SIEMENS

Desigo™

Building automation system 6.0 SP
with supplements for Desigo Insight SP2

Technical Principles

CM110664en
2017-05-31

Building Technologies

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Edition: 2016-09-20
Document ID: CM110664en

Table of Contents

1 About this Document

Revision history

Version	Date	Changes	Section
V6.0	2016-03-17	Revised for Desigo V6.0	Entire manual
V6.0 SP	2016-09-20	Revised for Service Pack V6.0	23, 24
V6.0 SP2	2017-05-31	Revised for Desigo V6.0 SP with supplements for Desigo Insight SP2	11 Reports: 11.1 15 Desigo Insight: 15.1.5 23 System Configuration: 23.3.26 24 Compatibility: 24.3.2, 24.3.3, 24.3.5, 24.3.6, 24.4.2, 24.5.1

IT security

Building automation and control systems such as Desigo are increasingly integrated into a building's IT infrastructure and will often also be remotely accessible. Besides using the IT security features of the various products, it's very important to implement an IT secure integration into the site's IT infrastructure. For guidelines for such an IT secure integration, see *IT Security in Desigo Installations* (CM110663). These guidelines are binding and must be implemented in every Desigo project.
Furthermore, the usual rules and best practice procedures from the IT world must also be observed to achieve a high protection level for the building automation and control system and the customer's IT infrastructure.

Cyber security disclaimer

Siemens products and solutions provide security functions to ensure the secure operation of building comfort, fire safety, security management and physical security systems. The security functions on these products and solutions are important components of a comprehensive security concept.

It is, however, necessary to implement and maintain a comprehensive, state-of-the-art security concept that is customized to individual security needs. Such a security concept may result in additional site-specific preventive action to ensure that the building comfort, fire safety, security management or physical security system for your site are operated in a secure manner. These measures may include, but are not limited to, separating networks, physically protecting system components, user awareness programs, defense in depth, etc.

For additional information on building technology security and our offerings, contact your Siemens sales or project department. We strongly recommend customers to follow our security advisories, which provide information on the latest security threats, patches and other mitigation measures.

http://www.siemens.com/cert/en/cert-security-advisories.htm

2 System Overview

The Desigo building automation and control system has three levels:

- Management level
- Automation level
- Field level

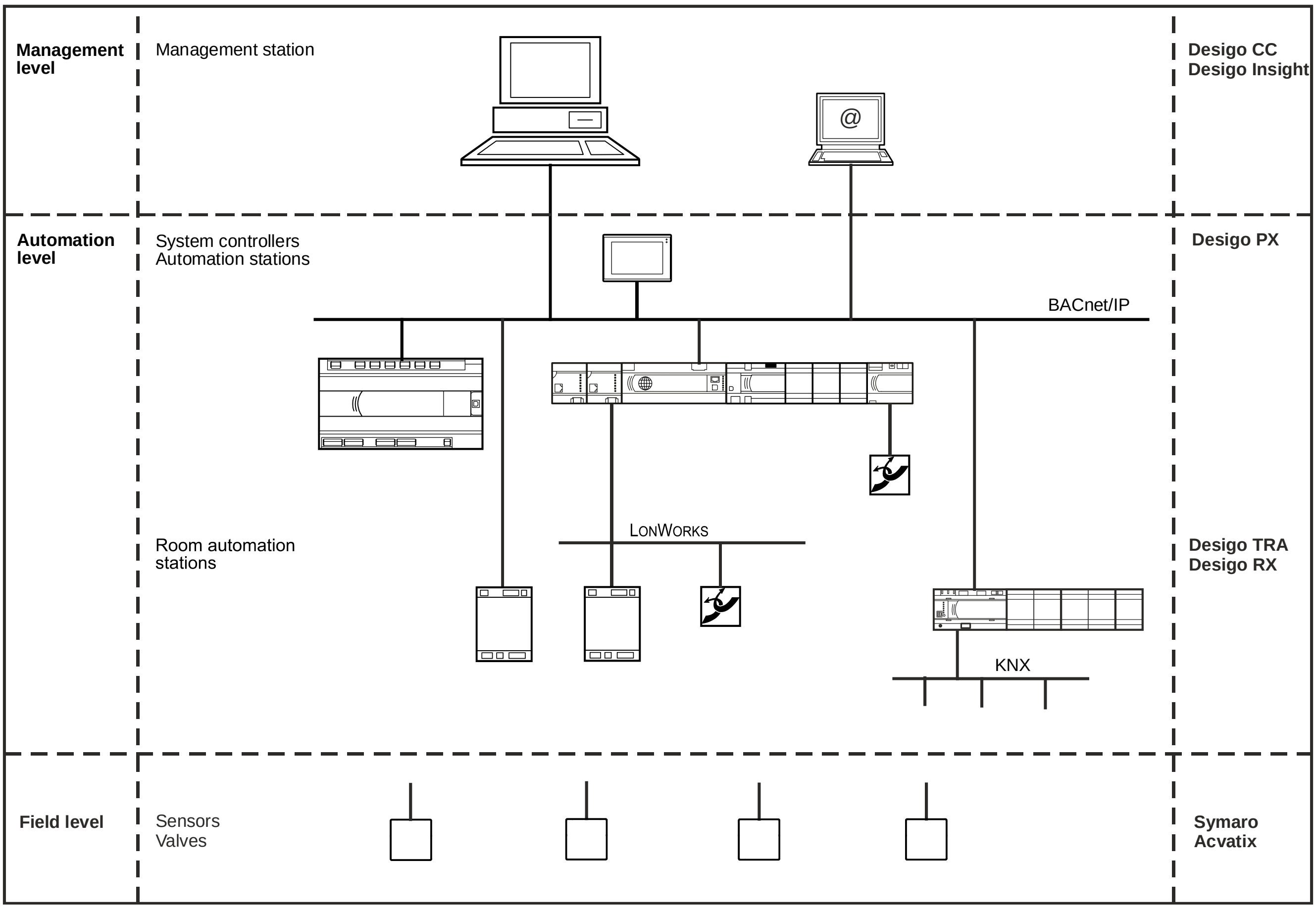


Figure 1: System hierarchy

2.1 Management Level

Operation and monitoring

The key functions at the management level are operation and monitoring of the plant, including:

- Graphics-based operation of the plant
- Cross-site alarm generation and alarm transfer
- Maintenance of a long-term log
- Storage and graphical display of trend data
- Graphics-based operation of time schedules
- Display, navigation and modification of data objects, which are displayed in a hierarchical tree structure
- Visual monitoring of the operation of primary plants (monitoring to reduce energy consumption and wear and tear)
- Visual monitoring of the rooms (HVAC, lights and blinds)
- Reporting function including energy reports
- Centralized time control and calendar functions
- Event program: Triggering system reactions based on system events

What is operation and monitoring?

Operation and monitoring encompasses all the interaction between a user and the plant via the building automation and control system.

Task	Activity
Observing the operational status of the plant or building	Reading current values of all process variables, data objects and parameter settings Receiving and acknowledging alarms Overview of all pending alarms Recording and analyzing trends
Observing the operational status of the building automation and control system	Overview of failed automation stations and network interruptions Signaling of anormal hardware or software states in an automation station or in the associated field devices
Manipulating the operational status of the plant or building	Modifying parameter settings (for example, setpoints of control programs) Setting values for physical outputs of automation stations Modifying system and management objects, especially calendars and time schedules

Table 1: Operation and monitoring

Devices for operation and monitoring

The following devices let you operate and monitor the system:

- Desigo management stations Desigo Insight and Desigo CC, both either locally and/or with web operation
- ADP/CC for evaluating long-term recorded operational data, energy amount metering, consumption monitoring, and generating reports
- PXM touch panels and operating devices
- PXWeb for operating PX automation stations via a web client

Operation and monitoring types

There are four operation and monitoring types:

- Generic operation
- Limited (station-specific) generic operation
  You can limit the generic view to one or more selected automation stations (including alarm display).
- Engineered (project-specific) operation
  You can generate a project-specific view in the engineering phase.
- Limited (user-specific) operation in the management station

Management stations

Desigo Insight can be installed as a desktop, server or web application.

Desigo CC can be installed on one computer, with full server and client functionality, or on several separate computers. Web Clients, Windows App (ClickOnce) Clients and installed Clients can be added.

Remote desktop

Desigo Insight can be installed as a terminal server and then supports remote engineering and configuration in addition to operation and monitoring.

Desigo Web

Desigo Web is a web solution for operation and monitoring via Desigo Insight. Remote engineering and configuration is not supported.

Remote management

Management stations can operate and monitor the automation level via a public network.

Data analysis

Offline applications, such as integrated energy reports from Desigo Insight or the ADP/CC software package for Desigo Insight let you analyze data, for billing, energy optimization, statistics, etc.

The management stations can be linked to Simatic S7, the Sinteso FS20 fire protection system, and third-party subsystems, such as programmable logic controllers (PLCs) for electrical applications.

2.2 Automation Level

The Desigo PX automation system meets all the requirements for the control and monitoring of heating, ventilation, air conditioning systems and other building services. Desigo PX with its programmable automation stations and graded range of operator units is a scalable and open system.

D-MAP programming language

The starting point for the engineering of the application functions is the range of user-friendly application blocks and function blocks in the D-MAP (Desigo Modular Application Programming) programming language. D-MAP is optimized for applications for technical building installations and is based on the IEC 1131 standard. The graphical user interface of the Xworks Plus (XWP) [→ 45] engineering software ensures an efficient approach.

System functions

All PX automation stations have comprehensive system functions, such as alarm mangement, time schedules, trend histories, time synchronisation, global data distribution, and life check, that work completely autonomously.

BACnet communication for maximum openness

Devices on the automation level communicate with each other and with the management station and the operating devices via the BACnet protocol.

The use of BACnet/IP or BACnet/LonTalk underlines the openness of the system and allows the easy integration of systems and components from third-party manufacturers.

Automation stations and system controllers

PX Modular

The Desigo PX range of programmable modular automation stations provides maximum flexibility for controlling and monitoring building services. Comprehensive system functions, such as alarm management, time schedules and trend histories, meet all requirements for technical building installations.

The PXX-Lxx extension modules let you connect LonWorks devices, RXC room controllers and third-party devices.

The PXX-PBUS extension module lets you integrate PTM IO modules.

The PXA40-T/Wx option modules provide functions, such as web operation.

TX-I/O

Desigo TX-I/O modules provide the interface between PX Modular and the field level devices, the actuators and sensors.

A range of configurable and flexible I/O modules are available for signalling, measuring, metering, switching and controlling.

Some modules can be manually operated according to ISO 16484, and have an LCD display with configurable LEDs.

The integrated isolating-terminals facilitate the hardware test during commissioning.

TX Open

TXIx.OPEN lets you integrate third-party systems, such as M-Bus meters, pumps (Grundfos, Wilo) and variable speed drives (Siemens G120P), and connect intelligent aggregates, for example, chillers, via the Modbus protocol.

PX Compact

The Desigo PX range of programmable compact automation stations with integrated I/Os provides optimized solutions for small to mid-sized technical building installations. Comprehensive system functions, such as alarm management, time schedules and trend histories, meet all requirements for technical building installations.

PX Open

PX Open system controllers let you integrate third-party devices via Modbus, M-Bus, KNX and other protocols. System functions, such as alarm management, time schedules, trend data storage and flexible programming are available.

Operating devices

The various operator units in the Desigo PX range cover all the various requirements in terms of location and function.

PXG3.W100 web interface

The PXG3.W100 web interface lets you operate and monitor PX automation stations that are engineered in the PXG3.W100. It is the system interface for the PXM40/50 touch panels. It allows the homogenous operation on-site via PXM40/50 and remotely via a standard web browser.

PXM40 and PXM50 touch panels

The PXM40 (10,1") and PXM50 (15,6") touch panels let you operate several PX automation stations and monitor technical building installations in technical rooms. The touch panels can be mounted in control cabinets. They are used in combination with the PXG3.W100 web interface. Its user interface is optimized for touch handling. If a fault occurs, a text message or email can be sent via a PXC Modular (IP version).

PXM20/PXM20-E network capable operating units

The network capable PXM20 and PXM20-E operating units let you operate PX automation stations connected to a BACnet network.

PXM10 local operating unit

The PXM10 operating unit lets you locally operate the PXC automation station it is connected to. The device has a user friendly single button operation with an LCD display.

PX Web

The web solution in PXC Modular (BACnet/IP) together with the PXA40-Wx optional module allows the generic operation of all values of the PX automation stations from a web client. If a fault occurs, text messages or emails can be sent. You can set up a graphical operation with a supplied tool.

See *Desigo PX Automation system for HVAC and building services - System overview* (CM110756).

2.3 Room Automation

The room automation is part of the automation level. The room automation includes devices for the control functions within a room.

In addition to the long-standing RX room controllers, the new Desigo Room Automation PXC3/DXR2 room automation stations are also available.

The PXC3/DXR2 room automation stations have the following functions:

- Measuring, controlling and processing of I/O signals
- Logging trend data
- Monitoring process variables and generating alarms
- Acknowledging and resetting alarms
- Monitoring process variables for value changes
- Exchanging data with clients and other automation stations
- Monitoring hardware and software functions and generating events in case of faults or errors
- Processing BACnet access for operation and monitoring of one or multiple clients
- Handling errors, for example, during data point exchange

The PX automation stations carry out coordination functions (Desigo Room Automation system functions), such as time synchronisation, life check, scheduling, etc., for the room automation stations.

Desigo supports the following communication technologies:

- BACnet
- KNX technology
- DALI (Digital Addressable Lighting Interface)
- LonWorks technology (only for RX)

Desigo Room Automation (PXC3..)

In Desigo Room Automation freely programmable PXC3 room automation stations control the room climate. The Desigo Room Automation product range integrates several disciplines (HVAC, lighting, shading). A room automation station can cover several rooms. The room automation stations are integrated seamlessly into Desigo PX and the management level via BACnet/IP.

Buttons, sensors, and actuators are connected to the PXC3 room automation via TX-I/O modules or KNX PL-Link modules.

The KNX interface of the PXC3 room automation stations allows the direct integration of devices with KNX PL-Link and KNX S-Mode in Desigo Room Automation. KNX PL-Link is fully compliant with the KNX standard. The PXC3 room automation stations support plug and play functionality with automation device detection. Devices with KNX PL-Link are parameterized with the Desigo tools. The KNX commissioning software (ETS) is not needed.

The PXC3.. room automation stations have an integrated web server for IP communication with QMX7.E38 touch room operator units. Engineering access is available via the web interface.

A subset of the available TX-I/O modules can be used with the PXC3 automation station.

The DALI (Digital Addressable Lighting Interface) bus of the PXC3...A room automation station lets you integrate lighting.

The PXC3.E16A room automation station is tailored for lighting applications. It has an on-board DALI interface for integrating up to 64 ECGs (electronic control gear).

Desigo Room Automation (DXR2..)

The DXR2 room automation stations let you automate heating, ventilation, air conditioning, shading, and lighting for rooms.

The room automation stations communicate with each other and other system components via BACnet/IP (DXR2.E…) or BACnet MS/TP (DXR2.M...).

The room automation stations support different I/O mixes, protocols (KNX S-Mode and KNX PL-Link for IP and KNX PL-Link for MS/TP) and power supplies (240/24V). Operating devices, buttons, sensors, and actuators for lighting and shading can be connected to the room automation stations via KNX PL-Link.

The room automation stations contain preloaded applications, but are also freely programmable. A comprehensive library of proven, standardized applications is available.

The DXR2.. room automation stations have an integrated web server for IP communication with QMX7.E38 touch room operator units. Engineering access is available via the web interface.

Desigo RXC and RXB

The RXC and RXB room controllers control the room climate in individual rooms and important parameters of the applications can be configured.

The RXC room controllers and the bus room operator units (QAX50/51) communicate via LonWorks. The RXB room controllers communicate via KNX.

The LonWorks system controller (or a modular PXC50/100/200..D automation station) or the PX KNX system controller connects the room automation devices to Desigo PX and the management level and assumes coordination functions for room automation (grouping, scheduling, demand signal exchange, peer-to-peer, etc.).

2.4 Desigo Open

Desigo Open lets you integrate devices and systems from different manufacturers into the Desigo system.

Desigo Open supports various protocols, for example, OPC, Modbus, KNX/EIB, LonWorks, M-Bus, KNX, DALI, etc. for integrating energy monitoring, fire security, access control and security, power distribution, refrigeration machines, pumps, meters, variable speed drives, ligthing and blinds, etc.

Regional companies can use Software Development Kits (SDKs) to develop their own solutions.

Integration on the management level

Desigo Insight Open lets you exchange information between the Desigo Insight management station and third-party systems and devices.

Desigo CC uses BACnet, Modbus, OPC, S7 Ethernet, SNMP, and RESTful web services to exchange data with third-party systems.

SX Open is a configurable third-party system - BACnet/IP gateway that allows the data exchange between third-party systems and the Desigo system with Desigo Insight in an IP network.

Integration on the automation level

PX Open system controllers let you integrate third-party devices on Modbus, M-Bus, KNX and other protocols, by converting all data into standard BACnet objects.

Integration on the field level

TXIx.OPEN lets you integrate third-party systems, such as M-Bus meters, pumps (Grundfos, Wilo) and variable speed drives (Siemens G120P), and connect intelligent aggregates, for example, chillers, via the Modbus protocol.

2.5 Workflow and Tools

The Desigo tools cover parts of the technical process and parts of the Desigo system:

- *Desigo Configuration Module (DCM)* lets you plan the system and determine the quantity during the sales phase.
- *Xworks Plus (XWP)* lets you engineer, commission and service Desigo PX system components.
- *ABT Pro* and *ABT Site (Automation Building Tool)* let you engineer, commission and service Desigo Room Automation (BACnet) system components.
- *RXT10* lets you commission and service RXC room controllers.
- *PX KNX-Tool* lets you commission and service PX KNX.
- *Desigo Insight Graphic Generator (DIGG)* lets you automatically generate Desigo Insight plant graphics using information from the System Definition Unit (SDU) and XWP.
- *System Definition Unit (SDU)* lets you define application texts in different languages.
- *PX Open MONITOR* lets you debug PX Open programs.
- *TX Open tool* lets you configure and commission TX Open modules.
- *BIM tool* lets you:
  - Commission TX-I/O modules and the Bus Interface Modules (BIM)
  - Simulate programs without I/O modules on the test rack
  - Configure the colors of the I/O status LED on the TX-I/O modules
- *Desigo Automation Level Migration Tool* lets you copy engineering parameters, such as I/O addresses, texts, data point parameters, PID controller parameters and trend objects, of a Visonik controller to a PX automation station.
- *Desigo Point Test (DPT)* lets you test data points for field devices and PX automation stations during commissioning.

Preloaded applications

Some automation stations contain preloaded applications, but are also freely programmable. A comprehensive library of proven, standardized applications is available and can be used instead of the preloaded applications.

XWP to PXC communication

XWP communicates with the PX automation station via BACnet/IP or BACnet/LonTalk. The CFC or Parameter Editor can communicate online with the PX automation stations. This is a useful aid both for commissioning and testing the automation stations, and for operation and monitoring. The pin values and some attributes of the compounds and blocks can be modified online.

To commission a Lon-based PX automation station, XWP must be connected to the same LonWorks network as the automation station. The program or program changes can be downloaded via BACnet router or PTP connection, which can also be used for monitoring and operation. The functionality to configure and commission the BACnet router is integrated in the XWP Network Configurator.

