix>.<IOObjectRefName>.IN_ALARM	Bool	%I<ByteAdr>.4
		<Prefix>.<IOObjectRefName>.FAULT	Bool	%I<ByteAdr>.5
		<Prefix>.<IOObjectRefName>.OVERRIDDEN	Bool	%I<ByteAdr>.6
		<Prefix>.<IOObjectRefName>.OUT_OF_SERVICE	Bool	%I<ByteAdr>.7

I/Q: Input/output bit address

IB/QB: Input/output byte address

ID/QD: Input/output double word address

Diagnostics

10.1 Status LEDs

10.1.1 Operating state of the PN/BACnet LINK / PROFINET diagnostics

The LEDs for visualizing the operating states of the PN/BACnet LINK and the PROFINET ports are located on the front of the housing.



Figure 10-1 Status LEDs – Operating state of the PN/BACnet LINK / PROFINET diagnostics

RUN LED	ERROR LED	MAINT LED ¹⁾	Operating state	Description
■ On	■ On	■ On	Power-up test / Serious error	- For approximately 1 second: LED test during startup - Longer than 1 second: HW error detected during power-up test or other serious error
□ Off	□ Off	□ Off	System run-up	System not completely booted yet but power-up test is complete.
⚡ Flashes	□ Off	□ Off	Not connected to S7 controller	- No "IO controller" connection established or - configuration not yet completed.
■ On	x	□ Off	Connected to S7 controller	"IO controller" connection established and configuration completed.

RUN LED	ERROR LED	MAINT LED ¹⁾	Operating state	Description
x	 Flashes	 Off	Error state	"IO controller" connection established and configuration completed, but an error occurred: - Diagnostic message to the S7 controller is pending or - Incorrect configuration by the S7 controller Flashes for at least 3 seconds.
 Flashes	 Off	 Off	Firmware update	While the firmware is written to the flash memory.
 Flashes	 Flashes	 Off	LEDs are flashing (triggered by TIA Portal)	3-second intervals - For identification of the device

1) The MAINT LED currently has no meaning.

x: LED state is irrelevant

During boot-up of the PN/BACnet LINK and after connecting the power supply, the sequence is as follows:

1. The three LEDs light up briefly for about 1 second and then go dark again.
2. None of the LEDs light up for about 4 seconds.
3. The RUN LED starts flashing.
4. When the run-up of the PN/BACnet LINK is successfully complete and the connection to the S7 controller is established, the RUN LED lights up.

10.1.2 Connection status BACnet bus

Connection status BACnet bus

The PN/BACnet LINK signals its state with the BACnet LEDs on the front of the housing.



Figure 10-2 Status LEDs BACnet bus

Table 10- 1 Behavior of the RUN LED

RUN LED	Meaning	Note
 Off	The PN/BACnet LINK is not in RUN operating state	- Server: System_Status is not OPERATIONAL - or - If client references are configured: Status = INACTIVE (0)
 On	The PN/BACnet LINK is in RUN state.	- Server: System_Status is OPERATIONAL - and - If client references are configured: Status = ACTIVE (1)
 Flashes	The PN/BACnet LINK is in CONFIGURATION state.	- Device is waiting for HWConfig from the CPU. The old configuration (if any) is discarded. - When foreign device registration is activated, the device waits for the result of the registration. - New Server objects and/or object references are created. This may take up to 30 seconds. During this time, the PN/BACnet LINK is not accessible for the other BACnet devices.

Note**Definition of RUN state**

The RUN state is defined as follows: PN/BACnet server is in the OPERATIONAL state and the client function is enabled for configured client references.

Note

If the server and client are configured, then the RUN LED indicates whether it is the operating state of the server or that of the client which keeps the RUN LED in the "Off" state. If required, this detailed information can be found in the corresponding status byte in the cyclic I/O image.