2.6 Topologies

Small system

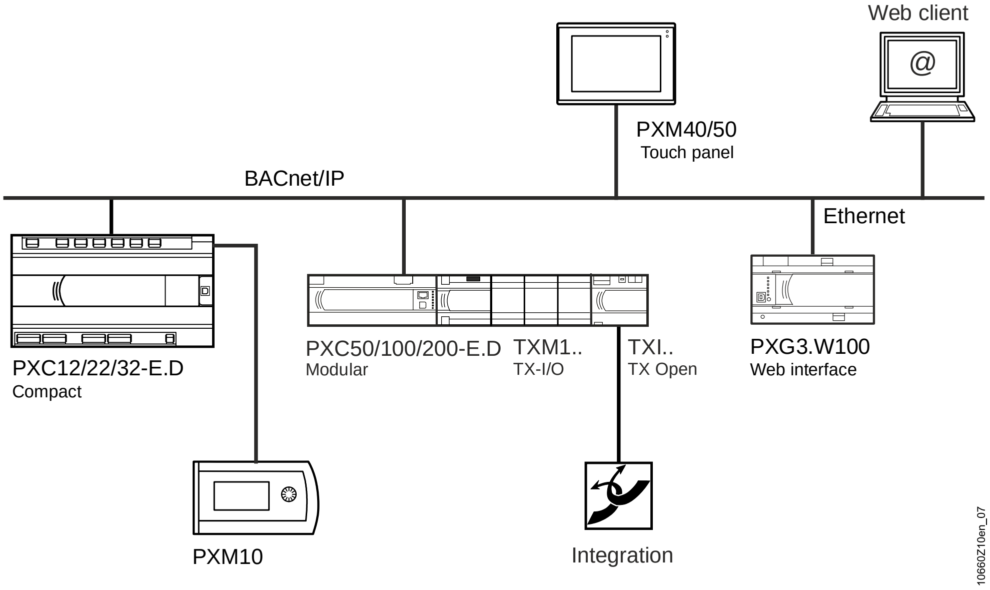


Figure 2: A typical small system on BACnet/IP

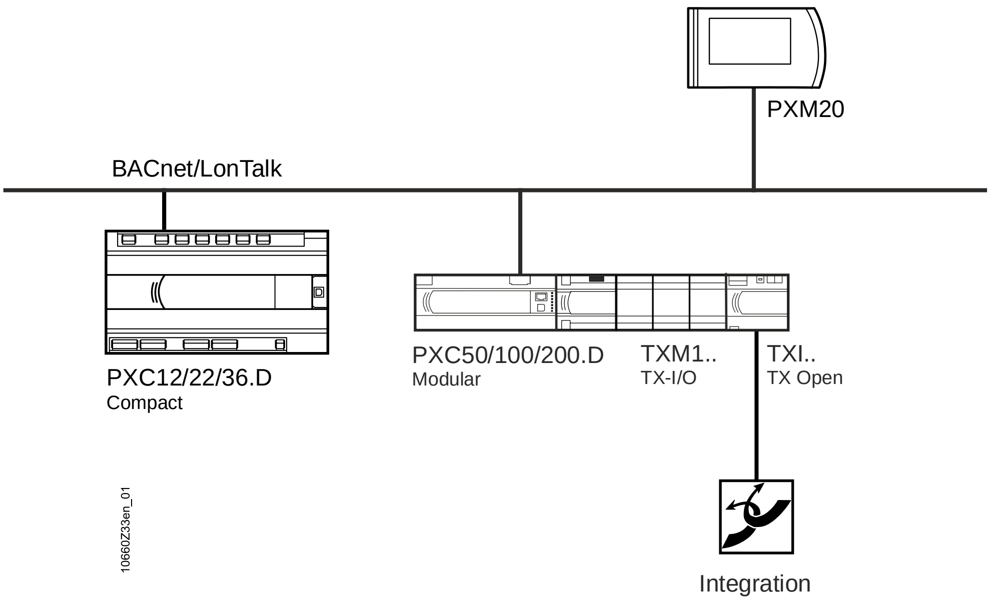


Figure 3: A typical small system on BACnet/LonTalk

Medium system

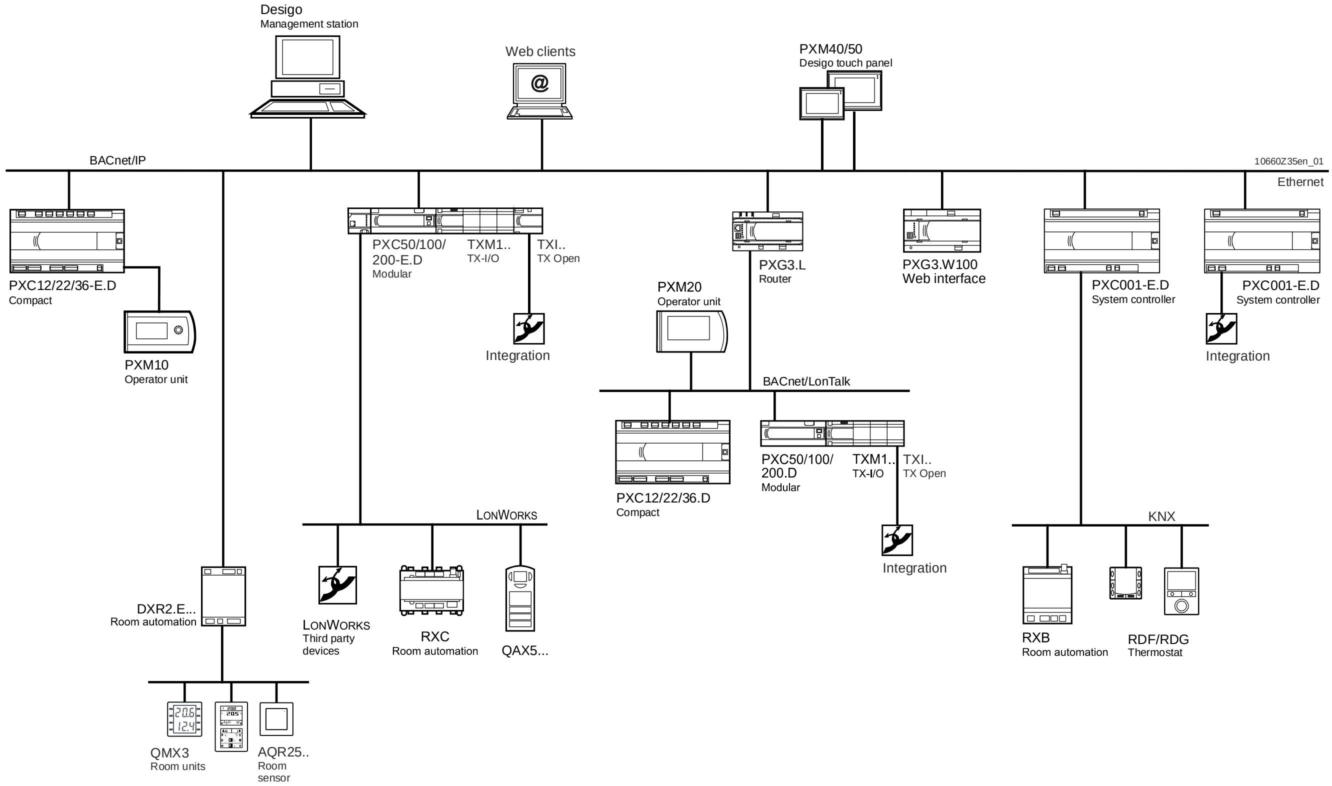


Figure 4: A typical medium system

Large system

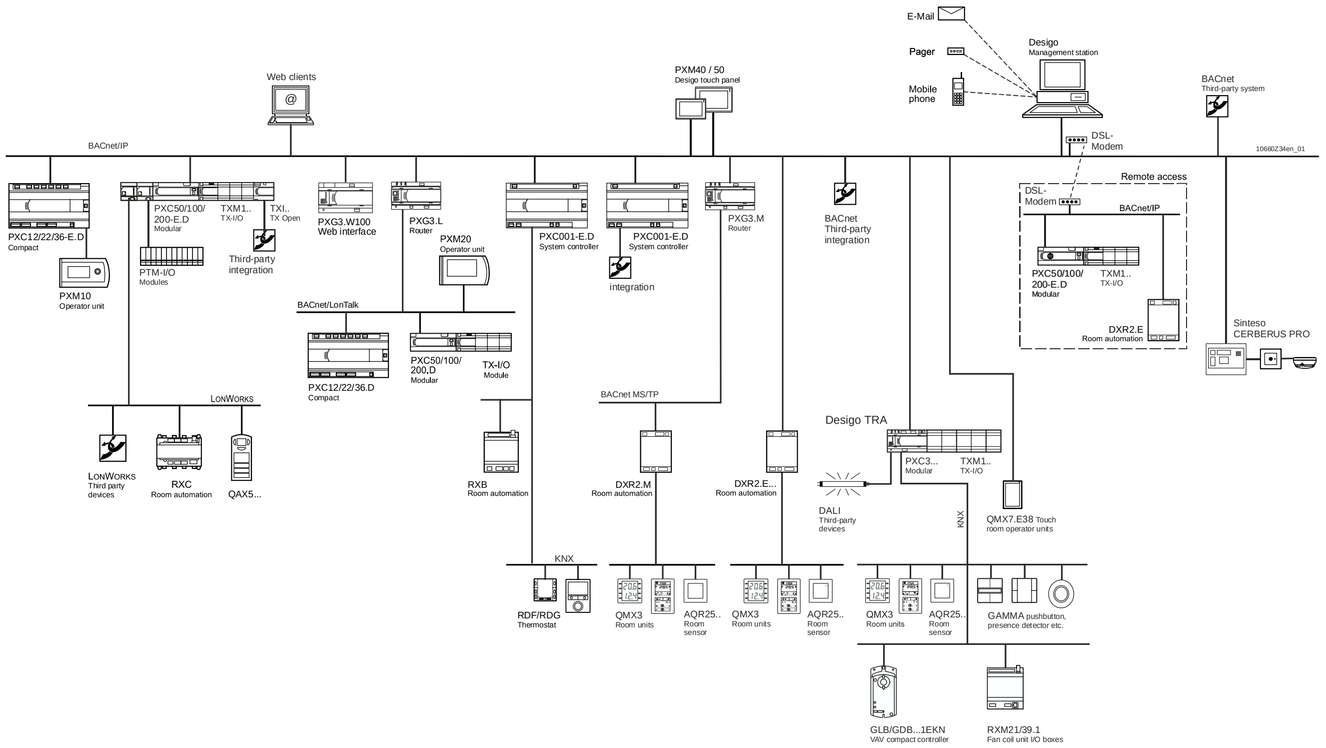


Figure 5: A typical large system

PX site

PX site is a means of structuring large PX projects. Desigo room automation stations are not part of a PX site.

In a PX site one PX automation station is defined as the primary server and all other PX automation stations are defined as backup servers. Every automation station can be defined as the primary server.

The primary server carries out system functions, such as time synchronization, life check and the distribution of global data:

- Time synchronization: The primary server distributes the current time to the backup devices.
- Life check: The backup servers detect the failure of the primary server and the primary server detects the failure of the backup servers. If a server fails, an alarm message is sent. If the primary server fails, another automation station must be defined manually as the primary server.
- Distribution of global data: Global objects are available on all PX automation stations. The primary server synchronizes changes, for example, calendar object, notification class object, that are made on the primary server to the backup servers.

Handling a PX Site in Desigo clients

When PXM20/PXWeb starts, it searches for all primary servers and offers a log in to the PX site.

A Desigo management station site can contain several PX sites and third-party devices. The management station registers itself as a global alarm recipient for the PX site on the primary server.

2.7 Communication Principles

Desigo uses open communications to connect various technical building systems based on open and standardized data interfaces:

- BACnet is used from room automation to the management level
- KNX®, DALI, EnOcean® and LonWorks® are used in room automation and decentralized secondary processes
- M-bus, Modbus, OPC, MS/TP, and other interfaces are used for connecting third-party devices and systems

BACnet

BACnet (Building Automation and Control Networks) is a communications protocol for building automation and control networks. BACnet ensures the interoperability between devices from different manufacturers. See http://en.wikipedia.org/wiki/BACnet.

VendorID

Each BACnet device has a VendorID to identify the manufacturer. The VendorID for the Siemens BACnet system devices is 7.

BACnet over Ethernet/IP

Applications on the management level (for example, Desigo Insight file server) can interact via standard IT network services concurrently to BACnet services.

Desigo supports BACnet/IPv4 and BACnet/IPv6 (via PXG3.M/L router). IPv6 to IPv4 is NOT compatible. The parallel operation of IPv4 and IPv6 is possible with the use of a PXG3.L/M BACnet router. See http://de.wikipedia.org/wiki/IPv6.

Network performance

The performance of the network depends on the following criteria:

- Number of devices on the bus
- Segmentation of the topology via routers (for LonTalk bus)
- Number of simultaneously active clients (PXM20, management station, PX Web)
- Peer-to-peer communication resulting from distributed PX applications
- Other communications services using the same transmission medium, where, for example, office communication on a separate VLAN share the same IP trunk
- Application download on the network

Due to these factors, which can vary widely from project to project, it is not possible to make any generalized statements about network performance. If the specified product quantities are adhered to, performance is adequate.

If the network performance is not satisfactory, the following actions may help:

- Use the same automation station for items of equipment with frequent process interaction.
- Divide the network into segments via BACnet router and an Ethernet/IP backbone.
- Isolate the automation station from the network when downloading an application.

BACnet and IP network structuring

BACnet supports various application services which are transmitted to all BACnet devices (broadcasts). Global broadcasts are blocked by the IP router. BACnet solves this problem by using a BACnet Broadcast Management Device which ensures that IP broadcasts only appear in one IP segment. The logical BBMD functionality can be configured in every BACnet router and in every PX automation station with BACnet/IP. One BBMD can be configured per BACnet/IP port. Devices with BBMD must have a static IP address.

BACnet over MS/TP

MS/TP stands for Master Slave / Token Passing. Each device on the link is considered the master when it has the token. If it does not have immediate need to use the token, it passes the token along to the next device. All devices on the link which do not currently have the token are regarded as slaves, and listen to any messages the current master may have for it. As all devices take turns being master, the link is effectively peer-to-peer.

Use of other network technologies

IP networks (besides the other technologies mentioned above) provide the network infrastructure Desigo devices are connected to. In case a Desigo installation is spatially distributed (for example, several buildings on a campus, multiple branches in a country) the connection of these local IP networks (LANs) normally is done using a Wide Area Network (WAN) or a point-to-point transmission line. These can be based on non-IP technologies but typically are transparent for IP traffic. In this way, all the BACnet devices connected via an IP network can communicate with each other.

Client/Server

A BACnet device can assume two different roles within a system, the role as a server and the role as a client. These roles are defined as follows:

- Client: A system or device which uses another device via a BACnet service (service request) for a specific purpose. The client (for example, management station, PXM20 operator unit) requests a service from a server.
- Server: A system or device which responds to a given service request. The server (for example, PXC automation station, Desigo Room Automation room automation station) performs a service for a client.

Most system devices in Desigo can act either as a client or as a server, but they normally each carry out their more typical role. An automation station is normally a BACnet server, which supplies process data to other system devices (for example, PXM20). The automation station can also act as a client, when it, for example, subscribes to a process value from another automation station.

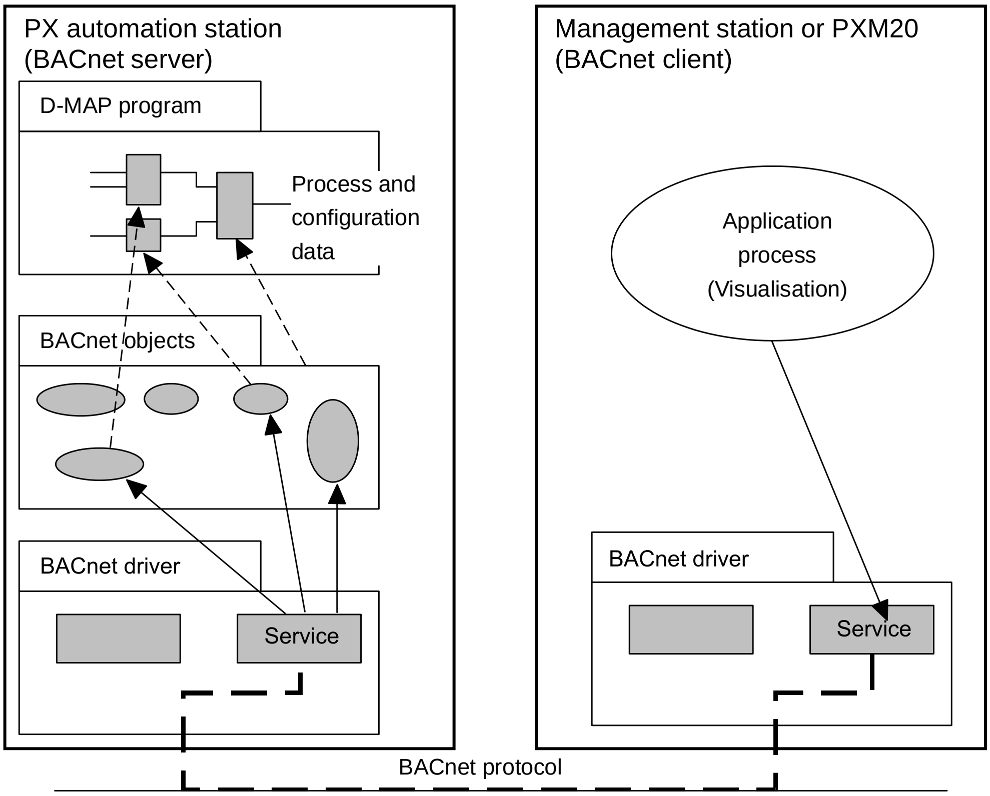


Figure 6: Distribution of client/server roles

Desigo Touch and Web and PX Web are not BACnet clients. The associated operator units (PXM40/50 or browser) are web clients.

BACnet standard device profile

The BACnet standard defines several device profiles that simplify to judge (and test) a device's capabilities against a specified function set. Desigo always tries to work with such profiles and prove their fulfillment by independent test laboratories and respective BTL logos and BACnet certificates.

- The PXC3 and DXR2 room automation stations comply with the B-ASC standard device profile.
- The PXC automation stations comply with the B-BC standard device profile.
- The Desigo Insight and Desigo CC management stations comply with the B-AWS standard device profile.

For a complete list with additional details, see *BACnet Protocol Implementation Conformance Statement (PICS)* (CM110665) and the products page of the BIG-EU website (www.big-eu.org).

BACnet protocol version

Desigo is based on BACnet protocol versions 1.12 and 1.13:

- The management stations are based on version 1.13.
- The PXC3 and DXR2 room automation stations are based on version 1.13.
- The PX automation stations are based on version 1.12.
- PXM20 are based on version 1.12.

In BACnet, it is the BACnet client which ensures the backwards compatibility. As a rule of thumb, a management station should thus have a BACnet revision that is at least the same as all of its connected BACnet servers.

AMEV guideline

Desigo complies with the AMEV guideline BACnet 2011 Version 1.2 with the following profiles:

- Desigo Insight and CC: AMEV profile MOU-B
- Desigo PX: AMEV profile AS-B

Desigo room automation

BACnet is used to exchange information between PX automation stations and DXR2 and PXC3 room automations stations and the management station.

Desigo RX

The Desigo RXB room automation range communicates via KNX S-Mode (EIB) and the RXC room automation range communicates via LonWorks standard.

Restrictions for LonWorks

A LonWorks network cannot be segmented with LonWorks routers, as the message length for BACnet is 228 bytes for performance reasons. Commercially available LonWorks routers do not have sufficiently large buffers for this length. No other media (power lines, infrared, etc.) can be used either.

For performance reasons, we do not recommend the operation of LonWorks and BACnet devices on the same LonTalk cable.

2.8 Data Maintenance

A running Desigo system contains various categories of data, each with different requirements in terms of consistency, period of useful life and visibility. The data is distributed throughout the system, with each category having a unique origin. There is no central data maintenance in the Desigo system. The system data is distributed on all devices throughout the network, but is primarily located in the automation stations.

During the sales, planning, engineering and commissioning phases, project data is created. Part of the data is loaded into the system, while another part is tool-specific and used, for example, for documentation of the project.

System data is:

- Process-data and parameter settings
- Archived data
- Configuration and description data
- Metadata
- D-MAP program
- Graphics and masks
- Libraries
- Offline trend object values

Process-data and parameter settings

Process data

Process data is data generated by the physical process in the building using a process control algorithm. Process data represents the process variables, such as a temperature or a damper position.

Parameter settings

Parameter settings are function parameters, settings, setpoints, etc. which are defined for each plant or project and which affect the way in which an application works. Parameter settings can be modified during operation.

Process data and parameter settings can be accessed within the system via BACnet objects, for example, Present Value [PrVal] and Status [StaFlg], if the associated mapping is enabled in the engineering phase.

If process data is used by several automation stations, the data origin is the location where the physical variable is measured (for example, outdoor temperature) or generated (for example, the control signal from a time schedule). Copies are updated on an event-driven basis after a short delay.

The PXM10 local operator unit does not have its own means of storing process data.

Displaying process data and parameter settings

To display process data and parameter settings mapped to BACnet on clients, only one copy of the data needed for current operation and monitoring is stored. The Desigo system does not store complete copies of process data or parameter settings. The data (copy) required by a client is normally updated via the BACnet protocol on an event-driven basis and with a short time delay.

All process data and parameter settings, even those that are not mapped to BACnet objects (engineering setting), can be monitored and operated in Xworks Plus (XWP). BACnet clients only see what is available via BACnet.

If several clients modify the same process data, the last change is accepted.

Volatile and non-volatile process data and parameter settings

The majority of the process data is volatile data, which is recalculated when the automation stations are restarted. However, certain process data is retained even after an automation station restart, for example, self-adaptive control parameters, run-time totalizers, etc., which are specifically identified as such in a function block. Even in the event of a program change, this non-volatile process data remains in memory and can be read back with XWP.

All parameter settings are non-volatile, that is, they are retained in the event of a power failure.

Readback

All non-volatile PX process data and parameter settings can be read back into XWP. However, parameter settings in the PXM20 operator unit cannot be read back into a tool.

Global parameter settings

Some parameter settings are identical in all automation stations, for example, date and time, calendar function blocks and Notification Class function blocks. To ensure consistency, they are held in global objects which are automatically replicated in the system.

Archived data

Setting parameters can be logged and archived. Archived data illustrates the response of process or system variables or events over a time period. For example, trend data can be moved from the trend database into archive files. Archived data are typically lists of one or more of the aforementioned variables and are preferably stored and processed on the management level. Only small amounts of data are archived at the automation level. Such data is normally forwarded to the management level.

Ensuring consistency

Archived data only requires a consistency check in cases where it has been moved from one application to another, for example, from the automation level to the management level. The data origin is not deleted until a check has been carried out to ensure that the data has been transferred in full. This data is stored in the non-volatile memory.

Irregularities in the logging of archived data are recorded in the data itself.

The life of the data is determined either by the user or by a configurable application which automatically condenses or deletes this archived data.

Configuration and description data

Configuration and description data is data which is defined for a specific system or project and only affects the appearance and response of the plant for operation and monitoring purposes. Some configuration parameters are tool-specific and control the options in XWP (for example, connection allowed / not allowed, etc.). Most configuration parameters, however, are mapped to BACnet and are available to the clients. Typical data in this category is COV increment, operating limits, access level, descriptive text, engineering unit, etc.

This data is defined during engineering and always originates in the tool itself. Normally, the data is predefined with likely default values or even generated automatically from the context. This data is static and cannot be modified during operation. It is therefore not subject to consistency problems, and may be duplicated elsewhere in the system (for example, on the management station) to improve performance. If engineering changes are made, you must ensure manually (through data import) that the copies are identical to the original data in the engineering tool.

This data cannot be read back from the automation stations, and must therefore be stored with the project data.

Metadata

Metadata is project-independent data from standard BACnet objects (for example, analog input, schedule, etc.) which needs to be known by a tool or a client, for example, texts for predefined BACnet enumeration, maximum size of arrays, data-type information, fixed operating limits, etc. The metadata is loaded into the relevant clients or tools at HQ and (except texts) cannot be modified after delivery. Text, like the text for BACnet enumeration referred to above, must be localized (language translation) and distributed to the clients and tools. This is part of the localization process.

D-MAP program

The D-MAP program is an executable program, and contains instances of the function blocks with the associated process data and parameter settings, the configuration and description data and the interconnection and order of processing of function blocks.

The D-MAP program can be modified during operation either by reloading the complete program including any changes, or by delta (differential) loading. Delta loading only reloads the changes.

The D-MAP program is generated in XWP/ABT from the information in the program charts, compiled and downloaded into the automation station.

Libraries (LibSet)

The Desigo Library Set (LibSet) is a set of mutually interdependent libraries that belong to a given Desigo system version.