Table 10-2 Behavior of the ERR LED

ERR LED	Meaning	Note
Off	No error on BACnet bus	--
On	Error on BACnet bus	Diagnostics active, see Events that trigger a diagnostic message (Page 83)

10.1.3 Connection status of Ethernet interfaces

The LEDs for indicating the connection status of the Ethernet interfaces are located under a housing flap.

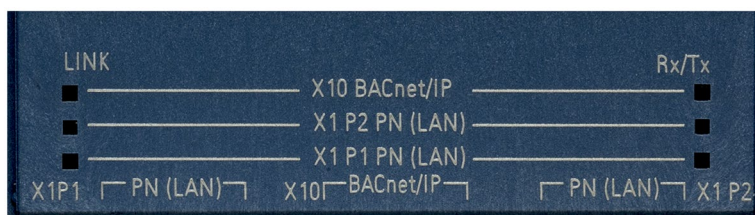


Figure 10-3 Status LEDs Ethernet interfaces

LINK	Indicates whether there is a physical connection on the Ethernet level.
On	Connection exists
Off	No connection exists

Rx/Tx	Indicates whether a package is being sent or received
On	PN/BACnet LINK sends or receives a package
Off	No package is sent or received

10.2 Diagnostic messages to the S7 controller

10.2.1 Events that trigger a diagnostic message

Diagnostics

The PN/BACnet LINK sends diagnostic information to the S7 controller with the usual PROFINET methods.

The following table provides an overview of

- Event text which is assigned to diagnostics
- Event for triggering diagnostics
- Possible remedy

Event text	Event for triggering	Possible remedy
BACnet application error - Internal application error	Internal firmware error	Restart
BACnet application error - Internal timeout	Internal timeout in the firmware	Restart
BACnet application error - Error code: {1:x}	Error code = 0x80: Ethernet configuration faulty	Correction of Ethernet configuration
	Error code = 0x81: Initialization of BACnet server failed	Correction of configuration or Restart
	Error code = 0x82: Client initialization failed	Correction of configuration or Restart
Foreign device registration failed	Defective configuration for foreign device registration or BBMD cannot be accessed	Correction of the configuration for foreign device registration or Check whether BBMD is available
BACnet/IP interface failure	The Ethernet connection on the BACnet interface has failed.	Checking the Ethernet connection on the BACnet interface
BACnet device cannot be accessed - instance {1:d}: Error while accessing the device	A BACnet device is not accessible, incorrectly configured or has failed	Checking the configuration for the devices and of the BACnet connection and the BACnet device in question

Event text	Event for triggering	Possible remedy
BACnet object not available – Object Identifier {1:x}: Error while accessing the object ·	Defective configuration for the BACnet object	Checking the configuration for the object and whether the BACnet object in question exists with the required permissions and whether the associated BACnet device can be accessed.
BACnet object not available – object identifier {1:x}: Cycle time exceeded during object access.	Cycle time was significantly exceeded when accessing the I/O object.	Extend cycle times accordingly

Only one message can be pending at any given time on each BACnet device. A message that applies for the entire device has a high priority (for example, different BACnet device cannot be accessed). A high-priority message can replace a message which applies to an individual reference object (for example, BACnet object cannot be accessed).

The pending messages are still shown and are not automatically removed both after reconfiguration of the device and after deactivation of the client function.

In the event of an error in several reference objects, the message for the first reference is displayed.

Diagnostic messages with specification of the BACnet object identifier

A diagnostic message can contain the BACnet object identifier as additional information.

The BACnet object identifier has the following structure:

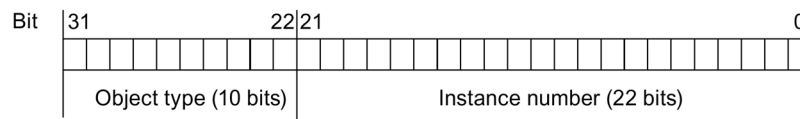


Figure 10-4 Structure of the object identifier

Object identifier		Value
Object type	Analog input	0
	Analog output	1
	Binary input	3
	Binary output	4
Instance number		1 ... 4191302

Example

The following figure shows an example of a diagnostic message with object identifier. The object identifier is output in hexadecimal form.