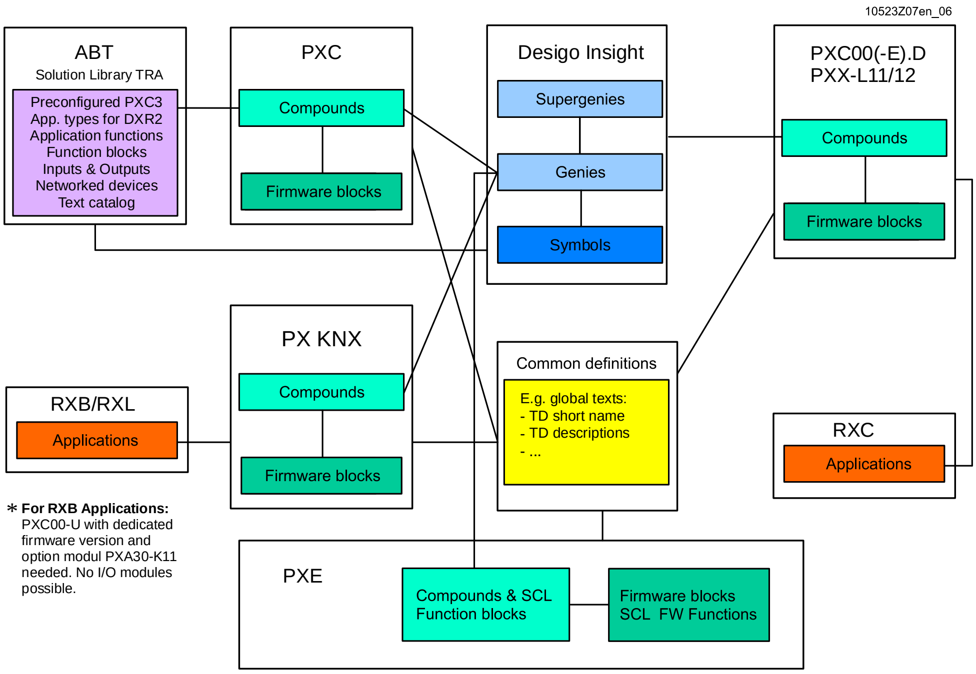


Figure 7: Libraries (LibSet)

The library contents are continuously extended. Every *LibSet Extension of Desigo* (LED) is a comprehensively tested collection of solutions covering all the necessary parts of the Desigo system.

The LibSet version number defines which LED runs on which system version. The first part of the version number represents the applicable system version.

A LED includes the latest library per automation station type (PXC, PXC00(-E).D, PXX-L11/12, PXKNX) for the latest Valid Version Set.

New LEDs are delivered at regular intervals. The individual LEDs are consecutively numbered (LED0 to LED16).

LibSet version number

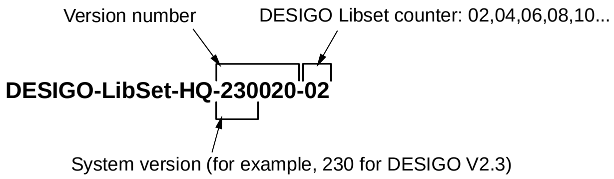


Figure 8: LibSet version number

Desigo LibSet consists of various libraries for all system levels:

- Desigo Insight library
- Shared text library for PXC, PX KNX, PXE, PXR
- PXC library
- PXKNX library (RXB)
- PXE library
- PXE SCL library (Structured Control Language)
- PXR library
- RXC library
- Library to monitor primary plants
- Library for collaboration between Desigo PX and Desigo Room Automation
- ABT library (Desigo Room Automation Solution Library)

LibSet version number and LED

When a LibSet version number is released (new LED), the incremental part of the version number is increased accordingly, for example: Desigo-LibSet-HQ-410080-10 > Desigo-LibSet-HQ-410080-20

The remaining numerical values in the decade (for example, 11 to 19) can be used by the RCs for localization versions.

If the version number changes, the LibSet number is reset to 10 again. If the scope of the Desigo application changes, the LED number is also incremented, for example: LED02 > LED03

The following table shows the relationship between LED and LibSet version numbers and an overview of current and planned application content for the Desigo LibSet. The necessary Desigo Insight genies are included.

LED	Description	LibSet version number	Date
LED00	Basic application content for LibSet	Desigo LibSet-HQ-220031-02	August 2003
LED01	PXC: Additional applications for ventilation and heat generation and distribution	Desigo LibSet-HQ-220031-04	October 2003
LED02	All RXC applications for refrigeration generation and distribution	Desigo LibSet-HQ-220041-02	December 2004
LED03	PXC: Applications for refrigeration generation and distribution RXC: Additional combined applications (INT..)	Desigo-Libset-HQ-220041-06	March 2004
LED04	PXC: Air quality and domestic hot water applications and recovery function after power failure	Desigo-Libset-HQ-220041-08	June 2004
LED05	RXB room automation PXC: District heating application Temperature cascade / Humid supply air control Field test version for peak load program	Desigo LibSet-HQ-230010-02	September 2004
LED06	PXC: Additional applications for ventilation and domestic hot water Desigo Insight: Update to genie library for Visonik, Unigyr and Integral	Desigo LibSet-HQ-230010-02	January 2005

LED	Description	LibSet version number	Date
LED07	PXC: Additional solutions for ventilation facilities, refrigeration plants, heating functions, heating plants and universal functions	Desigo-Libset-HQ-230010-06	November 2005
LED08	PXC: Like LED07 and compounds for QAX, RX DI: Genies for lab management integration PXR: Compounds for Lab Management integration	Desigo-Libset-HQ-235040-02	November 2005
LED10	PXC: Heating degree days, three-point actuator, storage management, adjustment of humidity control	Desigo-Libset-HQ-235040-04	July 2006
LED11	Like LED10 and RXB and RXL integration solutions	Desigo-Libset-HQ-236040-02	July 2006
LED12	PXC: Solution for combined heating/cooling circuit, room model, quality monitoring of control circuits, leakage suppression PX/KNX: New integration compounds	Desigo-Libset-HQ-237030-02 Desigo-LibSet-HQ-236050-04	February 2007
LED13	PX Open compounds	Desigo-LibSet-HQ-237070-02	December 2008
LED14	PXC: Additional applications for ventilation facilities, heating/refrigeration circuit, heating circuit Heat storage tank and trend	Desigo-LibSet-HQ-400210-10	March 2009
LED15	PXC: Energy-efficient application AirOptiControl for ventilation and air conditioning plants Compounds to integrate Grundfos and Wilo pumps	Desigo-Libset-HQ-410090-10	April 2010

LED	Description	LibSet version number	Date
LED16	PXC: CAS21 (HVAC) Compound for Desigo Room Automation demand signals, compounds for pumps and fans based on PTM16.xx PXC: CRS01 (Collaboration Room Solutions) Compounds for Desigo Room Automation collaboration PXC: MON01 (Eco monitoring) Monitoring compounds und standard solutions for monitoring primary plants ABT (Desigo Room Automation): - TRA02_V5.0_HQ_ABT1.0 (for firmware TRA V5.0)* - TRA03_V5.0_HQ_ABT1.0 (for firmware TRA V5.1)* Basic library for integrated Desigo Room Automation room solutions (HVAC/Lighting/Shading) -TRA01_QMX3V5.0_V5.1_HQ_ABT1.1 (firmware TRA V5.1)* Like TRA02/TRA03_V5.0_HQ_ABT1.0 (see above) plus room units QMX3.P34, QMX3.P34, QMX3.P37, QMX3.P02 with V5.0 functionality like with QMX3.P36	Desigo-Libset-HQ-500204-10	March 2012
LED17	PXC: CAS22 (HVAC) Integration variable speed drive G120P	Desigo-Libset-HQ-500260-10	October 2012
LED20	PXC: Ventilation & air conditioning: Extensions for night ventilation, room temperature monitoring, predefined trend objects, timer function, temperature and humidity control, outside temperature controlled heating and cooling function, fire control Heating: Extensions for hot water coordinator. PX KNX: CAS09 Integration RDG/RDF/RDG ABT (Desigo Room Automation): - TRA01_V5.1_HQ_ABT1.1 (for firmware TRA V5.1)* VAV application extensions, chilled ceiling and fan coil application, boost heating and optimum start/stop, air quality applications, extended support for QMX3/AQR25	Desigo-Libset-HQ-510xxx-10	Summer 2013
LED21	PXC: - MON Library changed Compounds: SetRlb-Pin at KPI is set, if there is invalid information - This state is displayed in EcoViewer, All Observers are now changed to reduced I/Os ABT: - TRA03_V5.1SP_HQ_ABT1.1 - Extended support for QMX7	Desigo-Libset-HQ-51SPx-10	March 2014

Table 2: LibSet version number and LED

Key:

* The PXC3 room automation station supports several firmware versions independent of the functional content of the application library.

Desigo CC

The application libraries for Desigo CC are delivered as extension modules for the respective system versions. For information about compatibility, see *Desigo CC System Description* (A6V10415500).

2.9 Views

There are four views:

- Technical view
- User view

- System view
- Program view

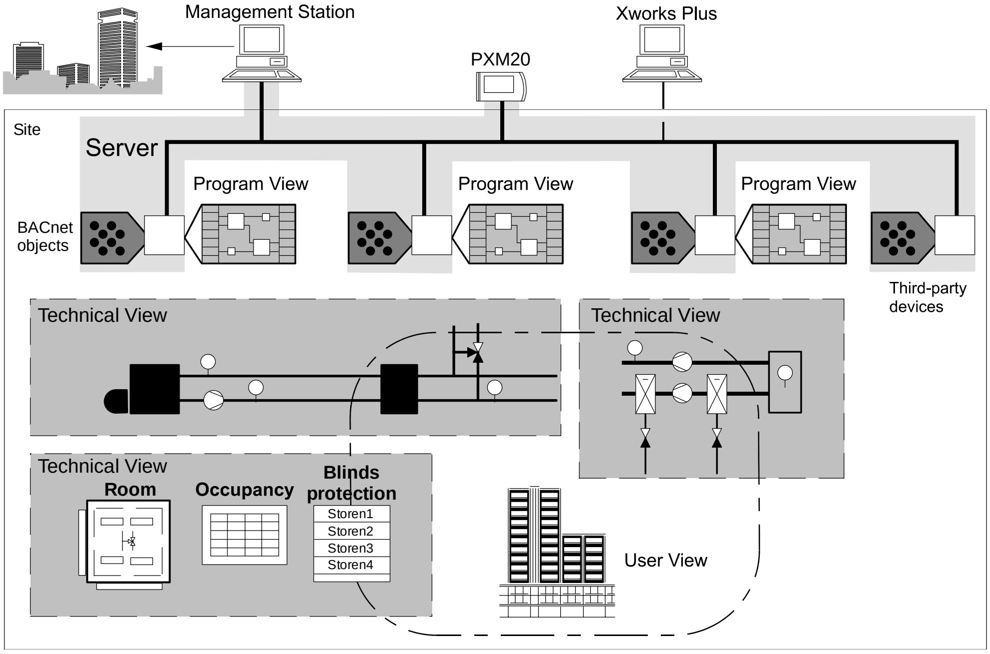


Figure 9: The technical, user, and program view in the building automation and control system

Technical view

The technical view illustrates the technical building services equipment, such as HVAC systems and associated elements, in the building automation and control system. The technical view is always present and can be used as a substitute for the user view if the user does not have his own user designation.

User view

Freely defined and structural user view

The user view is optional in a project. The user view is based on user designations, for example: PL7'FL3'ELE"HEAT.STPT

The structure and syntax of the user designations can be defined for each specific project and customer. Example of a structure: Installation/building/room/plant element/signal

User view via the User Designation (UD)

Desigo supports different user views, depending on the application:

In Xworks Plus (XWP) a User Designation (UD) can be entered for function blocks or compounds in addition to the Technical Designation (TD) and description. This entry is carried through in the system and can be evaluated by clients. The UD allows customers to use their own preferred designations for the plant without changing the technical structure. The UD can be used in the management station in addition to the TD. The detailed view in the PXM20 operator units shows the UD as information.

User Designation for Desigo Room Automation

You can define the user view for Desigo Room Automation as follows:

- Define a structure for the user view
- Copy Desigo Room Automation objects into the user view
- Define UDs that can be used as object names

System view

The system view shows the standard system hierarchy (BACnet view):

- Network, topology
- Device and third-party device view
- Flat representation (no hierarchy) of all BACnet objects in one device

The system view provides access to all BACnet devices (including third-party BACnet devices) and all BACnet objects. A third-party client displays this view of a PX device.

The system view is used in the PXM20 only for third-party devices.

Program view

The engineering and program view corresponds to the XWP/ABT view. The structure is matched to the automation station. Within an automation station, the view is program oriented: nested CFC charts (compounds) and function block instances.

Views and users

The views reflect the differing needs of their users. The following table shows the users of the system and the type of view each might prefer.

Per	User	Technical view	User view	System view	Program view
1	Operator (without technical training)	Main view	Main view	No access	No access
2	Operator (with technical training)	Main view	Main view	Occasionally	No access
3	Engineer (management station), User (PXM...)	Main view	Main view	Occasionally	No access
4	Service engineer, Siemens service engineer	Main view	Rarely	Rarely	Main view

Table 3: Views and users

Flexible object name / device ID engineering

You can flexibly generate the object name during engineering in XWP. This is called the Free Designation (FD). However, the FD has no inherent hierarchical structure, which makes it tedious to engineer and lowers its helpfulness to orientate in larger buildings. It should thus be considered as a naming type for very special purposes only.

Flexible object name engineering causes a greater engineering effort and must thus be requested specifically by the customer.

Each BACnet object has an object name for identification on the BACnet network. This object name must be unique within the automation station. The Technical Designation (TD) is used as default for the object names. The TD is a technical identifier and is used to identify the plant and associated elements in the technical view.

You can select how the object name is created for each standard BACnet object. This especially applies to BACnet multivendor projects, where a special object name structure is required.

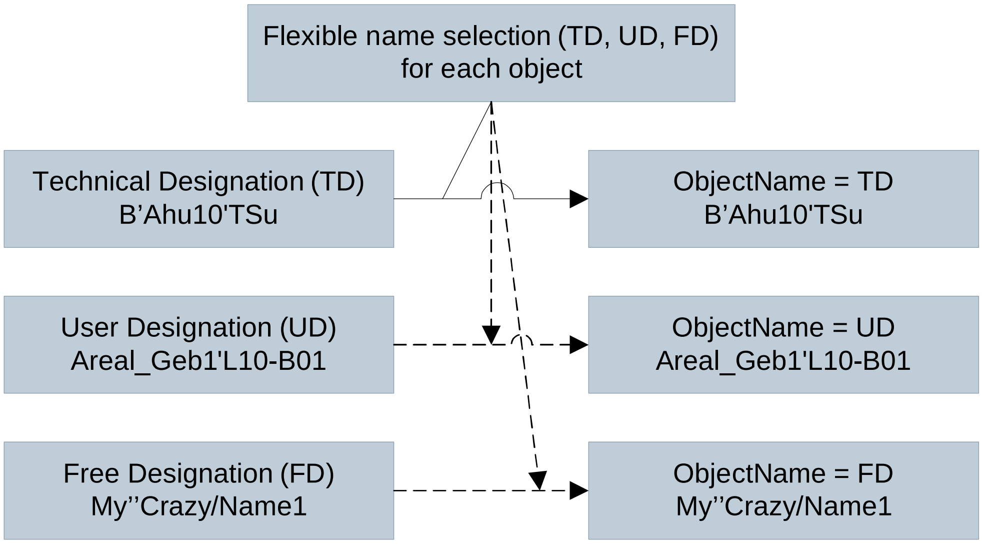


Figure 10: Object name engineering

Defaults and rules

The following defaults and rules apply when you engineer the object name in the XWP Hierarchy Viewer:

- The Free Designation (FD) can be max.69 characters.
- Only ISO-Latin-1 code points from [32..127] and [160..255] may be used. This excludes all characters from [0..31] and [128..159]. These ISO-Latin-1 code points are identical to Unicode code points.
- No lead or post blanks [32] may exist and object names containing only blank characters are not possible.

The FD values and the object name selection are transferred automatically to the automation station or exported to the management station during compiling or loading in the CFC.

The CFC Editor checks during compilation if the object name is unique for each automation station under the following rules:

- The same resulting object name may exist only once per automation station. This also applies to the device object that must be unique in the BACnet internetwork.
- The resulting object name may not correspond to a TD of another object in a Device. The TD is used to resolve BACnet references.

Exceptions for object name assignment

Object names cannot be engineered in CFC charts or compounds. These elements always define the TD and the object name is always the same as the TD.

Special blocks, such as Heatcurve and Discipline I/Os generate reduced value objects in the background whose object name per default is the TD during compilation.

Free definition of the Device ID

The device ID (the object ID of the device object) can be freely defined. Range: 0…4'194'303

3 Desigo Workflow, Tools and Programming

The Desigo tools cover parts of the technical process and parts of the Desigo system.

Main tools

The most important tools are:

- Desigo Configuration Module (DCM): For designing the Desigo system in the sales phase
- Xworks Plus (XWP): For engineering, commissioning and servicing Desigo PX system components
- Automation Building Tool (ABT): For engineering, commissioning and servicing Desigo room automation system components

Special tools

There are also special tools, for example:

- Tools for configuring and commissioning specific product families, such as RXT10 for the configuration of room devices on LON
- Tools for specific tasks, such as the AL Migration Tool for the migration of legacy system components to Desigo PX

  See *Automation level migration, Engineering manual* (CM110776).

3.1 Coverage of the Technical Process

The Desigo tools are used in the technical process, especially for designing the system in the sales process, for engineering, commissioning, and servicing. The tools have interfaces to specific tools of the regional companies, such as tools for designing electrical wiring diagrams.

Which processes do the tools cover?

The Desigo tools cover the entire technical process from sales to service:

- Sales
- Planning
- Engineering
- Installation
- Commissioning
- Service

For service operations the Desigo tools support remote data access to project data via Branch Office Server (BOS). SSP provides the service platform.

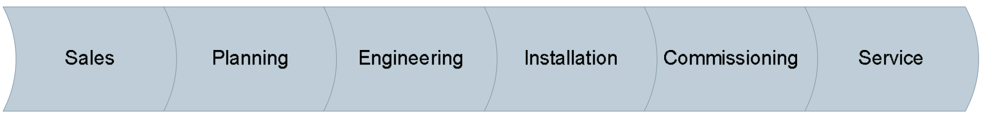


Figure 11: Technical process

Europe	Sales	Planning	Engineering	Installation	Commissioning	Service
STST	•					
DCM	•					
XWP			•	•	•	•
ABT			•	•	•	•

Table 4: Coverage of the technical process by Desigo tools

USA	Sales	Planning	Engineering	Installation	Commissioning	Service
STST	•					
DCM	•					
ABT			•	•	•	•
Apogee tools			•	•	•	•
Desigo tool	•	•	•			

Table 5: Coverage of the technical process by Apogee and Desigo Tools

Sales

DCM supports system design and quantity determination during the sales process. Price calculation, offer preparation and tracking, and invitation of tenders are supported by country-specific tools.

Planning

The planning tools are country-specific and comprise the following:

- Network planning, design and documentation
- Cable planning and design (network cables, field device cables)
- Texts for equipment plates
- Building planning (system components in the building, room segmentation)
- Plant planning and documentation (plant schematics, function description)
- Planning of the groupings for Desigo Room Automation
- Order lists

Engineering

Most of the Desigo system components are engineered offline, before they are commissioned. This way you can verify and document the configuration (for example, for the uniqueness of addresses), and define work packages for subcontracting.

XWP and ABT are Desigo engineering tools and allow the following:

- Engineering the primary equipment, room automation, BACnet router
- BACnet references for the integration from/to third party systems
- Interfaces to ElektroCAD, Pharma Validation
- Exports for documentation
- Export for management station engineering

Desigo CC is engineered in Desigo CC and Desigo Insight is engineered in Desigo Insight:

- The tool export generates information for illustrating the generic operation (technical hierarchy, User Designation hierarchy)
- The tool export contains information for efficiently generating graphics (mapping functions to genies and supergenies in Desigo Insight and symbols and graphic templates in Desigo CC)
- Graphics are engineered in the management station engineering editor

Installation

XWP and ABT allow the following:

- Creating order lists that can be used for ordering the devices
- CAD export for connecting to ElektroCAD for designing control cabinets
- Parallel working of several subcontractors/engineers in a project
- Creating pack and go's for commissioning and the point test for subcontractors
- Loading configurations
- Creating commissioning data point lists

Commissioning

XWP and ABT allow the following:

- Commissioning of the systems (loading programs, program function test)
- Online trending during commissioning

- Diagnostics during commissioning
- Parallel working of several commissioning engineers in the project

Service

XWP and ABT allow the following:

- Data access to Branch Office Server (central engineering data management of the regional companies)
- Data security (reading system data in the engineering database)
- Remote engineering and operating, diagnostics and error recovery via an external network connection

3.2 Coverage of the System

The Desigo tools cover all levels of the Desigo system except the management stations:

- Xworks Plus (XWP) covers Desigo PX.
- Automation Building Tool (ABT) covers Desigo Room Automation.

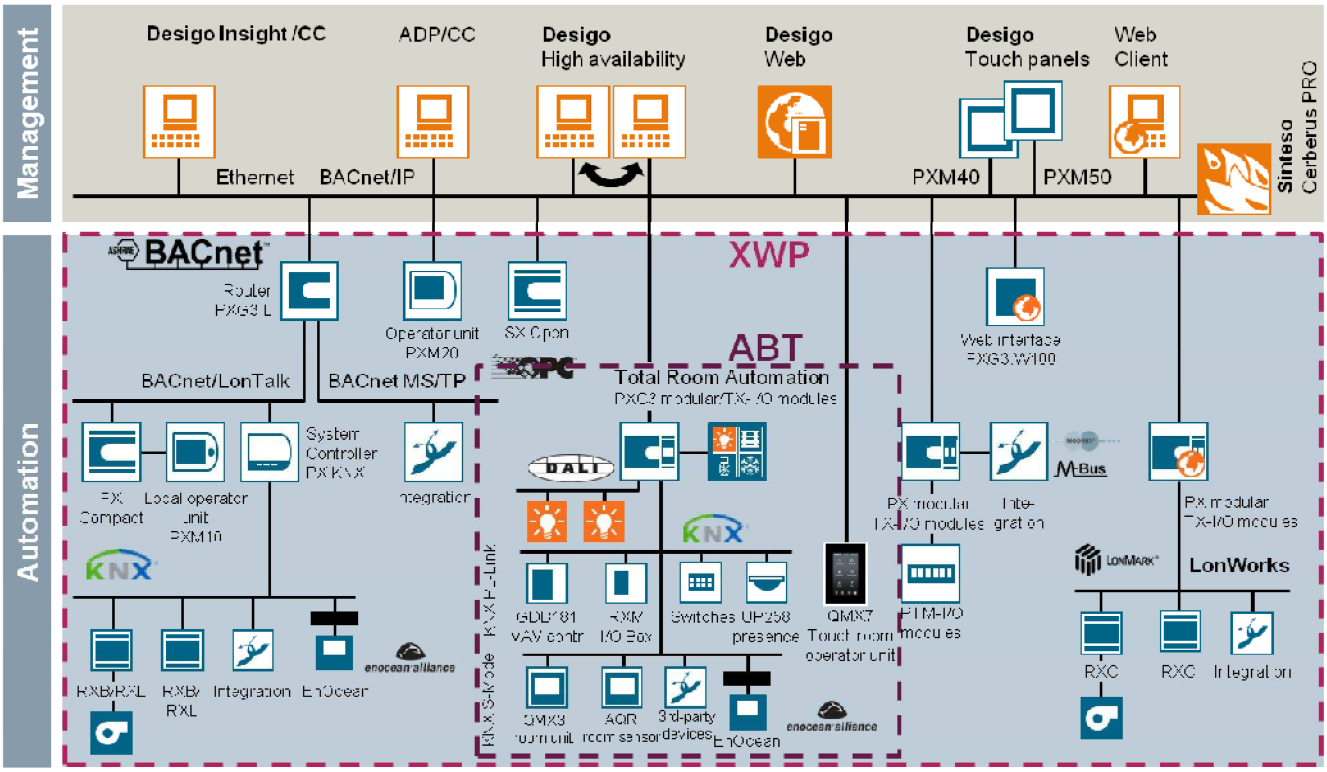


Figure 12: XWP and ABT cover almost all levels of the system

Tools for Desigo PX

The following tools are used for Desigo PX:

- DCM: For designing the system and determining the necessary quantities
- XWP: For configuring and commissioning BACnet routers
- LNS Tool: For loading applications into the RXC controllers
- ACS: For configuring, commissioning and operating Synco and RXL/RXB devices
- PX KNX Tool: For configuring the KNX side of the PX KNX system controller
- AL Migration Tools: For migrating Unigyr, Visonik and Integral to Desigo

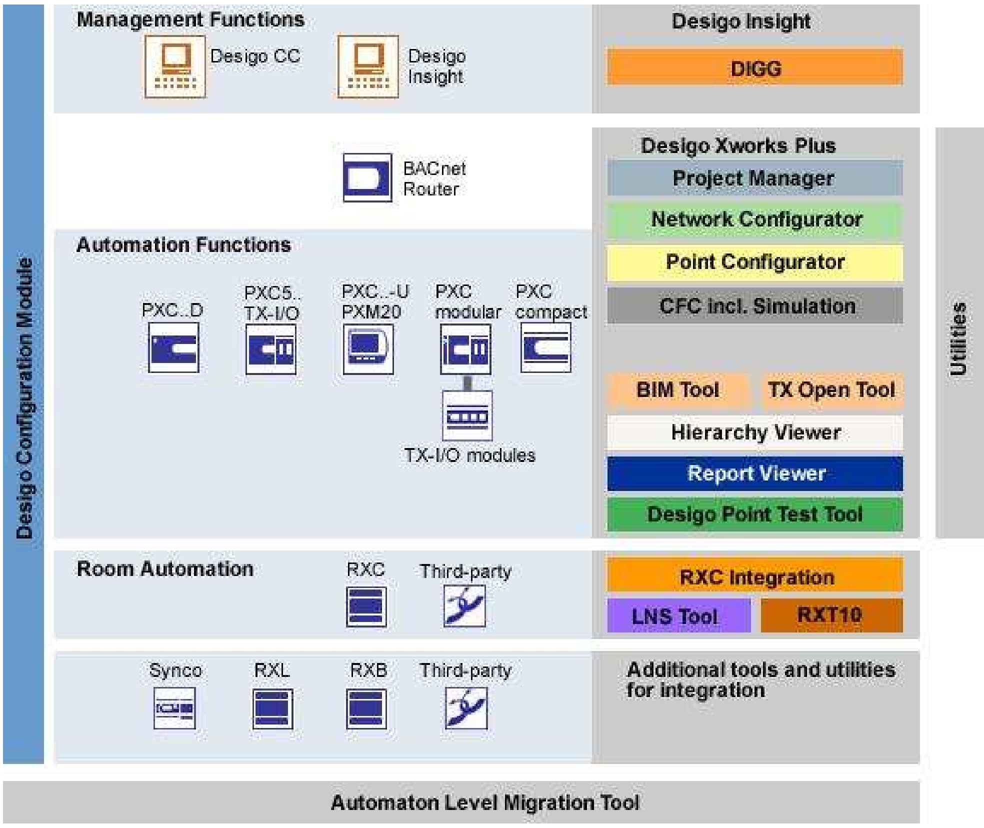


Figure 13: Tools for Desigo PX

Tools for Desigo Room Automation

The following tools are used for Desigo Room Automation:

- DCM: For designing the system and determining the necessary quantities
- XWP/ABT:
  - For configuring, programming and loading PXC3 room automation stations
  - For integrating KNX devices into Desigo Room Automation (on KNX PL Link Bus)
  - For engineering and commissioning PXC3, TX-IO, In-Room Bus DALI and KNX PL Link

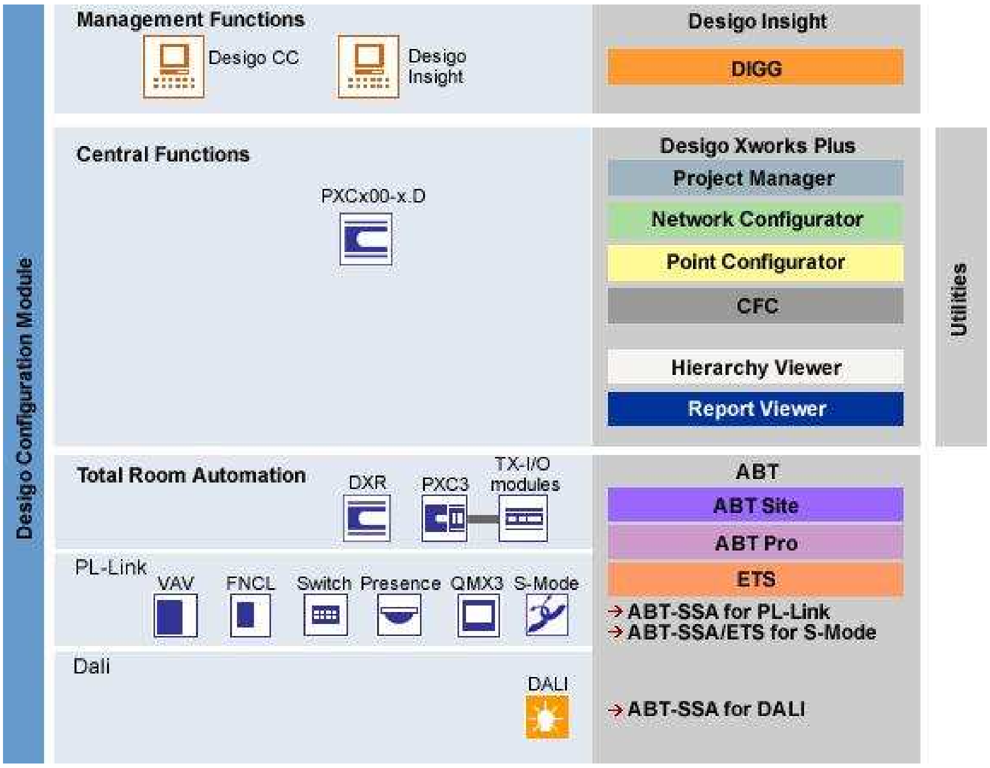


Figure 14: Tools for Desigo Room Automation

3.3 Main Tasks

What's covered by the Desigo tools?

The Desigo tools let you design, document and maintain Desigo systems, that is, you design and document technical configurations and programs for the Desigo system.

What's NOT covered by the Desigo tools?

The following processes and products are covered locally by SSP or VAPs and not by the Desigo tools:

- Sales: Offer preparation and tracking
- Planning/Engineering: Network planning and design, floor plan, cabling, designing control cabinets, designing electrical wiring diagrams, creating rating plates, validating pharma systems
- Project management: Ordering devices, project planning, claim management, project task planning
- Service management: Service database for devices, network planning, remote service platform

Sales support

Desigo Configuration Module (DCM) supports the calculation of the Desigo configuration for the sales process.

You can verify if:

- The Desigo configuration is technically correct, that is, the solution that was sold can be implemented with Desigo
- The system limits have been taken into account, that is, the number of possible devices and functions in the network is verified
- The quantity is correct, that is, correct device types for the automation and room functions, field devices, accessories and licenses
- Services are correctly calculated

- The design for the review with the customer is well documented
- Prices are correct (regional companies can add their prices to the DCM database)

Configuration and programming

The configuration and programming flexibility of system devices depends on the product or product family. Some devices contain preloaded applications and connections only to specific periphery device types.

You can configure and parameterize the devices offline or partly online with a configuration tool. You can replace the preloaded applications on some devices in the project.

You can freely program some devices. To create loadable applications, you can use libraries to assemble project-specific solutions.

Degree of standardization and flexibility

The following table shows engineering methods by degree of standardization and flexibility:

- Level A: High degree of standardization with predetermined flexibility
- ...
- Level E: Low degree of standardization with very high flexibility

Solutions with a high degree of standardization

Solutions with a high degree of standardization are:

- More efficient to configure and commission than freely programmed solutions
- Easier to maintain, because the functions are verified and well documented

Solutions with a low degree of standardization

Solutions with a low degree of standardization, that is, freely programmed solutions, are:

- More laborious to create and document
- More error-prone than verified solutions
- Harder to maintain in the service phase, because they do not adhere to the standard and are often not as well documented as verified solutions

The intermediate levels B, C and D allow you to choose a solution with the right balance of flexibility and standardization.

	Level	Description	Library	Example	Engineering Effort
Standard	A	Solution Browser in XWP	Locked CAS solutions	AHU10	Low
	B	Solution Configurator in CFC, CAS library	CAS solutions, aggregates, components	AHU10, fan, valve	
	C	CFC programming, CFC library	Charts, blocks	CAS library with charts	
High flexibility	D	CFC programming, solution creation	Charts, blocks, LMU (Library Maintenance Utility), simulation	RC library	High
	E	CFC programming, SCL block creation	CFC, SCL, simulation, LMU, development tools	HQ library	

Table 6: Desigo PX

	Level	Description	Library	Example	Engineering Effort
Standard	A	Application selection	Application type	Standard, VAV	Low
	B	Application assembling	Application modules	Blind, radiator, light	
	C	Application creation	XFBs	VAV	
High flexibility	D	Application engineering	CFC FB's	Regional specialties	High
	E	Development	All levels	All	

Table 7: Desigo Room Automation

Level A

You can create solutions with the available options and variants with little prior training and detailed knowledge.

The device is preconfigured and can be configured for the specific project. The functions are predefined. You can configure the application using options and variants. You can set the function of the application and the peripheral devices with a configuration tool. The solutions are delivered by HQ as verified and documented solutions.

Level B

The device can be configured for the specific project. You can assemble the application using library elements. This is a major advantage of the Desigo application libraries. Even though assembling a solution is relatively easy, the functions of the solutions are powerful. Using many options and variants, you can customize the standard solutions to your project requirements.

Level C

The device is preconfigured and can be configured for the specific project. You can assemble the application using library elements. You can program the application with default function modules with predefined interfaces. You can program using simple programming functions.

Level D

This level offers full flexibility, but requires detailed knowledge of the application's structure, the programming tools, BACnet and the Desigo system functions. You can program in CFC (Continuous Function Chart) with basic function modules. You can use all available programming functions. You must ensure that the programs you develop fit together regarding execution, priorities, auto-connecting in the tool, interface usage, etc.

Level E

This level offers full flexibility, but requires detailed knowledge of the application's structure and the programming tools. You must ensure that the functions of the program work. You must ensure that the programs you develop fit together with all elements in the library and that they are well tested and documented. You must take care of the compatibility, the versioning and the library packaging.

Creating a technical hierarchy

The technical hierarchy is the BACnet view on the Desigo system. It is based on the plant-related structure in the building. This hierarchy is defined during engineering. In special cases, if the customer requires it, the technical hierarchy can be built according to a plant-specific structure defined by the customer (user designation).

This lets, for example, the customer in the management station view the building according to this structure:

- Building topology (area, building, floor, plant, plant section, etc.)
- Naming in the system (names according to technical hierarchy, user designation or free designation)

Creating loadable components for the automation stations

The result of the engineering are loadable configurations:

- Configuration of the automation station: Network configuration (IP, LON, MS TP addresses), BACnet configuration (BACnet name and BACnet ID)
- Application: I/O configuration and setting parameters or program (for programmable automation stations)
- Operating language: When you load the configuration, the operating language for the generic operation is also loaded
- Firmware: For system upgrade or bug fixing

Creating the configuration of operation

The system devices can be operated locally, over the web, on a touch panel or a management station. Operations can either be generic (without additional engineering) or dedicated (with additional engineering via favorites or operating graphics).

- The generic operation is based on the technical hierarchy. It must not be engineered.
- The room operation can be configured.
- Favorites are a simple grouping of operable elements in a summarized view. This view can also be generic, for example, as a favorite in ABT-SSA, or it can be engineered, for example, as a favorite for PXM20.
- The graphic operation must be engineered.

Installation, test and commissioning

An I/O configuration must be loaded for the point test. An application program is not always loaded with the configuration.

You can carry out a point test with an application program if the application program can be turned off during the point test. This way you can carry out a test if, for example, a central security function would prohibit you from operating the I/O, for example, if a central security function does not allow lowering the blinds.

The test protocol can store which points have passed the test and which points have an error.

Creating local documentation and project documentation

The tools have two types of documentation:

- Local documents (work documents, simple templates, Excel exports) can be used to, for example, verify results. You can, for example, export them to Excel and add additional data to them.
- Project documentation (template with logo, author, table of contents, etc.) can be attached to the customer documentation either in printed form or as a PDF.

Managing project data

You can manage project data in three ways:

- Local project data management - You can save project data locally, that is, on the local computer or on a share.
- Project data backup - You can create project data archives to, for example, locally save the intermediate status of engineering data.
- Project data on the Branch Office Server (BOS) - You can store project data on a BOS. This allows:
  - Data storage on a server, incl. data backup
  - Control of project data access, through login data
  - Checking project parts in and out for working on engineering data in parallel

3.4 Tools for Different Roles

In a project different roles are responsible for different tasks. Based on these roles, there are various tool packages with different functions and licenses.

Role	Description	Application area
Application Engineer	Can reprogram applications on a project-specific basis.	System and room automation
Design Engineer	Can carry out a project. Can select and configure solutions from the library.	System and room automation
Commissioning Engineer	Can commission solutions, Can configure applications online.	System and room automation
OEM, Installer	Can carry out a project. Can select, configure and commission solutions from the library.	Room automation
Electrical Installer	Can load configurations. Can configure devices. Can test points.	System and room automation
Balancer	Can balance rooms regarding air and water supply.	Room automation

Table 8: Roles

Tool	Tasks	Application / Design / Commissioning Engineer	Adv. OEM Installer	OEM, Installer	Electrical Installer	Balancer
XWP	Create projects and reports, design networks, BOS	•				
ABT Site > Projects	Create and open projects		•	•	•	•
ABT Site > Building	Create building structure and grouping hierarchy	•	•	•		
ABT Site > Configuration	Configure applications, mass create devices	•	•	•		
ABT Pro	Configure HW, edit applications, CFC (TIA), debug	•	•			
ABT Site > Startup	Device discovery, persistence of readbacks, set up nodes, load web pages, ABT-SSA for KNX PL-Link, MS/TP	•	•	•	•	• Simple GUI
ABT Package		XWP ABT	ABT	ABT Site	ABT Site not licensed	ABT Site not licensed
ABT-SSA Access via role and password	Point Test Operate and monitor Balancer	• • •	• • •	• • •	• • 	 •
ABT-SSA						

Table 9: Tools for different roles

3.5 Working with Libraries

Libraries ensure efficiency and quality.

HQ libraries

There are HQ libraries for every engineering level. HQ libraries:

- Allow you to work efficiently
- Are verified

- Are well documented
- Are based on a text data basis that allows you to switch the language in engineering, that is, the library is language neutral
- Are versioned
- Can be installed with the library setup

RC libraries

Based on HQ libraries, you can create country-specific RC libraries that cover country-specific function requirements.

Project-specific libraries

Project-specific libraries are based on HQ or RC libraries and contain components with the specific settings needed in the project. This lets you use reuse already configured solutions in the project.

3.6 Working in Parallel and Subcontracting

Project data management during parallel working

Project data management for the Desigo tools allows several users to work in parallel in different phases of the customer project, for example:

- Several users are engineering and commissioning in the same project
- Parts of the project are outsourced to subcontractors, for example, for the point test

To ensure the consistency of the project data, parts of the project data are stored on the Branch Office Server (BOS). This way several engineers cannot modify the same data elements of the data basis at the same time.

Check-in/Check-out mechanism

The check-in/check-out mechanism ensures that when several users are working in parallel during engineering, commissioning or service, they cannot make changes to the same automation station. This way no inconsistent data can be created.

To quickly transfer project data, the data is compressed before it is sent from the computer to the server. The data is managed on the Branch Office Server. The project creator transfers the data from his local hard disk to the server.

In large projects the data can be moved in two steps:

1. Step: Part of the project is transferred from the Branch Office Server to a computer in the plant.

2. Step: Parts of the transferred project can be transferred to local computers. This is called a sequential check-out.

Parts of the project, such as the building or network topology are checked out in read-only mode, so that all users always have the project overview.

Working in parallel during engineering

Several users can work on different automation stations in the same project at the same time. To do this, data is transferred from the central data storage on the Branch Office Server to the local hard disks. For example, individual automation stations are being commissioned at the customer's site while some automation stations are still being engineered at the office.

Working in parallel during commissioning

Several users can work on different automation stations in the same project at the plant at the same time. To do this, the components to be loaded are transferred (Pack & Go), so that the user, for example, can load the configuration or program and then perform the point test. The test results are saved in the automation station and can be viewed and transferred back to the engineering database by the commissioning engineer at any time.

Working in parallel during service

A service technician can connect with the plant by remote and make changes. To do this, data is transferred from the Branch Office Server to the local hard disk. After the technician is done, the changes are transferred back to the Branch Office Server, so that the project database is up-to-date again.

Subcontracting

Project-specific solutions can be developed outside the project organisation and specific tasks, such as configuration and point test can be outsourced to subcontractors.

If you outsource specific tasks, make sure that:

- The work packages for the subcontracting can be easily transferred to the subcontractor
- The subcontractor's work can be documented
- The changed data can be transferred back to the engineering database

3.7 Workflow for Primary Systems

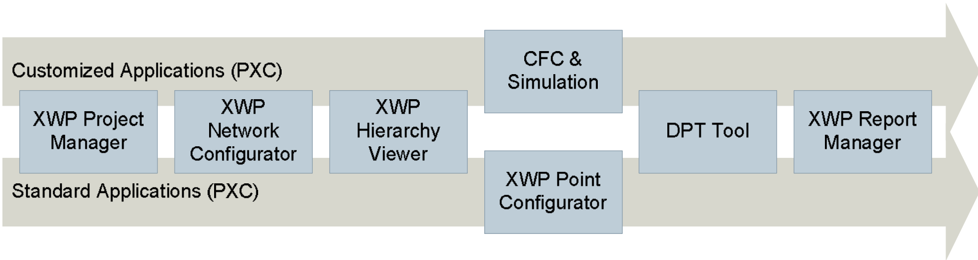


Figure 15: Workflow for primary systems

XWP Project Manager

Create project:

- Create project
- Check project in on Branch Office Server (BOS) and define access to project
- Define project defaults
- Create control cabinet topology (local specification of the automation station, for example, control cabinet view)

XWP Hierarchy Viewer and XWP Network Configurator

Create project structure (the building structure is system-oriented):

- Create project structure
- Create building topology (building, building parts, etc.)
- Create system topology (sites)
- Create network topology (XWP Network Configurator, third party devices, router, computer)
- BACnet references from third party devices and between primary system and room (demand signals, supervisory)
- ACP (passwords for accessing the automation stations)

XWP Point Configurator

Create systems:

- Define systems (systems, system sections, components, data points) (solutions, data points, I/O modules)
- Configure the operations (XWP Hierarchy Viewer)
  - configure the generic operation
  - Configure the project-specific operation (favorites)

CFC & Simulation

Program and configure:

- Program in CFC
- Define points in the I/O Address Editor
- Parameterize in the Parameter Editor
- Define alarming and trending

DNT and DPT

Test and commission:

- Export data to the management station
- Download firmware (upgrade if necessary)

- Load configurations and programs
- Carry out point test
- Debug in CFC (if necessary)
- Create commissioning documentation (local reports)
- Specialties:
  – Integration (TX Open Tool, BIM Tool)
  – AL Mig (AL Mig Tool)
  – Simulation

XWP Report Manager

Create documentation:

- Create project documentation

3.8 Workflow for Room Automation Classic

See *Desigo Xworks Plus Overview of Workflows* (CM111000).

3.9 Workflow for Desigo Room Automation

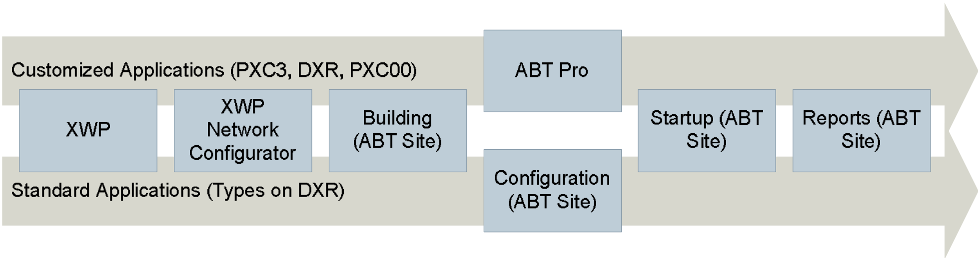


Figure 16: Workflow for Desigo Room Automation

XWP

Create project:

- Create project
- ACP (passwords for accessing the automation stations)

ABT Site > Building

Create Desigo Room Automation project structure (the building structure is room-oriented):

- Create building topology (buildings, floors)
- (Optional) Create user-specific building topology (UD structure)
- Create network topology (define address ranges)
- Create documentation (XWP Report Manager)

ABT Pro and ABT Site > Configuration

Create project library:

- Program automation stations (ABT Pro)
- Create templates for type-based automation stations (ABT Site > Configuration)
- Create templates for room control units

ABT Site > Building

Create instances in the building:

- Create automation stations, or rooms, based on the project-specific library per floor
- Edit room parameters

ABT Site > Startup

Commission:

- Configure and load automation stations (node setup)
- Carry out point test (ABT-SSA) (subcontracting)
- Parameterize (ABT-SSA)

3.10 Desigo Configuration Module (DCM)

Desigo Configuration Module (DCM) lets users, who work in sales or project execution, design the building automation and control system.

See *Desigo Configuration Module* (CM110752).

DCM can be installed and operated autonomously (without a permanent connection to a server) on a desktop or laptop under Windows 7 or Windows 8. DCM is automatically updated with the latest data if installed correctly by using the provided setup program, keeping the suggested installation path, and if an online/network connection is available. The updated data can also be updated regionally or dependent on a user to reflect relevant requirements.

Field of application

DCM calculates the required materials for an installation from raw system data, such as data points, panels, and building and plant structures.

You can use DCM to conduct analysis of variants after defining and completing the installation structure by generating copies and then subsequently changing the hardware specifications. If prices are stored in DCM, you can also compare prices to find the best possible device for the money. You can copy the devices calculated in DCM from the price lists or export them as an Excel file to calculate a bid.