"BACnet object not available – object identifier 400003h: Error while accessing the object".
Meaning: An error occurred when accessing the object with object type "Analog Output" (1), instance number 3.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
	Object type: Analog output										Instance number: 3																					

Figure 10-5 Example of object identifier

Maintenance and service

11.1 Firmware update

Procedure

1. Set the S7 CPU to STOP mode.
2. Start the update of the PN/BACnet LINK in the TIA Portal. Depending on the configuration in the TIA Portal, the PN/BACnet LINK resumes running on its own after a successful update and waits for configuration information from the S7 controller.
3. For operation, reset the S7 CPU to RUN mode.



CAUTION

Critical plant state

The Ethernet switch installed in the PN/BACnet LINK is only in operation after run-up of the PN/BACnet LINK. A restart of the PN/BACnet LINK interrupts the Ethernet Switch function.

Existing Ethernet connections over the switch are interrupted for the duration of the PN/BACnet LINK startup. This can result in critical plant states.

11.2 Reset to factory settings

In the TIA Portal you have the option of resetting the device to factory settings.

The following data is deleted on reset to factory settings:

- PROFINET parameter assignment (IP address for the PN side, PN name) and the SNMP parameters
- The I&M data are also deleted depending on the setting in the TIA Portal.

11.3 Replacing the PN/BACnet LINK

Below you will find a description of the basic steps required for replacing the PN/BACnet LINK.

Preparations

De-energize the S7 configuration including PN/BACnet LINK.

Replacing the device

Follow these steps:

1. Remove the 24 V power supply cables and the functional grounding from the screw-type terminal.
2. Remove PROFINET connector and BACnet connector.
3. When mounted on a control panel: Remove the securing collar on the BACnet connection.
4. Dismantle the device. Proceed in the reverse order to that described in Chapter Assembly (Page 51).
5. Installing and connecting the new device.

Commissioning the device once again

Switch on the power supply again for S7 configuration and the PN/BACnet LINK.

The initialization and engineering data is then downloaded automatically from the higher-level S7 CPU.

The STEP 7 program switches the PN/BACnet LINK to "RUN" mode by setting the corresponding bits in the control bytes to "ON".

11.4 Recycling and disposal

The PN/BACnet LINK can be recycled due to its environmentally friendly components.

NOTICE
• Disposal of the products described in this manual must be in accordance with the applicable statutory requirements. • For ecologically compatible recycling and disposal of your old device, contact only a certified disposal service for electronic scrap.

There is no provision for returning the device to Siemens.

For further questions regarding disposal and recycling, please contact your local Siemens contact. You will find the contact details in our database on the Internet at:
<http://www.automation.siemens.com/partner>

Technical specifications

12.1 Technical specifications

Technical specifications PN/BACnet LINK

Article number	6BK1621-0AA00-0AA0
General information	
Product type designation	PN/BACnet Link
Firmware version	
• FW update possible	Yes
Vendor identification (VendorID)	7
Product function	
• I&M data	Yes
Engineering with	
• STEP 7 TIA Portal configurable/integrated as of version	V14 SP1
Installation type/mounting	
Mounting	DIN rail, wall mounting, portrait mounting
Mounting position	Any
Recommended mounting position	Horizontal
Supply voltage	
Type of supply voltage	24 V DC
Rated value (DC)	24 V
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Overvoltage protection	Yes
Short-circuit protection	Yes
Mains buffering	
• Mains/voltage failure stored energy time	10 ms
Input current	
Current consumption (rated value)	0.11 A
Current consumption, max.	0.13 A
Power loss	
Power loss, typ.	2.7 W
Interfaces	
PROFINET IO	
• automatic detection of transmission rate	No
• Transmission rate, max.	100 Mbit/s
• Number of RJ45 ports	2
• Number of FC (FastConnect) connections	2