Flexibility

You can enter the data directly into DCM or import it as an Excel file for the automation and Desigo Room Automation level.

The structure in DCM is hierarchical, but you can customize the structure according to your requirements.

Management level

The required software licenses for the selected functions, devices, integrations and data points are calculated on the management level. The licenses are listed and the required software units are calculated.

Calculations can be made for new installations and for upgrades and migration. To calculate upgrades and migration, you can import existing license keys. The import provides the exact installed basis and explicitly allows additional, required licenses and software units.

Devices for the Desigo Web Interface are also determined on the management level. The calculation is based on the number of data points to be integrated in the web interface and by the number of desired touch panels.

Desigo Room Automation level

The Desigo Room Automation level lets you create highly complex building structures with the sublevels building, floor, zone, room, and room segment for Desigo Room Automation.

The required hardware is calculated from the specified functions and/or data points and/or KNX PL-Link and KNX devices. The specification follows a model function set that is then assigned to the structure within the Desigo Room Automation level. In addition, multiple model function sets can be created in a project and each of them assigned as needed. A structure at the Desigo Room Automation level may have multiple, assigned model function sets, and a model function set can be assigned to different structures. As Desigo Room Automation often uses the same structures and functions, you can indicate a multiplier on each sublevel within the Desigo Room Automation level.

Automation level

At the automation level you can calculate the required hardware based on specified data points.

You can choose and calculate many variants using presettings. Variants include, for example, the automation station type or I/O module type, larger automation stations, or if plants are to be distributed among multiple automation stations. You can also consider other criteria, such as available panel sizes.

Room automation

You can choose solutions with LON and/or KNX. You can choose predefined solutions with drag & drop and then equip them with the required field devices. This way you can create a sample room and replicate it as required.

Third-party devices

You can integrate third-party devices with protocols, such as LON, KNX, ModBus, M-bus or OPC, on all levels.

3.11 Desigo Xworks Plus (XWP)

You can edit project data in the Xworks Plus Editors.
See *Getting Started: Desigo Xworks Plus* (CM110629).

Xworks Project Manager

The Xworks Project Manager lets you:

- Create, open and archive projects
- Check in/out project data for parallel engineering from the Branch Office Server (BOS)
- Define PXC automation stations, control units and management stations. The automation stations are not engineered here, but only used in the documentation and considered during the network check.
- Define rough network overviews (network data) and control cabinet assignments (panel data)
- Define further project data, data and automation stations for RXC, RXB, RXL and Desigo Room Automation
- Create control cabinet assignments, that is, group automation stations to control cabinets. This way you can export data and create documentation per control cabinet.
- View locally available projects. There is no connection to the Branch Office Server (BOS) in this mode.
- View the properties of an object, for example, a network, an automation station, etc.

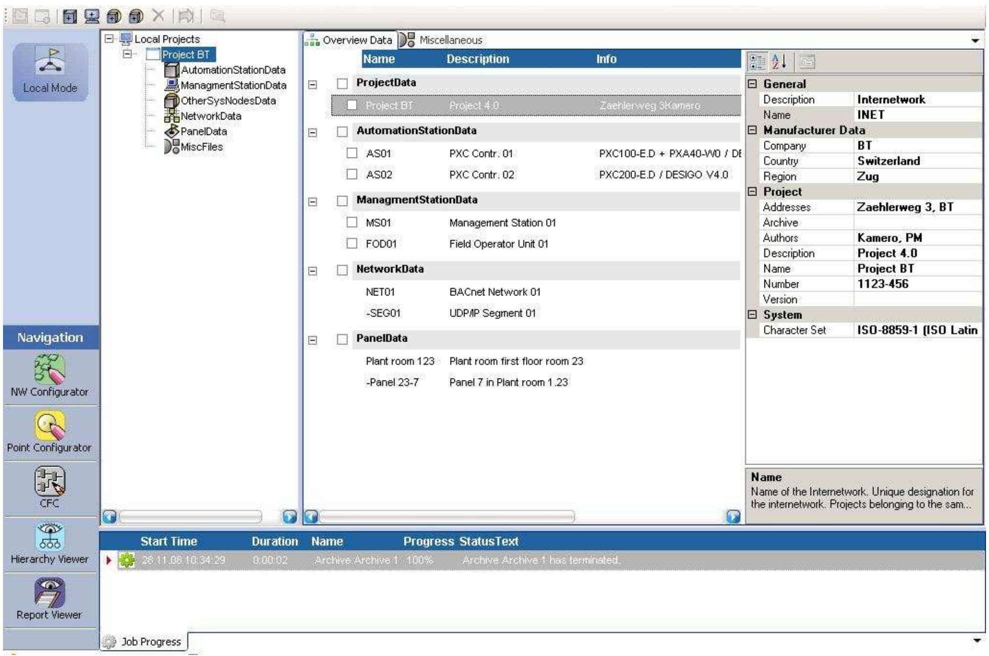


Figure 17: Xworks Project Manager

Xworks Point Configurator

The Xworks Point Configurator lets you define the functions of an automation station. You can insert solutions for the object plant, plant section, aggregate and component into this technical hierarchy. You can configure prebuilt verified solutions using options (leaving out) or variants (options). After you select and configure the solution, the program is automatically created.

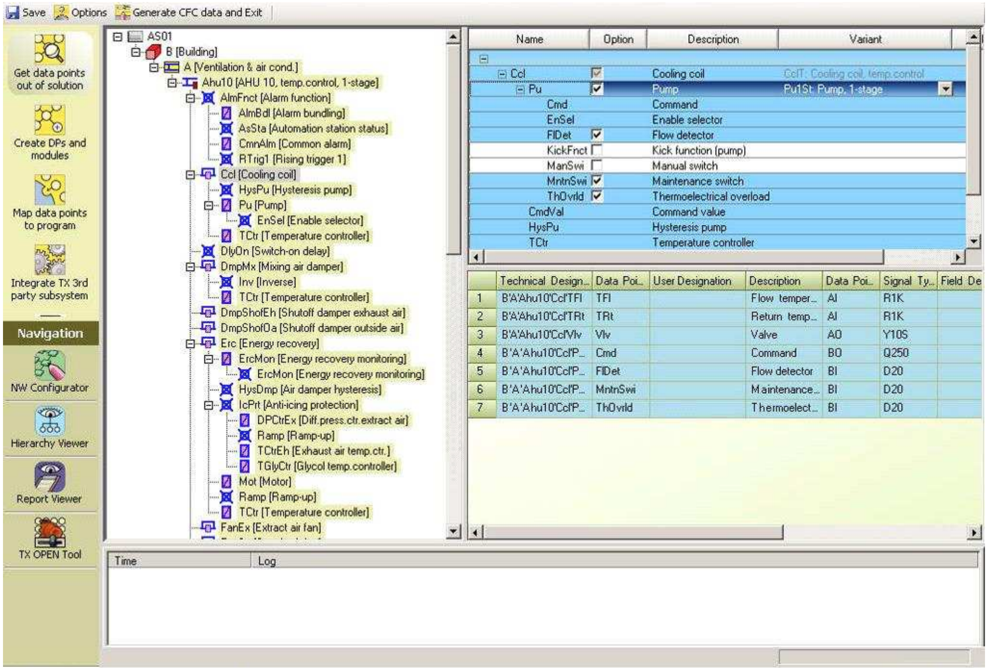


Figure 18: Xworks Point Configurator

The Solution Browser lets you select and configure a plant.

- The tree view shows all selected objects of the plant.
- The configuration view shows all possible options and variants for the selected object.
- The data point window shows all I/Os of the selected object.

You can configure I/Os and I/O modules and connect I/O channels with the I/Os.

You can design the integration of the room automation and the third party integration. The import function lets you integrate third party data points on the automation level. You can import data point information via a standardized interface (SDF format). The BACnet reference browser lets you address BACnet references. You can import BACnet references via a standardized EDE import file (CSV or XLS format).

Xworks Hierarchy Viewer

The Xworks Hierarchy Viewer lets you verify the technical hierarchy of an automation station or entire project. Conflicts in the technical hierarchy are displayed.

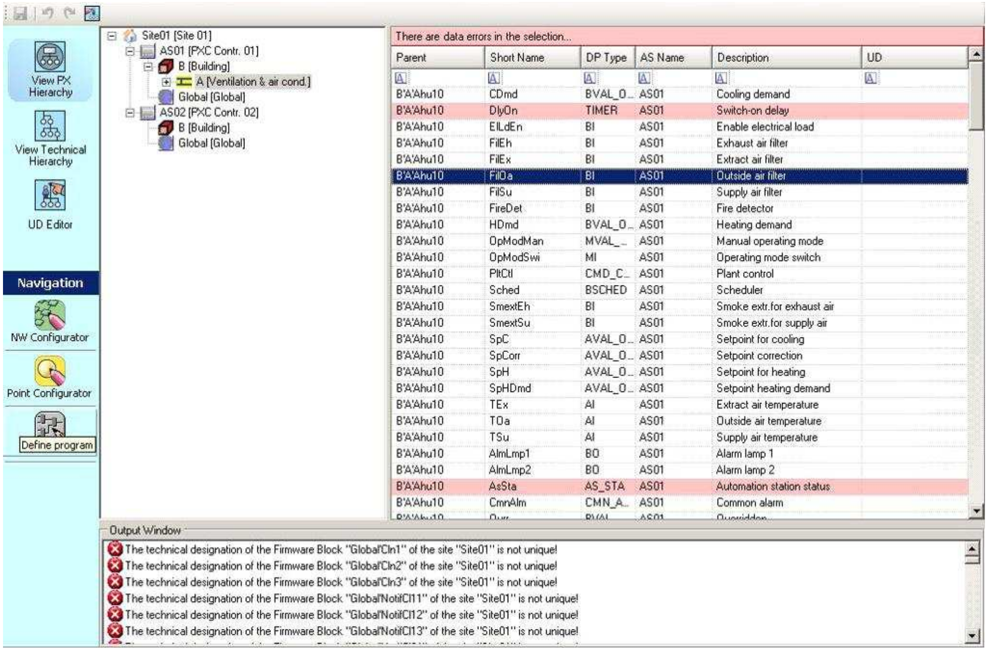


Figure 19: Xworks Hierarchy Viewer

The Xworks Hierarchy Viewer shows the technical hierarchy per PX and the technical hierarchy as it is shown, for example, in the generic view on the management station.

You can define the user designation (UD) and the free designation (FD). You can define the structure of the user designation with the field lengths and the separators and assign the data points in the structure of the user designation. You can verify the consistency of the user designation and free designation in the entire project and assign the technical designation (TD = default value), the user designation (UD) or the free designation (FD) to the object name (ON).

Xworks Network Configurator

The Xworks Network Configurator lets you define the network topology. You can define LON, IP networks and network segments, assign and address automation stations to the corresponding segments, and define automation stations and routers.

You can define several sites in a project. The network check verifies all sites in the project. You can verify all automation stations that have been defined in the Automation Building Tool (ABT) for correct and unique addresses, and document it in the network report.

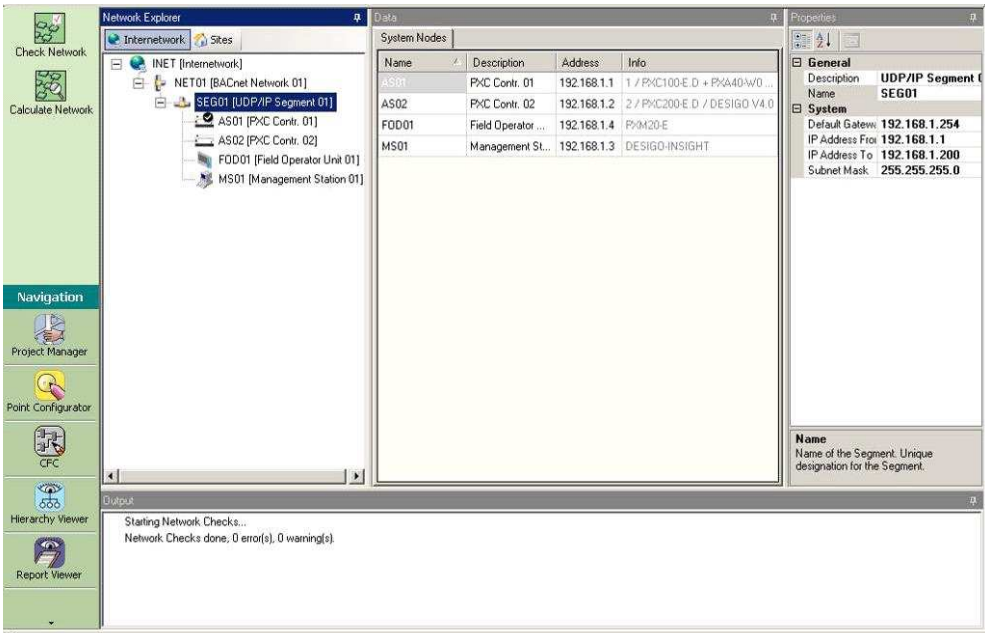


Figure 20: Xworks Network Configurator

Programming in Xworks Plus

When the technical hierarchy and the automation station are defined, and the I/Os are configured and addressed, you can create a program that corresponds to the selected and configured solutions from the Xworks Point Configurator.

If you use the solution library, you do not have to program in CFC.

Workflow

The workflow for creating programs usually runs as follows.

Workflow in the Xworks Point Configurator

- Select PXC hardware (compact or modular)
- Select and configure solutions
- Configure data points: data point type, signal type and conversion type to field device
- Create and change programs

Workflow in the CFC Classic editor

- Define timer program
- Parameterize alarm behavior and I/Os
- Provide data signals for the energy exchange between different plants
- Transfer plans (create programs)
- load programs
- Carry out commissioning
- Test programs
- Create documentation: data point lists, device plaques, commissioning lists, print parameter lists, etc.

CFC Classic editor

The CFC Classic editor (Continuous Flow Chart) is a graphic tool tor creating plans. The CFC Classic editor lets you create and change programs. A CFC plan consists of function blocks and connections.

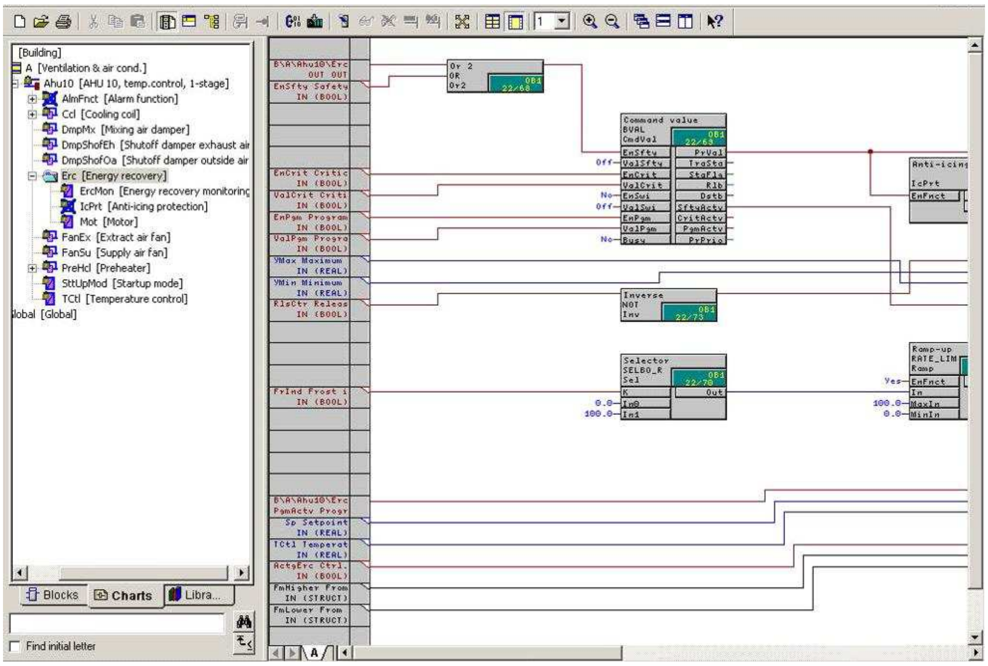


Figure 21: CFC Classic

The CFC Classic editor shows all blocks that are used in the program, nested plans, all available CFC block libraries and the selected plan with the plan interfaces to other plans. This view is available offline for programming and online for checking the signal flow. The CFC Classic editor lets you compile programs, that is, create loadable programs.

Additional editors

In addition to the graphic programming, you can configure the programs in the following editors:

- Parameter Editor: Lets you parameterize attributes.
- I/O Address Editor: Shows all I/Os of an automation station.
- Plant Control Editor: Lets you configure the plant controls for ventilation and energy generation.
- Solution Configurator: Lets you configure solutions, that are from the CFC library or have been generated from the Xworks Project Configurator.
- Simulation: Lets you simulate programs of a modular automation station without hardware on the computer.
- Alarm display: Continuous update and local caching of all alarm status changes during commissioning. Lets you view, acknowledge and reset alarms.

Xworks Report Manager

The Xworks Report Manager offers comprehensive customer documentation and supports project staff during project handover. The customer can check the documents and after handover the customer is supported during operations, for example, when handling alarms and interruptions.

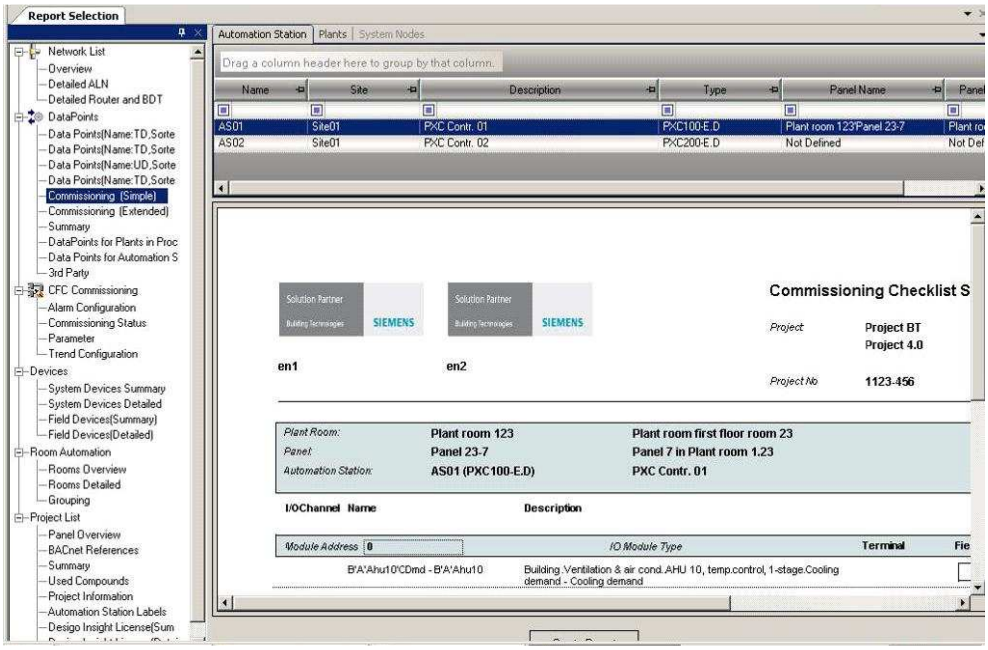


Figure 22: Xworks Report Manager

You can select one or more automation stations for the documentation, per automation station, plant or system node. You can select document templates and verify reports in a preview.

Desigo Point Test (DPT)

Desigo Point Test lets you test data points during commissioning of a Desigo PX automation station. To carry out a data point test with configured I/O modules, you must download the I/O configuration file for the modular PX automation stations in the empty PX automation station.

BIM Tool

The BIM Tool is used for TX-I/O modules that are integrated with a BIM on automation stations. The BIM was used on old automation stations for integrating I/O modules.

TX Open Tool

The TX Open Tool lets you configure TX Open modules. You can define the TX Open integration and commission the TX Open modules. To commission TX Open, load a configuration into the modules with the TX Open Tool.

See *TX Open Tool online help* (CM111005).

RXT10 Tool

The RXT10 Tool lets you configure and commission RXC controllers.

In RXT10 you can select and configure the RXC applications. Then you define the assignments in the rooms. After the room types have been tested, the applications are multiplied and commissioned. Then you integrate the room automation (PXR). Create the building hierarchy and design the rooms on CFC data. Finally group the system functions and commission the PX application.

PX KNX Tool (Room Automation)

See chapter *Room Automation*.

Room Automation RXL

See chapter *Room Automation*.

HVAC Integrated Tool (HIT)

HIT lets you design HVAC plants. HIT lets you to select and document any HVAC control device as an individual product or in a system configuration. Using its library of over 300 preconfigured HVAC applications for standard controllers (Synco™, Sigmagyr™, RXL and RXB) HIT generates a comprehensive specification including plant diagram, list of material, technical documentation for each device, and pricing.

3.12 Desigo Automation Building Tool (ABT)

The Desigo Automation Building Tool (ABT) is used for engineering and commissioning Desigo Room Automation.

XWP in the Desigo Room Automation project

Project data storage in a Desigo project is handled by Xworks Plus (XWP), that is, you can create a customer project in XWP and check it in to the Branch Office Server (BOS) using Xworks Project Manager. XWP is also used in the Desigo Room Automation project to carry out the network check and to create the network documentation. Some project reports, which also encompass the Desigo Room Automation automation stations are created in XWP.

ABT Site > Projects

In ABT Site > Projects you create projects and define project settings.

ABT Site > Building

In ABT Site > Building you create building topologies. The topology shows the assignment of room segments and rooms to floors and buildings.

You can define the grouping hierarchies for the central functions and assign the grouping members to the grouping masters. You can create a user designation with a user hierarchy.

ABT Pro

In ABT Pro you program automation stations (project-specific solution). ABT Pro contains the CFC Plus editor for programming in CFC.

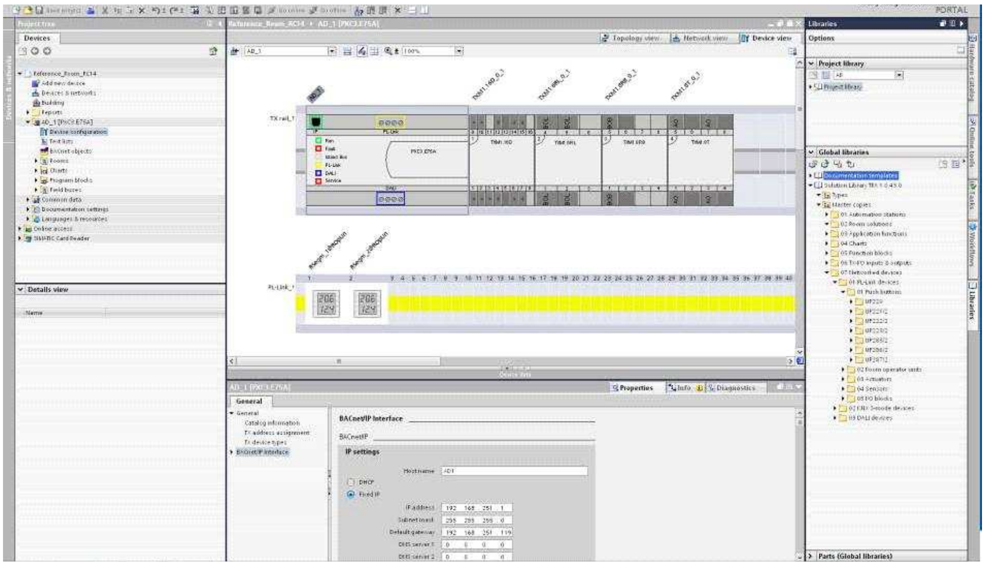


Figure 23: ABT Pro

ABT Pro shows:

- The automation station objects
- The hardware view of the automation station
- The properties of the selected object

- The project-specific library
- Installed libraries

In the ABT Pro editors you configure room applications, rooms and BACnet objects. In the CFC Plus editor you can program with CFC blocks. The CFC plan contains CFC blocks and connections. A CFC block library is available. ABT Pro is based on the Siemens TIA portal.

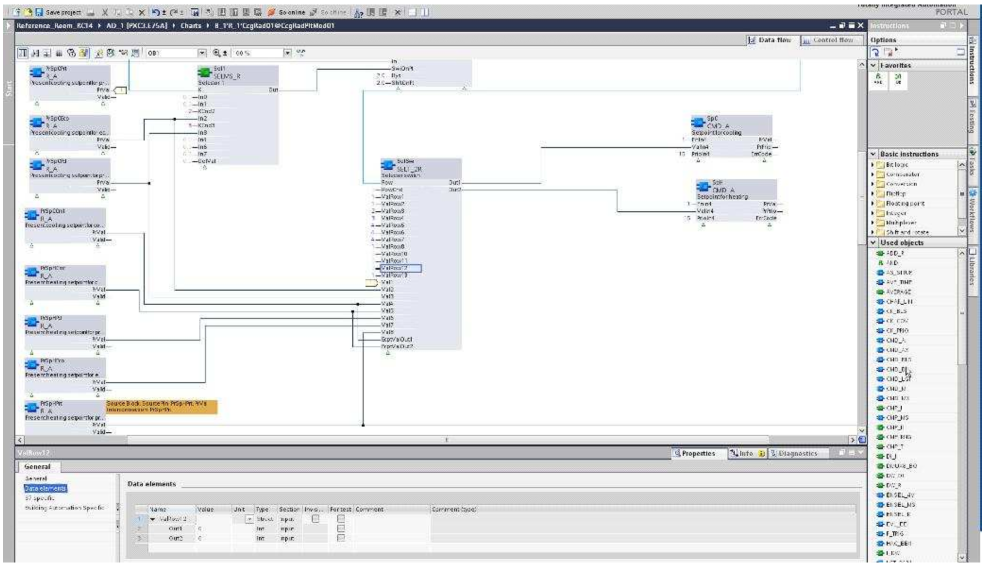


Figure 24: CFC Plus

ABT Site > Configuration

In ABT Site > Configuration you configure preloaded application types or project-specific types.

ABT Site > Startup

In ABT Site > Startup you scan networks, load configurations and read back parameters.

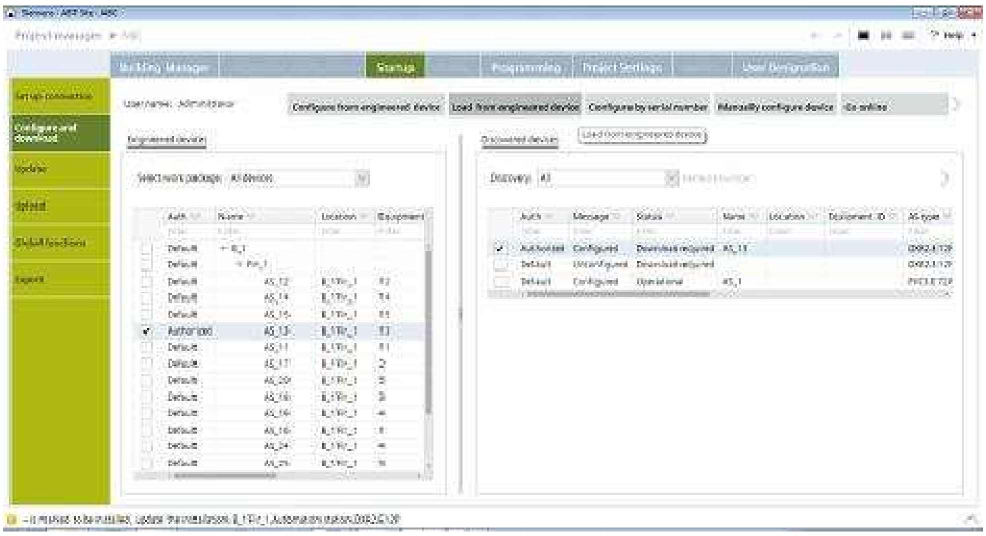


Figure 25: ABT Site > Startup

ABT-SSA

In ABT-SSA (Setup & Service Assistant) you commission I/Os and carry out the point test.

See *Desigo TRA - Setup & Service Assistant* (CM11105).

In ABT-SSA you can:

- Assign network points (DALI to device), make points available
- Test if the points work
- Define parameters, for example, time, desired value, default value, etc.

3.13 Generate Graphics for Management Station

In Xworks Plus (XWP) and Automation Building Tool (ABT) you create data for the graphic generation.

Engineering in XWP and ABT

The compile function in the CFC Editor creates an export file in the background for import into the system database of the management station.

The Desigo Insight Graphic Generator [→ 226] uses the following information from the XWP and ABT data:

- Plant structure with site, plant, plant section, aggregate and component
- Technical Designation (TD), family, name, locations, number of stages, technology
- Library name of the solution

By matching the selected solution with the genie library, you can almost automatically create Desigo Insight graphics, based on the information above. The degree of automatisation mainly depends on the trade type.

The Desigo Insight engineering environment generates the graphics. The data for generating the graphics from local libraries is created in XWP and ABT. This data is available in the Object Viewer.

In the Desigo Insight Graphic Generator you can create plant graphics with copy & paste with the objects from the Desigo Insight Graphics Browser. The tag name is copied from the Object Viewer into the genie field. You can edit existing graphics in the Graphics Builder with an Excel macro. No data is written back from Desigo Insight to XWP.

3.14 Programming in D-MAP

Programming is based on D-MAP principles (Desigo Modular Application Programming), where you assemble blocks into compounds and then you build hierarchically structured solutions using those compounds.

- In Xworks Plus (XWP) you program in the CFC Classic editor.
- In the Automation Building Tool (ABT) you program in the CFC Plus editor.

The CFC editors have a different look and feel. Their basic functions and basic library blocks are almost identical.

Programming in XWP for Desigo PX

The Program View describes the concepts and elements on which D-MAP is based: libraries, compounds, blocks, variables, data types and attributes.

The P&I diagram

The Program View is based on the P&I (Process & Instrumentation) diagram. The P&I diagram illustrates the plant and the associated instrumentation in the form of a principles diagram.

The following figure shows a simplified P&I diagram of a partial air conditioning system. The heating coil and its components, including the automation station sequence, are encircled.

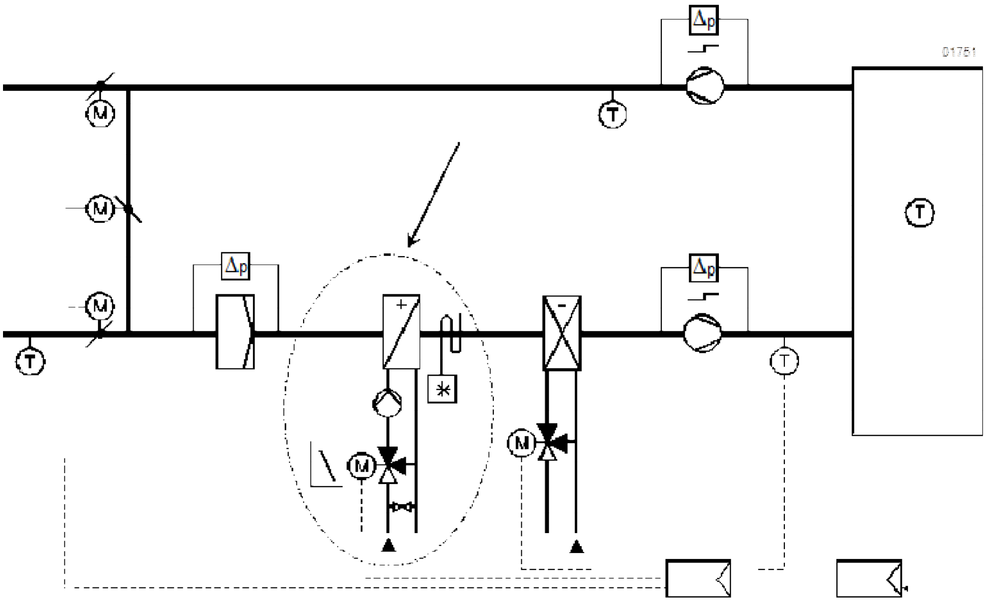


Figure 26: P&I diagram of a partial air conditioning system

XWP

XWP is the programming tool for the PX automation station and incorporates all system elements. XWP shows the structural view of the system with the plant, partial plant, aggregates, and components, and, for example, the compound functional unit for a valve.

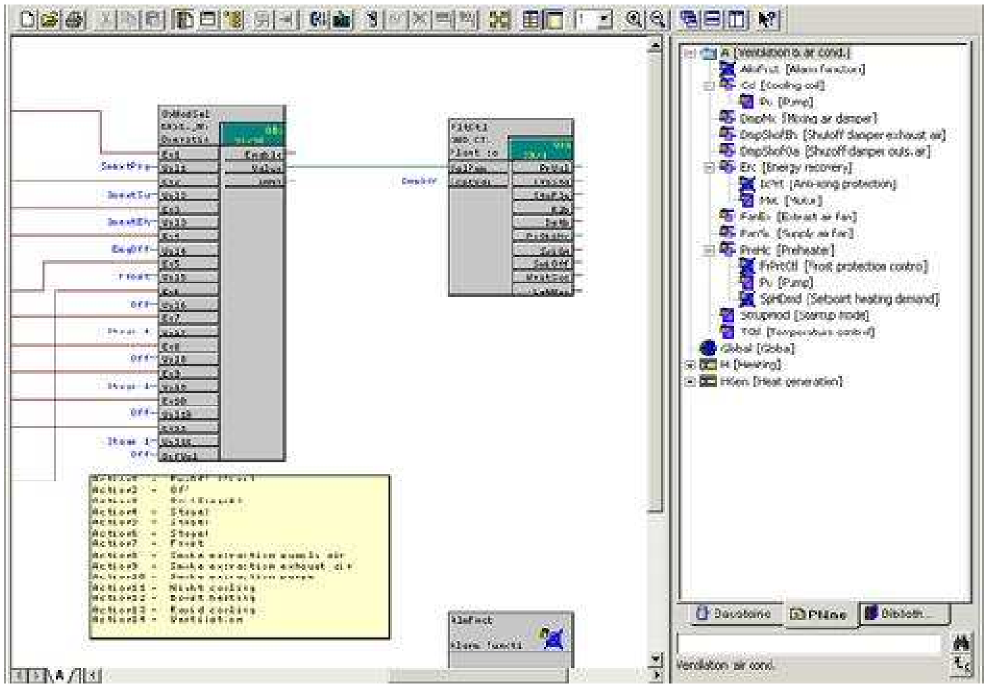


Figure 27: Structural view (left pane) of the system and compound for a valve (right pane) in XWP

Programming in ABT for Desigo Room Automation

In Desigo Room Automation, the application architecture comprises the following elements:

- Hardware configuration: Description of device configurations of the PXC3 automation station
- BACnet description with field device configuration for TX-I/O, PL-Link and DALI
- Automation program: Application description comprising application functions, I/Os and CFC charts

This division lets you define application functions or CFC charts independent of the hardware. The division is also reflected in the loadable units in the tool.

The program view describes the basic concepts and elements for programming for Desigo Room Automation: Libraries, CFC charts, blocks, variables, data types, configuration extensions and attributes.

In Desigo Room Automation, a program contains the application function (for example, the lighting function), the associated CFC charts (for example, the chart for manual control), and the I/O blocks (for example, the luminaries and buttons).

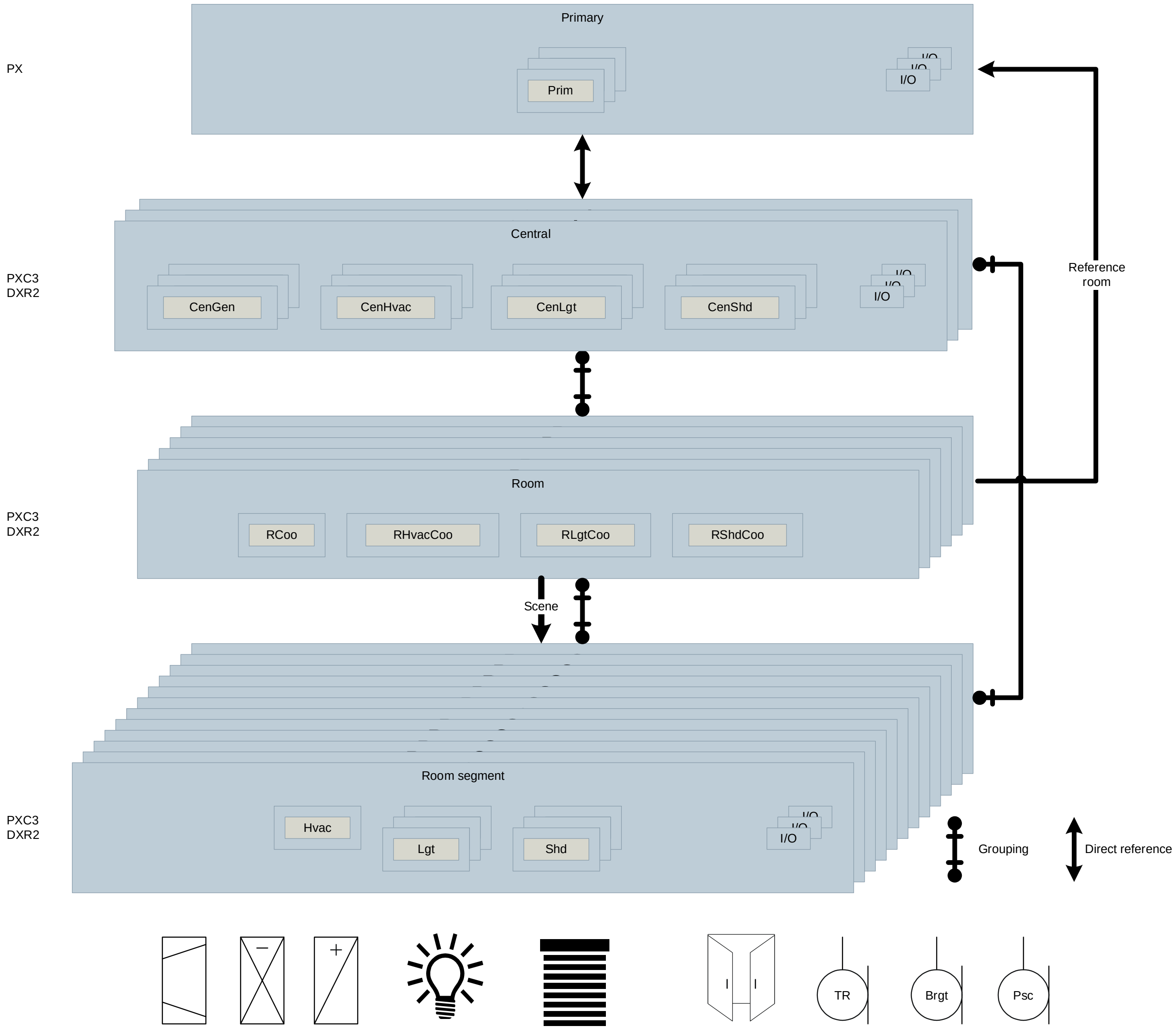


Figure 28: Desigo Room Automation program elements

4 Control Concept

Supply chain model

In building automation and control, media, such as warm water, cold water, warm air, and cold air are generated using energy, such as oil, gas, and electricity, and distributed to consumers.

Each medium can be assigned a supply chain. The supply chain starts at the generation or handling of the medium. The distribution system then transports the medium to one or several consumers. A supply chain for building services systems comprises the following links:

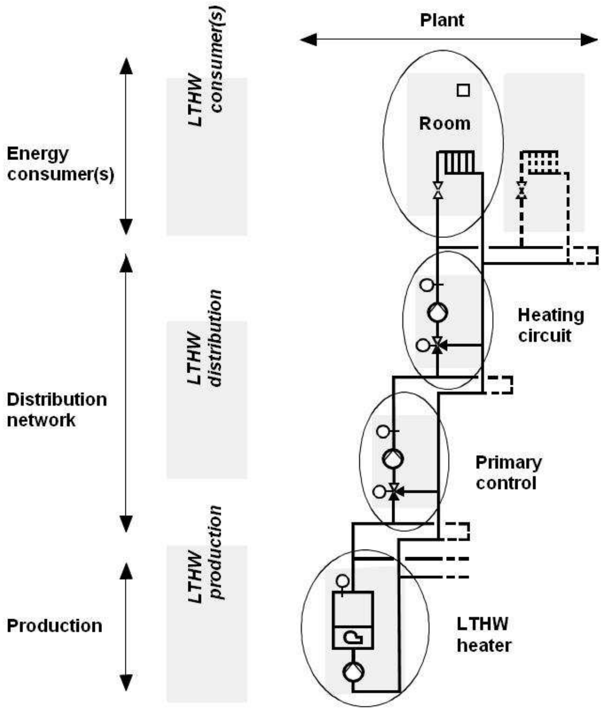


Figure 29: Supply chain for a hot water plant

Consumers

The consumer supplies the energy contained in the hot water medium to the room as per the requested demand (for example, via a radiator).

Distribution

The distribution system transports the medium from the producer to the consumer and adjusts it to the individual requirements (minimum losses).

Production

The production consists of a boiler where hot water is treated by means of energy (for example, heating oil, gas) and provided to the process.

Supply chains of various media

The following illustration shows a schematic view of the supply chains for the media air, hot water, and cold water with their respective production (treatment), distribution (for example, heating circuit, pre-control), and the consumers.

The supply chain for the medium electricity, which normally begins at supply or at production, if electricity is produced on-site (for example, cogeneration plant, photovoltaic) is also shown.

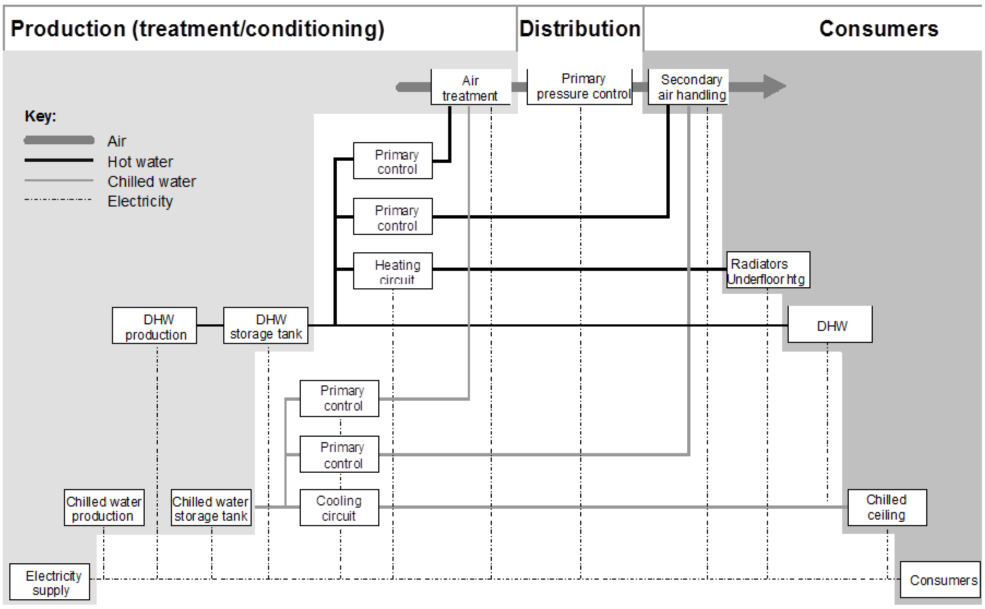


Figure 30: Supply chains for the mediums air, hot water and cold water

A tree structure opens to the right for the individual supply chains. In other words, one or more generators supply multiple primary controllers and each primary controller for its part supplies one or more consumers or other primary controllers.

From the air supply chain point-of-view, air treatment is a part of production (handling). From the hot water and cold water point-of-view, air treatment (or air heater/cooler) belongs to consumption.

The air supply chain comprises the central air treatment plant, optionally supplemented by pressurization control and air posttreatment.

Supply flow

In each supply chain, the medium flows from the producer, through the distribution system to the consumer. This flow within the supply chain is referred to as the supply flow.

Supply chain structure

A supply chain consists of at least one producer and one consumer. It can also have multiple chain links, that is, producers, distributors, and consumers, and be structured as follows:

1. One producer with one distributor and one consumer.
2. One producer with two distributors in series and one consumer.
3. One producer with two distributors in parallel and two consumers in parallel.
4. Multiple producers, distributors, and consumers in parallel.