12.1 Technical specifications

Article number	6BK1621-0AA00-0AA0
PROFINET functions	
• Assignment of the IP address, supported	Yes
• Assignment of the device name, supported	Yes
BACnet	
• BACnet device profile	B-GW
• Supported character sets	ISO 10646 (UTF-8)
• Network Security	No
1. Interface	
Interface type	BACnet/IP
Physics	RJ45
Isolated	Yes; 1 500 V AC or 2 250 V DC
Interface types	
• Number of ports	1
2. Interface	
Interface type	PROFINET
Physics	Ethernet, 2-port switch, 2*RJ45
Isolated	Yes; 1 500 V AC or 2 250 V DC
Interface types	
• Number of ports	2
• integrated switch	Yes
Functionality	
• PROFINET IO Device	Yes
Isochronous mode	
Isochronous operation (application synchronized up to terminal)	No
Interrupts/diagnostics/status information	
Status indicator	Yes
Alarms	Yes
Diagnostic functions	Yes
Diagnostics indication LED	
• RUN LED	Yes
• ERROR LED	Yes
• MAINT LED	Yes
• LINK LED	Yes
• RX/TX LED	Yes
Potential separation	
Potential separation exists	Yes
Degree and class of protection	
Degree of protection acc. to EN 60529	IP20

Article number	6BK1621-0AA00-0AA0
Standards, approvals, certificates	
CE mark	Yes
UL approval	Yes
cULus	Yes
PNO certificate	Yes
BTL certificate	Yes
RoHS conformity	Yes
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-25 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	-25 °C
• vertical installation, max.	55 °C
• Vertical installation, min.	-25 °C
• Vertical installation, max.	45 °C
• Horizontal installation, min.	-25 °C
• Horizontal installation, max.	45 °C
Ambient temperature during storage/transportation	
• min.	-40 °C
• max.	85 °C
Relative humidity	
• Operation, max.	95 %
Connection method	
Design of electrical connection	Screw connection
Dimensions	
Width	70 mm
Height	112 mm
Depth	75 mm
Weights	
Weight	210 g

12.2 Dimension drawing

Dimension drawing of PN/BACnet LINK

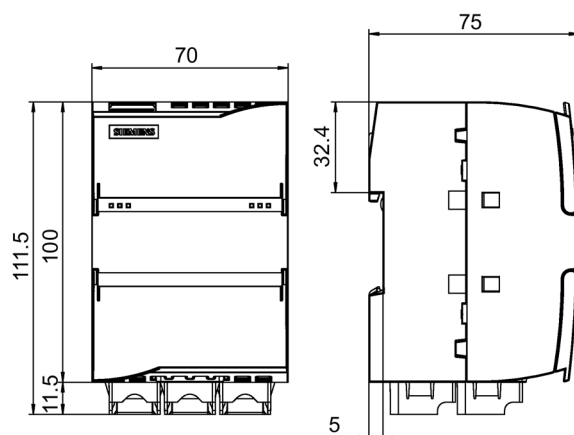


Figure 12-1 Dimension drawing PN/BACnet LINK

Appendix

A.1 Certificates and approvals

Note

Approvals are only valid when marked on the product

The specified approvals apply only when the corresponding mark is printed on the product. You can check which of the following approvals have been granted for your product by the markings on the type plate.

CE marking

The SIMATIC PN/BACnet LINK device complies with the requirements and protection objectives of the following EC Directives.

EMC Directive 2014/30/EU

The product is designed for operation in the following areas:

- Residential area according to EN 50491-5-1, EN 50491-5-2
- Industrial area according to EN 50491-5-3 and EN 61131-2 (programmable controllers)

EMC requirements:

Field of application	Noise emission requirements	Interference immunity requirements
Residential area	EN 61000-6-3	--
Industrial area	EN 61000-6-4	EN 61000-6-2

The product meets these requirements if you adhere to the installation guidelines and safety instructions described in these operating instructions and in the System Manual for the S7-1200 Automation System (<https://support.industry.siemens.com/cs/ww/en/view/109741593>).