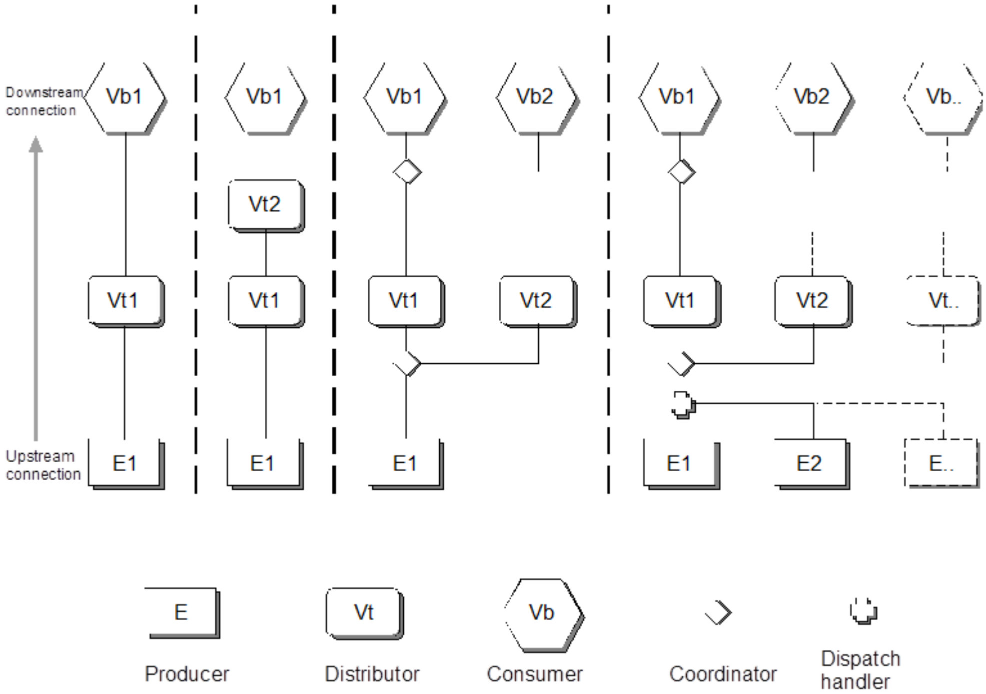


Figure 31: Design of supply chains

Producer

In practice, however, there are often multiple producer units, for example, boilers with the same or similar power, or a mixture of different units, for example, boiler combined with a solar plant and cogeneration plant (usually with additional storage units).

Logical producer

From the distributor and consumer point-of-view, there is only one single producer within the supply chain, the logical producer, with exactly one supply point as the interface to the distribution network. This logical producer knows nothing about the structure of the distribution network and the connected consumers. Also, neither the distributor nor the consumer knows whether the producer consists of one or multiple units.

Distribution components

The distributor or distribution transports the medium within the supply chain. In this process, energy losses and energy consumption of pumps and fans is to be kept to a minimum.

Conversion

Conversion (transformation) of the medium, for example, in a heat exchanger, is assigned to a supply chain of distribution. A change of temperature (for example, pre-control in the heating circuit) is also seen as conversion. Pre-controllers can be arranged in series (cascading).

Consumers

The following consumers, for example, belong to the various supply chains:

Supply chain	Consumers
Hot water	Air treatment and air posttreatment (heating register) Radiators (radiator, convector) Floor heating, domestic hot water heating
Cold water	Air treatment and air posttreatment (cooling register) Cooling surface (chilled ceiling)
Air	Air posttreatment (dampers)
Electricity	HVAC consumers, other consumers

Table 10: Supply chains and consumers

Coordinator and dispatcher

In addition to the three chain links producer, distributor, and consumer, there are the logical links named coordinator and dispatcher.

Supply chains for a room

You can define different consumer needs for a room, such as heat, refrigeration and fresh air.

Heat demand

The hot water supply chain exists for heat demand. The medium hot water is prepared in hot water generation and distributed via a heating circuit. The heat is emitted to the room as needed via a heating surface. If air is the carrier of heat, this is done via pre-control and air posttreatment.

Refrigeration demand

The cold water supply chain exists for refrigeration demand. The medium cold water is prepared in cold water generation and distributed via a cooling circuit. The refrigeration is emitted to the room as needed via a cooling surface. If air is the carrier of refrigeration, this is done via pre-control and air posttreatment.

Fresh air demand

The need for fresh air is met by the air supply chain, where the medium is produced by the air treatment plant, distributed via the ducting, possibly adjusted to differing requirements of the room by an air posttreatment plant, and transferred to the room via air outlets.

HVAC application architecture

The HVAC application architecture contains an overall view of typical heating, ventilation and air conditioning plants with distributed applications and is based very strongly on the supply chains (energy and substance flows) in building services systems.

- The mutually standardized exchange and re-use of HVAC-relevant demand and coordination signals is possible in distributed applications.
- The HVAC application architecture structures the HVAC functions into meaningful units, interfaces and functional mechanisms.
- The HVAC application architecture is scalable and independent of product and communication standards.

HVAC system view

The consideration and definition of the HVAC application architecture and its functionality gives rise to the HVAC system view, which comprises:

- Plant (primarily HVAC plants)
- Operator interventions
- Functional units

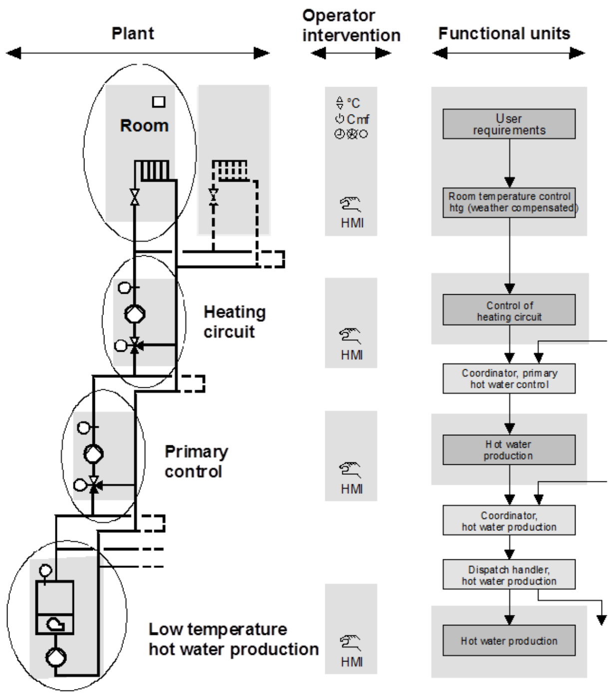


Figure 32: HVAC system view

Plant

A plant consists of partial plants, aggregates, and components, which, as a rule, form a supply chain with the chain links producer (here: boiler), distributor (pre-control, heating circuit), and consumer (radiator).

Operator interventions

Commands are executed at each link of the chain through operating interventions via HMI commands. The impact on the plant (or the process) takes place via the corresponding function unit and automation station.

Functional units

Functional units represent the software map of chain links and plant elements. The functional units contain all control, monitoring, and limiting functions that are necessary for operation.

Information signals

Energy demand information can be passed on implicitly via the medium within the supply chain, for example, if the hot water supply temperature falls because of a rise in heat consumption, more heat energy must be produced.

Information can also be represented by an explicit signal and transferred via a signal path (for example, via a bus). The following explicit signals have been defined in the Desigo system:

Explicit signals	Signal flow	Application
Demand signal	Consumer to producer	A plant functional unit communicates its demand (that is, operating mode, set points) to another partial plant functional unit in the direction of the producer. The demand signal eventually arrives at the producer.
Operating signal	Producer to consumer	A plant informs the downstream plants about its currently effective operating state. This signal is only used as an exception and is therefore switched depending on the situation.
Override signal	Producer to consumer	The producer demands a certain operating mode from a consumer. Forced signals are more the exception than the rule and are therefore not implemented in sample plants. Forced signals are used for solar plants and wood furnaces among others, where the minimum heat production cannot be controlled.

Table 11: Information signals

In addition to the functional units, there are two further elements that belong to the supply chain on the software side:

- Coordinator: The coordinator combines the demand signals of downstream (to supply flow direction) plants and delivers a resultant demand signal to the upstream plants. The coordinator also signalizes the operating state of the upstream plants to the downstream plants.

- Dispatcher: The dispatcher determines the demand signals for the producers on the basis of the resultant consumer demand signals. It decides which and how many producers must be activated.

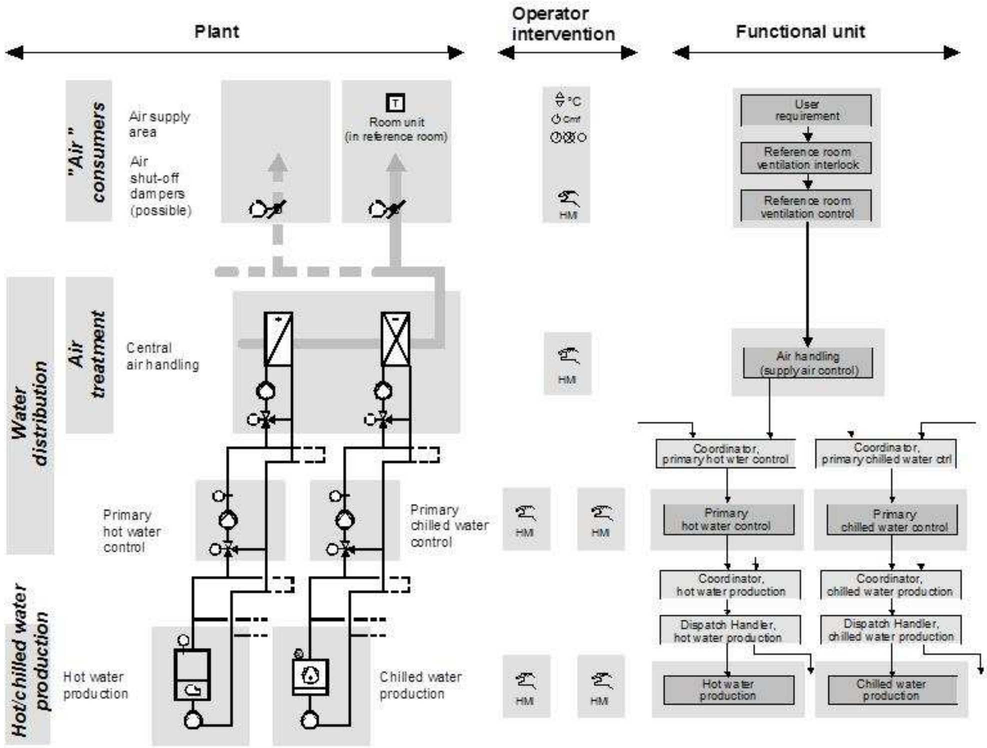


Figure 33: Example of a sequence control

4.1 Control Concept and Control Blocks

The Desigo control concept is a set a rules that determine in general terms the principles governing all control, reporting and monitoring operations and the switching interventions in the Desigo system. The rule applies to block-internal control (priority array) and to functional interactions among participating blocks.

This specifically deals with:

- Structure and design of control as function blocks
- The hierarchical assignment of the function blocks among themselves
- The function hierarchy within the control chain for the function blocks
- Processing operational and fault messages
- Interventions in monitoring functions
- Impact of emergency switching

The open loop control strategy is based on the exchange of predefined signals between functional units. Each functional unit is an image, or memory map, of an actual element of the plant, for example, ventilation or boiler plant.

Control functions

The open-loop control functions required for a given element are locally an integral part of the functional unit (for example, the increase, after a time delay, in the speed of a multi-stage fan, or the demand-based switch-on of a boiler). In each functional unit, various possible requirements are prioritized and evaluated. The resulting operating mode is then passed on to the elements or subordinate functional units. The functional unit already incorporates the I/Os needed for the physical data points.

Structure control functions

In this way, complex control and monitoring functions of a plant can be logically subdivided to allow for clear assignment of the function unit or the real element of the plant. The higher-level control concentrates on the control and monitoring of the overall plant, while the sub-control function units assume internal control and monitoring of the given elements for the function unit.

Standardization of control functions

Moreover, plant security and available was increased through standardized control and monitoring functions which would result in considerable expense using conventional methods.

Standardized control and monitoring functions:

- Unambiguous selection of operating mode
- Uniform fault-related shutdown
- Comprehensive status monitoring
- Switching sequence for ventilation systems
- Output stage control for heat generating plant
- Reporting of local intervention
- Avoidance of unnecessary attempts at switching
- Prevention of inadmissible switching operations
- Protection of plant by preventing switch-on or switch-off

Blocks bound by the control concept

The following table shows the blocks that are optimized for control tasks.

Function	Block name	Task in the control concept
Prioritization of influencing variables	ENSEL_BO ENSEL_MS	Collect information for the selection of the resulting plant operating mode. All superposed information are processed by priority resulting in the plant being turned on or off, for example, smoke extraction switch, frost protection, scheduler program. The blocks are primarily used on the hierarchy level plant/partial plant, but may also be reasonably used, for example, in aggregates.
Command control	CMD_CTL	Superposed control block for sequence control. The block ensures that individual plant aggregates are switched on or off sequentially in a certain order. The block monitors aggregates and can send alarms. It is optimized for controlling air handling plants, but can be used for other applications. The block is used on the hierarchy level plant/partial plant.
Power control	PWR_CTL	Superposed control block for power control. The block is used for control and monitoring of the performance of a number of energy producers (multiple boiler systems, refrigeration machines). Depending on the request power demand, energy produces are switch on or off in stages. PWR_CTL is optimized for controlling heating and refrigeration plants. The block is used on the hierarchy level plant/partial plant.
I/O blocks with control functionality	BO MO AO	Output blocks implemented per BACnet standard and therefore including a priority mechanism (priority array) that is well suited for control tasks. The priority array [PrioArr] be used through data flow interconnections and BACnet commanding. Moreover, the block integrate the following control functionality: - Motor control (pump, burner, etc.), one- to four-speed [BO, MO] - Fan control, one- to four-speed [BO, MO]
Value blocks with control functionality	BVAL MVAL AVAL	Value objects or value blocks are implemented per BACnet standard and therefore includes output blocks via the priority mechanism. These blocks are referred to as data points that can communicate within the system with the I/O modules via BACnet. These blocks are primarily used as the communication interface between superposed control [CMD_CTL, PWR_CTL] and the aggregates.
Rotation block	ROT_8	The Rotation block switches the operating mode on and off for a maximum of eight functional units in accordance with a selected mode of rotation (sequence or hours run). The change of operating mode is based on demand, hours run, occurrence of a fault or manual intervention (override). The block is used to process the functional units (for example, aggregates or components) as a function of run-time or faults. These blocks are used, for example, for double pumps, that are changed over based on runtime.

Table 12: Blocks bound by the control concept

Control hierarchy

Control hierarchy is the map of the functional assignment and linking of those function blocks included in the control concept for a plant. The structure of the control hierarchy is subject to certain rules. A distinction is drawn between higher-level plant control and local control of the functional units.

Superposed control

Within the hierarchical structure, higher-level control functions are typically assigned to the partial plant level. All the variables which are influencing factors on the overall plant are weighted and combined to give the effecting plant operating mode. In respect of each of the possible plant operating modes, a control strategy can be defined for each underlying functional element. This makes it possible to develop specific plant scenarios, such as fire control, smoke extraction, frost control, on/off-switch control.

Local control

Within the hierarchical structure, local control of the function elements is typically assigned to the partial plant level. The main function of local control is to respond to faults. The functional unit itself determines how the outputs are to be controlled in the event of a fault. Interlocks between functional units (for example, damper/fan) must be implemented locally. Local control prevents the risk of damage to plant, in the event that the command control parameters are set incorrectly.

The control hierarchy in the following figure considers only the example application for ventilation.

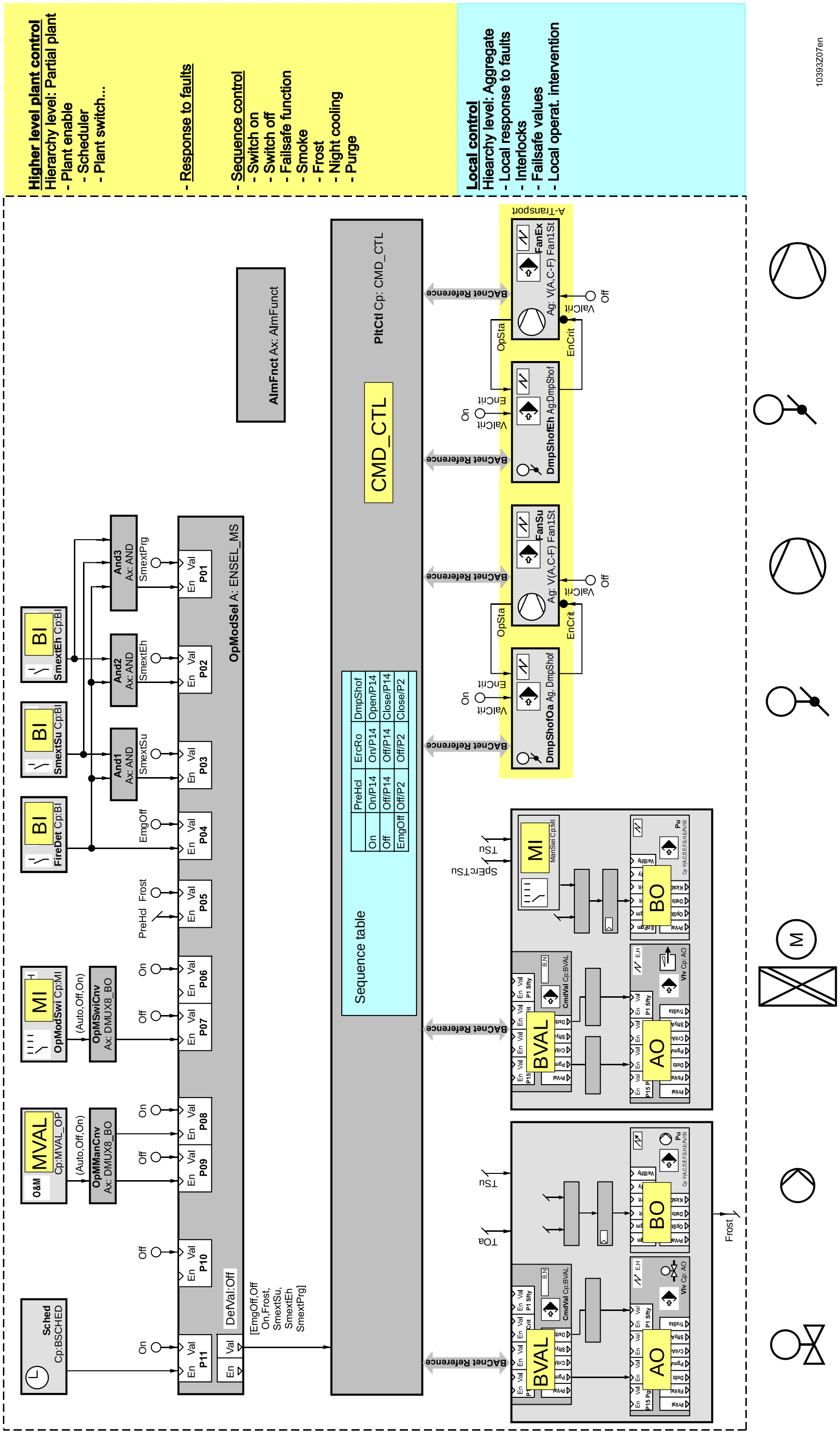


Figure 34: Control hierarchy in a sample ventilation plant

I/O block functions and interfaces

The I/O blocks are the most important blocks in the Desigo system. In addition to controlling the hardware, they are responsible for numerous control and monitoring functions. They enable otherwise complex functions to be implemented with just a small number of blocks. The following table shows the main functions and interfaces of the I/O blocks.

Function	Inputs	Description	AI	AVAL	AO	BI	BVAL	BO	MI	MVAL	MO
Stop transmission of input signal	OoServ	Out of service	•	•	•	•	•	•	•	•	•
Priority mechanism	DefVal	Default value		•	•		•	•		•	•
	PrioArr	Priority array		•	•		•	•		•	•
Local override	Ovrr	Override		•	•		•	•		•	•
	OvrrVal	Override value		•	•		•	•		•	•
Alarm value monitoring - Limits - Reference values - Monitoring periods	EnAlm	Alarm enable	•	•	•	•	•	•	•	•	•
	HiLm	Upper limit	•	•	•						
	LoLm	Lower limit	•	•	•						
	Nz	Neutral zone	•	•	•						
	RefVal(s)	Reference value	•			•	•		•	•	
	TiMonOn	Monit. time switch-on				•	•	•	•	•	
	TiMonOff	Monit. time switch-off				•	•	•	•	•	
	TiMonDvn	Monit. time deviation	•	•	•	•	•	•	•	•	•
Switching delays	DlyOn	Switch-on delay					•	•		•	•
	DlyOff	Switch-off delay					•	•		•	•
	TbTiDly	Time delay table					•			•	•
Switching action Normal (motor) Release command Trigger Switch Switch with delay	SwiKind	Switch kind		•	•		•	•		•	•

Table 13: Control and monitoring functions of the I/O blocks

Function	Outputs	Description	AI	AVAL	AO	BI	BVAL	BO	MI	MVAL	MO
Feedback monitoring	PrVal	Present value	•	•	•	•	•	•	•	•	•
	FbVal	Feedback value			•			•			•
Reliability monitoring	Rlb	Reliability	•	•	•	•	•	•	•	•	•
Fault monitoring	Dstb	Fault	•	•	•	•	•	•	•	•	•
Status monitoring	TraSta	Transitional state		•	•		•	•		•	•
Priority monitoring	SftyActv	Safey priority Active		•	•		•	•		•	•
	CritActv	Critical active		•	•		•	•		•	•
	PgmActv	Program active		•	•		•	•		•	•
	PrPrio	Present priority		•	•		•	•		•	•

Table 14: Control and monitoring functions of the I/O blocks

Function	Inputs	Description	AI_RED	AO_RED	BI_RED	BO_RED	MI_RED	MO_RED
Stop transmission of input signal	OoServ	Out of service						
	DefVal	Default value		•		•		•

Function	Inputs	Description	AI_RED	AO_RED	BI_RED	BO_RED	MI_RED	MO_RED
Priority mechanism	PrioArr	Priority array		•		•		•
Local override	Ovrr	Override		•		•		•
	OvrrVal	Override value		•		•		•
Alarm value monitoring - Limits - Reference values - Monitoring periods	EnAlm	Alarm enable						
	HiLm	Upper limit						
	LoLm	Lower limit						
	Nz	Neutral zone						
	RefVal(s)	Reference value						
	TiMonOn	Monit. time switch-on						
	TiMonOff	Monit. time switch-off						
	TiMonDvn	Monit. time deviation						
Switching delays	DlyOn	Switch-on delay						
	DlyOff	Switch-off delay						
	TbTiDly	Table for time delay						
Switching action - Normal - Release command - Trigger	SwiKind	Switch kind		•		•		•

Table 15: Control and monitoring functions of the I/O blocks

Function	Outputs	Description	AI_RED	AO_RED	BI_RED	BO_RED	MI_RED	MO_RED
Feedback monitoring	PrVal	Present value	•	•	•	•	•	•
	FbVal	Feedback value						
Reliability monitoring	Rlb	Reliability	•	•	•	•	•	•
Fault monitoring	Dstb	Fault	•	•	•	•	•	•
Status monitoring	TraSta	Transitional state		•		•		•
Priority monitoring	SftyActv	Safety priority Active		•		•		•
	CritActv	Critical active		•		•		•
	PgmActv	Program active		•		•		•
	PrPrio	Present priority		•		•		•

Table 16: Control and monitoring functions of the I/O blocks

Priority mechanism

Within the Desigo PX system, the BACnet priority mechanism is used for the I/O output blocks and in the value blocks. This priority mechanism provides a series of prioritized levels at which intervention is possible, for use with the control functions in HVAC plant and the associated components.