General approvals

The current approvals for the PN/BACnet LINK are listed in the Siemens Mall.

Declaration of Conformity

The EC Declaration of Conformity is kept available for the responsible authorities in accordance with the above-mentioned EC Directive at the following address:

SIEMENS AG
DF FA SE

A.2 Contact address

Breslauer Straße 5
90766 FÜRTH
GERMANY

Other applied standards

- IEC 61131-2 / DIN EN 61131-2 Programmable controllers
- IEC 61010-1 / EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

A.2 Contact address

Contact address

SIEMENS AG
DF FA SE
Breslauer Straße 5
90766 FÜRTH
GERMANY

A.3 Licenses

Use of open source software (OSS)

Open-source software is used in the SIMATIC PN/BACnet LINK product in unchanged form or in a form changed by us. Licensing terms and resources that are to be published are included on the DVD delivered with the product.

Sources under the GNU General Public License are provided to you free of charge on request. Use the communication channels specified under Service & Support (Page 95) to do this.

A.4 Service & Support

A.4.1 Technical Support

Technical Support

You can contact the Technical Support experts in Germany at the following number:

- Phone: + 49 (0) 911 895 7222
- The contact data for Technical Support in other countries can be found in the Siemens contact database (http://w3.siemens.com/aspa_app/).

A.4.2 Siemens Industry Online Support

Siemens Industry Online Support

You can find various services on the Support homepage (<http://support.automation.siemens.com>) on the Internet.

There you will find the following information, for example:

- The correct documents for you via product-related search functions
- Online support request form
- Your local representative
- A forum for global information exchange by users and specialists.
- Our newsletter containing up-to-date information on your products.

A.4.3 Online catalog and ordering system

Online catalog and ordering system

The online catalog and the online ordering system can be found on the Industry Mall homepage (<https://mall.industry.siemens.com>).

Glossary

AR (Application Relation)

S7 connection for data exchange in PROFINET

BBMD (BACnet/IP Broadcast Management Device)

The BBMD is used to distribute BACnet broadcast messages across IP routers.

BIBB (BACnet Interoperability Building Block)

BIBBs are a collection of one or more BACnet services. BACnet services are divided into A and B services. An A service operates as a client and a B service as a server.

EDE (Engineering Data Exchange)

EDE files are the BACnet procedure for the BACnet configuration recommended by BACnet Interest Group Europe eV. An EDE file contains the devices available in a BACnet network along with their objects and services. The electronic exchange of EDE files is made in .csv format.

FE (functional grounding)

Low-impedance connection to ground potential

HSP (Hardware Support Package)

The Support Packages enable the configuration of modules that are not included in the hardware catalog of the TIA Portal installation.

Object reference

Client object references are references to BACnet objects which are located in other BACnet devices (servers)

Object types

The PN/BACnet LINK supports the following BACnet object types

- Device
- Binary input (BI)
- Binary output (BO)
- Analog input (AI)
- Analog output (AO)

OSS (Open Source Software)

Open Source Software (OSS) is software that meets the definition of the Open Source Initiative (OSI), for example, that this software is subject to one of the Open Source Software licenses recognized by OSI.

PN (PROFINET)

PROFINET (Process Field Network) is the open Industrial Ethernet standard of the PROFIBUS User Organization for automation.

RoHs (Restriction of certain Hazardous Substances)

EU Directive 2011/65/EU restricts the use of certain hazardous substances in electrical and electronic devices.

SIMATIC Controller

The SIMATIC Controllers are available as Basic, Advanced, Distributed and Software controllers. The Basic Controller S7-1200 for small to medium-sized applications, the Advanced Controller S7-1500 for medium-sized and complex applications, the Distributed Controller ET 200SP for distributed applications and the Software Controller S7-1500 for PC-based applications.

Subscription

BACnet clients can use the COV subscription service to register so that they are notified in case of value change (COV).

TIA (Totally Automated Integration)

The TIA Portal offers complete access to the entire digitalized automation - from digital planning over integrated engineering all the way to transparent operation.

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