The following priority levels are available with blocks AO, BO, MO (and blocks AO_RED, BO_RED, MO_RED) and AVAL, BVAL and MVAL.

Level	Application	Description
Safety level	Life safety	The safety level is assigned the highest priority and is used for the protection of people and equipment. This is where local safety switches and emergency OFF buttons are wired or superimposed commanded, for example, smoke extraction control or frost control.
	Plant safety	
Operator level	Local manual intervention	The operator level is where components are overridden manually. Here, for example, the PXM20 operator unit, for example, may be used to force the output of an I/O function block. This operation overrides all operations at a lower priority level.
	Superposed manual intervention	
Automatic level	Local control	The automatic level is used for local control functions and for superposed BACnet commanding.
	General BACnet commanding	

Table 17: Priority mechanism

The following figure illustrates the structure of [PrioArr] and the influence of local and higher-level control.

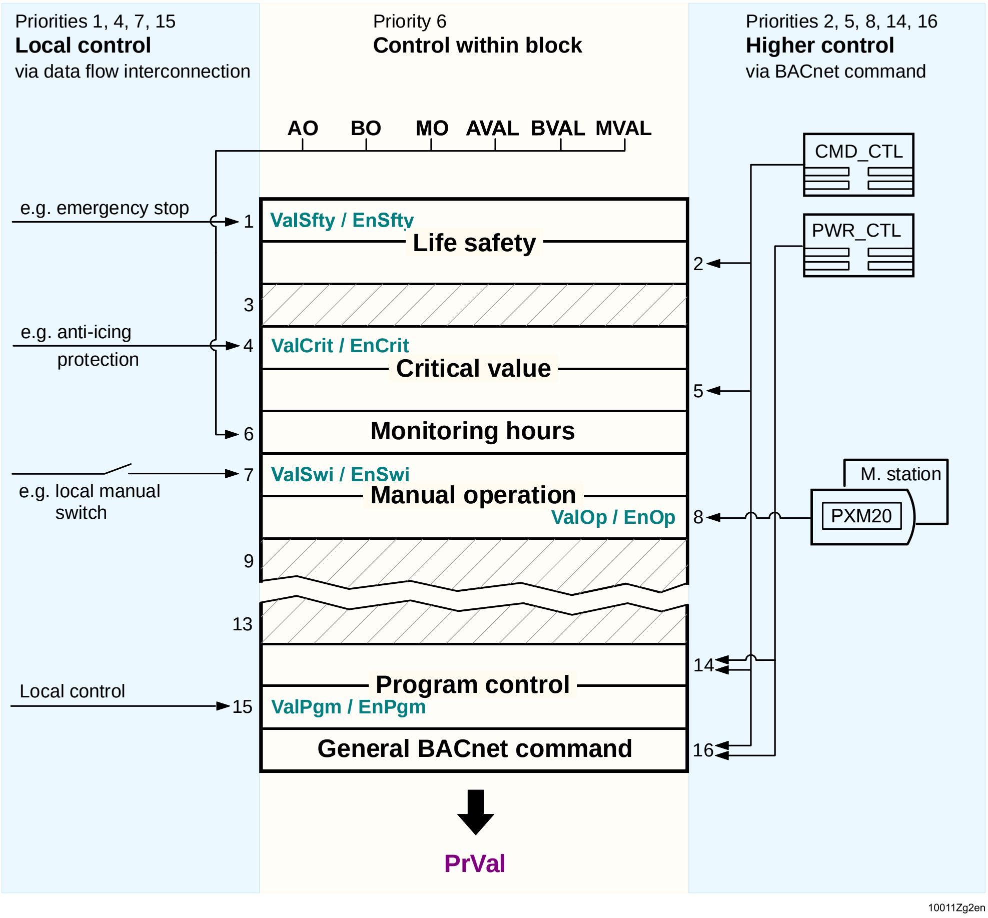


Figure 35: I/O block interface with [PrioArr]

Local override

The override switch overrides the block's switching value and determines in this way the switching value for the field device. Local override has priority over an active manual operation at the same time, that is, priority over local override.

Status monitoring

[AO, BO, MO, AVAL, BVAL, MVAL]

The process is monitored via the feedback signal, and in the case of switching blocks, also via the ramp-up and ramp-down parameters set in [TbTiDly]. If the feedback value deviates from the present value [PrVal] and the delay in [TbTiDly] has not yet expired, the process is in a transitional state. The status monitoring function shows the status at the transient state [TraSta] output. This output can be used to switch on any subsequent components.

Feedback monitoring

[BO, MO]

Monitoring feedback may be based on a data point or a purely internal to the block based on the feedback time parameter.

- Feedback data point available [FbAddr:] = Address

  Monitoring is based on the feedback signals. The delays can be defined with the time parameters for switch-on [TiMonOn], switch-off [TiMonOff] and open-circuit [TiMonDvn]. If the feedback signal [FbVal] deviates from the output value [PrVal], an OFFNORMAL alarm will be triggered (provided the alarm function is switched on).
- No feedback data point available [FbAddr:] = empty

  Based on the feedback time parameter [TiMonOn/TiMonOff], the output [FbVal] is delayed by [PrVal]. The output [TraSta] signals transition state.

Alarm value monitoring

[AI, AO, AVAL, BI, BVAL, MI, MVAL]

Alarm monitoring is optional and can be enabled using [EnAlm]. Analog limit or switching values can be monitored depending on the block type. The tolerance time [TiMonDvn] to trigger a process alarm can be set. Deviations for switch on and off procedures can be distinguished for switching blocks.

Alarm monitoring can be enabled based on the process or time. You can switch off frost protection monitoring in summer, for example.

Reliability monitoring

[AI, AI_RED, AO, AO_RED, AVAL, BI, BI_RED, BO,BO_RED, BVAL, MI, MI_RED, MO, MO_RED, MVAL]

The blocks monitor the reliability of input and output sources and configuration errors. A system alarm is generated for example when a source no longer communicates and the cause is displayed on output [Rlb]. The disturbance output [Dstb] changes to yes. This output, for example, can return to the block for the local disturbance to achieve a more secure position using a higher priority. Reliability monitoring can be switched off using [OoServ], which may make sense for defective or faulty hardware.

Reliability monitoring is always active for the RED blocks since no [OaServ] is available. Superposed control does not distinguish this state and plant safety is not provided under certain circumstances.

Minimum switching times

[BO, BVAL, MO, MVAL]

The minimum time on [TiOnMin] and the minimum time off [TiOffMin] may be defined to reduce switching frequency. For a switch on or off command, is written to [PrioArr] as priority 6 and maintained there during the defined switching period. No lower priority can change the switching value during this time frame.

Switch-on and switch-off delay

[BO, BVAL, MO, MVAL]

To delay switch on or off for elements [DlyOn/DlyOff]. For example to implement a pump run-on to extract residual heat. For a switch on or off command, the corresponding switching value is written to [PrioArr] as priority 6 and maintained there during the defined switching period. No lower priority can change the switching value during this time frame.

Ramp-up/down time

Runtimes for ramp-up and down

[BO, BVAL, MO, MVAL]

The runtime of a damper or the coasting time for a multi-speed motor can be defined in table [TbTiDly] to display or evaluate a transient state [TraSta]. The time parameter can also influence the switching response depending on the switch kind [SwiKind] used.

Plant fault

The block independently recognizes faults and reports them to the defined alarm class [AlmCl], which for its part is responsible for distributing the alarms to alarm receivers. Depending on the alarm function [AlmFnct] set in the block, you may have to acknowledge the alarm and reset it after eliminating the alarm.

The faulted block on output [Dstb] is reset only after the user action is run. The plant ramps up only after an alarm reset since both the local control, as a rule, with this output is blocked for a fault and as superposed control triggered a plant fault.

The alarm reset can be triggered:

- By triggering a common reset in the common alarm block CMN_ALM
- Via an alarm client, for example, AlarmDisplay or PXM20

4.2 Local Control Design

Fault-related shutdown

The disturbance output [Dstb] for an I/O function block is activated when the block recognizes a FAULT alarm (for example, broken wire) or an OFFNORMAL alarm (for example, exceeding a limit value).

The following figure shows how a valve and a pump are forcibly shut down or ramped up depending on the fault state.

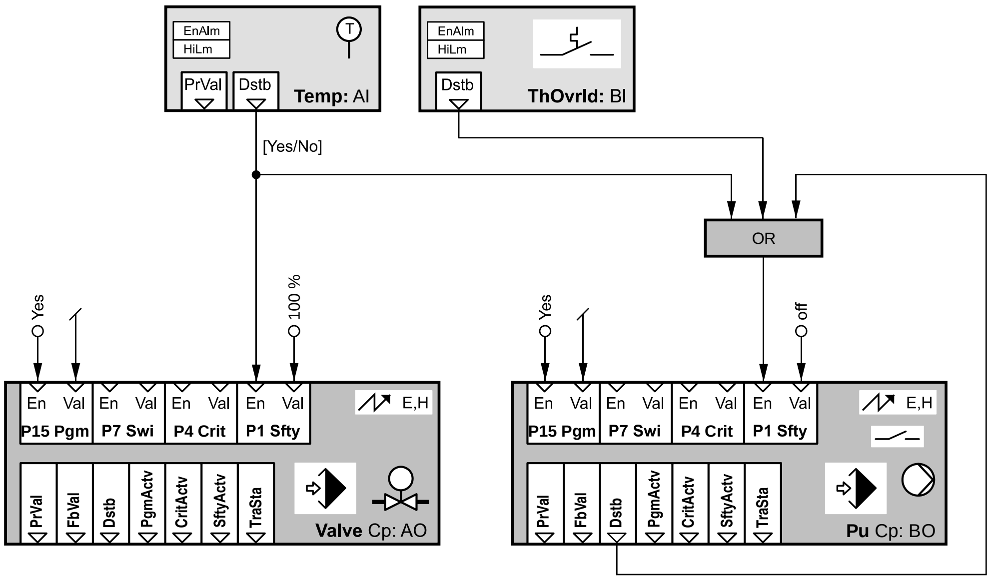


Figure 36: Fault-related pump shutdown

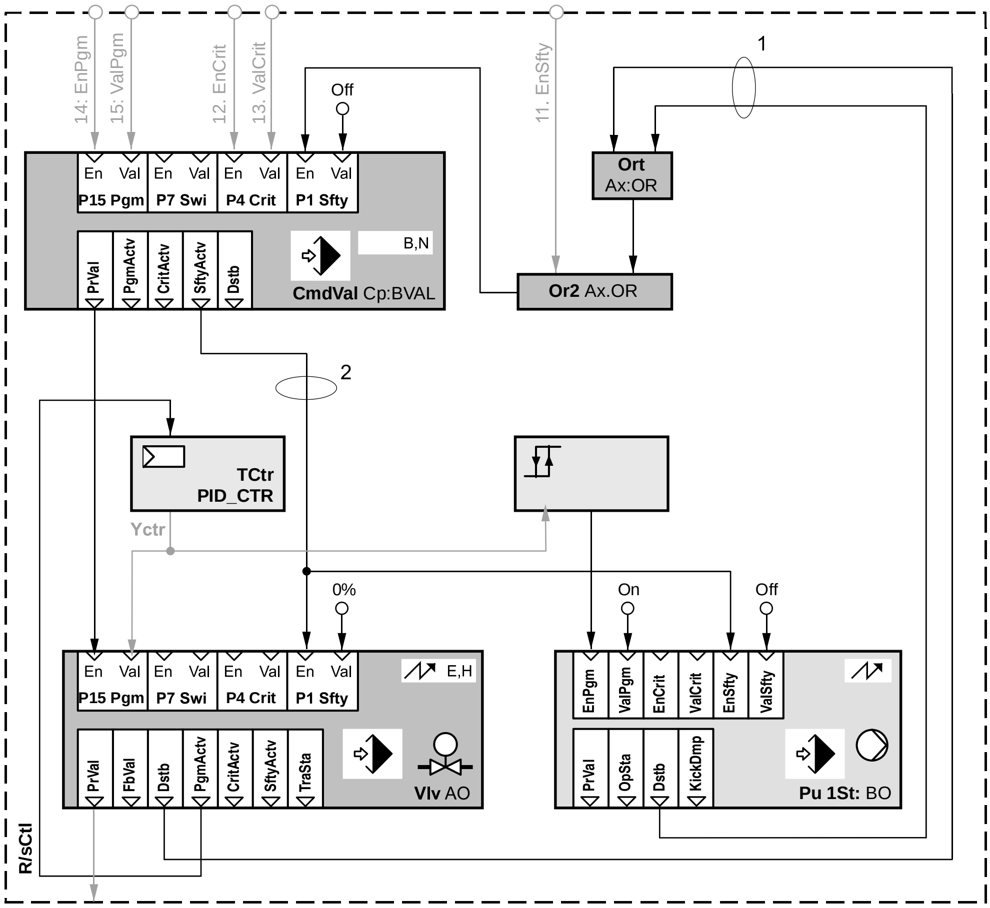
Example forced set-up

A limit value [HiLm] is defined for the temperature in block AI Temp. As soon as this threshold is reached, the output [Dstb] switches the valve via Enable [EnSfty] for the analog output value to 100%. At the same time, the pump is switched to off by Enable [EnSfty] for the Binary Output BO.

Example of fault-related shutdown

The block BI ThOvrld monitors the state of the pump’s thermal switch. If the contact is triggered, the function block is activated based on the parameterized reference value [RefVal] for [Dstb] output. The pump is shutdown through Enable [EnSfty] of the Binary Output BO. The Binary Output BO further monitors the contact’s feedback. In the event of a fault, where the feedback is interrupted, for example, the block reports the fault and shuts down itself via the back wired output [Dstb]. The pump can only be switched on again only after the fault is eliminated and the alarm message is reset as required.

The following figure shows a local fault-related shutdown related to superposed plant control. The compound mapped here as an example was reduced to make is easier to recognize the structure of the local control.



Data Sink: Receives Data
The Information is written by a Client with a certain priority or is read by the Function Unit.

Figure 37: A local fault-related shutdown

Local fault-related shutdown of the aggregate depicted here as an example is triggered as follows:

1. A fault is displayed at output [Dstb] when a component valve [Vlv] or pump [Pu1St] reports a fault (FAULT or OFFNORMAL). The signals revert to enable safety priority [EnSfty] for block BVAL (1). Fault-related shutdown of all components is triggered via the state output [SftyActv] (2).
2. You can also impact the safety shutdown of the components via the compound interface [I1 EnSfty].

The superposed plant control (not displayed here) can access the object directly via referencing since the block BVAL is mapped on BACnet and has a priority array [PrioArr]. As a result, plant control can also trigger a shutdown of the components by commanding the safety priority.

Interlocks

The following figure shows a solution where a fan is only enabled after the damper is completely open.

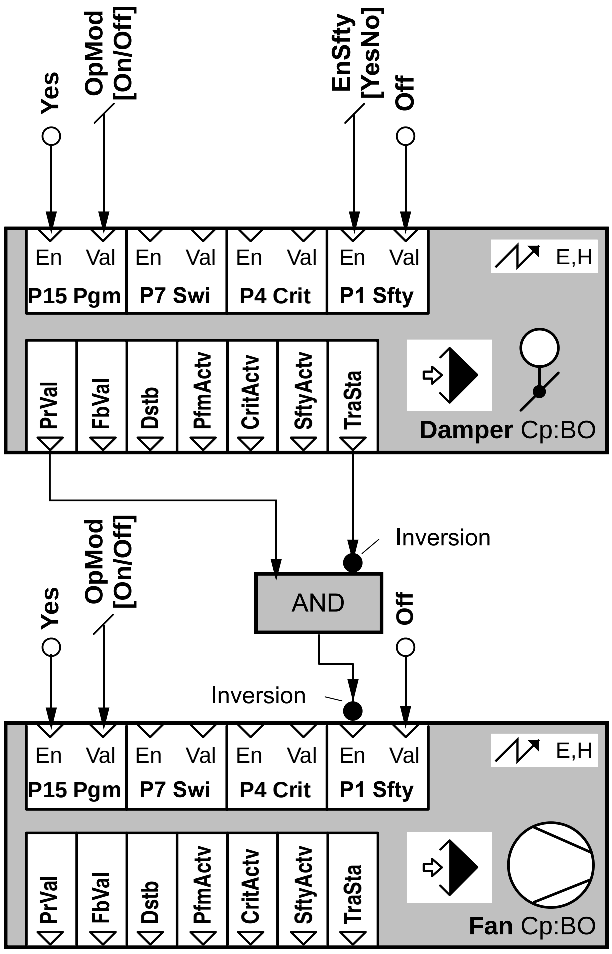


Figure 38: Local interlocks for damper/fan

Local interlocks

A command to ramp-up the plant [OpMod] =On, the damper output changes to [TraSta] = Yes, indicating that a transient state is now active, in other words, the damper is moving. This information is formed on the one hand from the parameterized damper run time [TbTiDly] and, on the other hand, from the feedback contact for the damper's mechanical stop.

The valve is blocked via input [EnSfty] as long as the damper is either blocked or moving, in other words, an intervention via the operator unit PXM20 directly on the fan is prevented. When the transient state ends and the damper is open, the Enable [EnSfty] is cancelled and the fan switched on via the program value [ValPgm]. Enable of the program value [EnPgm] is a constant in this example.

Interlock among aggregates

The targeted interlocking is employed in a modified form from the superposed plant control. To allow, for example, plant control to access the fan during smoke extraction control, the interlock is not implemented by enabling the safety value [EnSfty], but rather by enabling the critical value [EnCrit].

The fan is set to Off by the damper via Enable [EnCrit] until the damper is fully open. The fan can only then start. The damper is held open via [EnCrit] as long as the fan is running to prevent a mistaken operation that could destroy the plant.

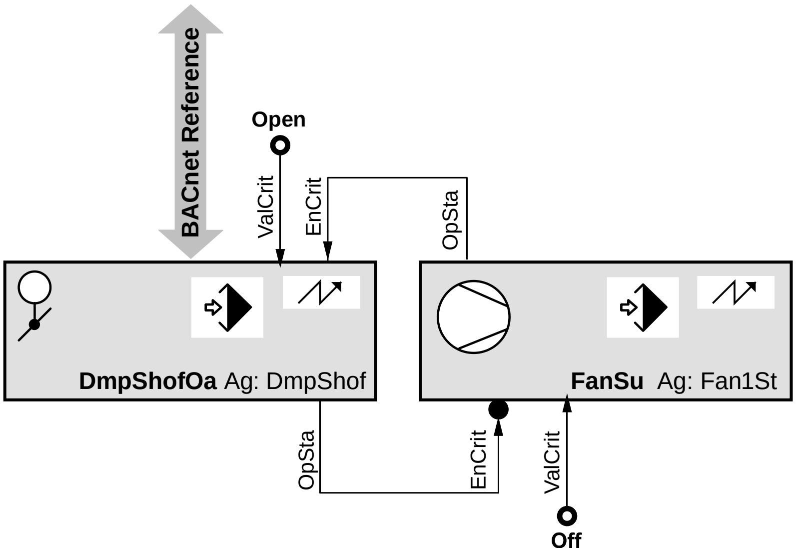


Figure 39: Cross-aggregate interlocking of damper/fan

The operating state [OpSta] for both aggregates are formed within the compounds as illustrated in the previous example from the AND link for [PrVal] and [TraSta].

4.3 Superposed Plant Controls

Two blocks are available in Desigo for superposed plant control:

- CMD_CTL command control for sequence control
- PWR_CTL power control for stepped control

Both blocks are based on the standard BACnet Command Object. They have both tables that define the operating modes and switching response of the underlying aggregates. The commandable blocks in the aggregates must have a BACnet [PrioArr] to use the following output and value blocks: AO, BO, MO, AVAL, BVAL und MVAL.

PWR_CTL may only be communicated using the MVAL blocks based on the specialized task – controlling steps.

Referencing

Referencing is used exclusively for communications by the superposed control blocks with the output and value blocks in the aggregates to be commanded. The references are derived from the Technical Designation (TD) of the block. The reference is defined relative to the control block to the command block. The aggregate does not have to be in the same hierarchy; cross-plant communications is possible.

Example for a reference: B = \...\...\PreHcl'CmdVal

Where CmdVal is the designation for a BVAL object in the PreHcl aggregate. More than one block can be referenced for each aggregate.

As the project-specific root is not part of the address, the references do not need to be modified if the root changes. This simplifies project-specific name changes and the copying of library solutions into a project.

The references, that is, the technical designations with relative addresses are resolved in the controller at runtime. Any addressing errors will therefore only be apparent during runtime. The cause of the error can largely be eliminated, however, when parameterizing the controls blocks with the help of the Plant Control Editors.

The figure shows that the [PrioArr] can communicate directly with the referenced blocks. You can command switch and positioning values and enable them. A commanded command remains valid until the priority entry is enabled again. The control blocks automatically enables all commanded priorities, when the block commands the aggregates to the new plant operating mode. The entries for the [PrioArr] are deleted in the commanded blocks when restarting the PX controller, with the exception of local, manual interventions to priority 8, for example, via PXM20.

Special Desigo S7 features

Interconnection in CFC and not referencing is used for superposed control blocks to communicate with the commanding aggregates! The control concept is otherwise the same as the one for Desigo PX.

Determining plant operating mode

A superposed plant control generally has different sources such as plant switch, scheduler program or important fault messages, from which the resulting plant operating mode must be determined.

The ENSEL_MS (Enable Selector Multistate) and ENSEL_BO (Enable Selector Boolean) blocks are available for evaluating the resulting plant operating mode in the firmware library of Desigo. As a rule, the block is placed before plant control as illustrated in the following figure. All potential influences are interconnected, prioritized by importance on the block and the corresponding required plant operating mode is determined.

Example:

- A fire detector as a high priority (P04) and requires the plant operating mode EmergOff.
- The smoke extraction switch has the highest priority (P01) and demands plant operating mode smoke extraction.
- The scheduler has a low priority (P11) and demands plant operating modes Stage 1, Stage 2 and Off.

The output [Val] for ENSEL_MS now supplies the CMD_CTL the resulting plant operating mode for additional processing. It is important that the multistate enumerations for both blocks ENSEL_MS and CMD_CTL are the same. The multistate values are not text, but rather numbers based.

Superposed command control CMD_CTL

The command control CMD_CTL block is used primarily for the sequence control in the ventilation plants. The block makes it possible to sequentially switch on and off the aggregates. As it is implemented in a very general and flexible way, other fields of application are also conceivable, for example, for refrigeration plants.

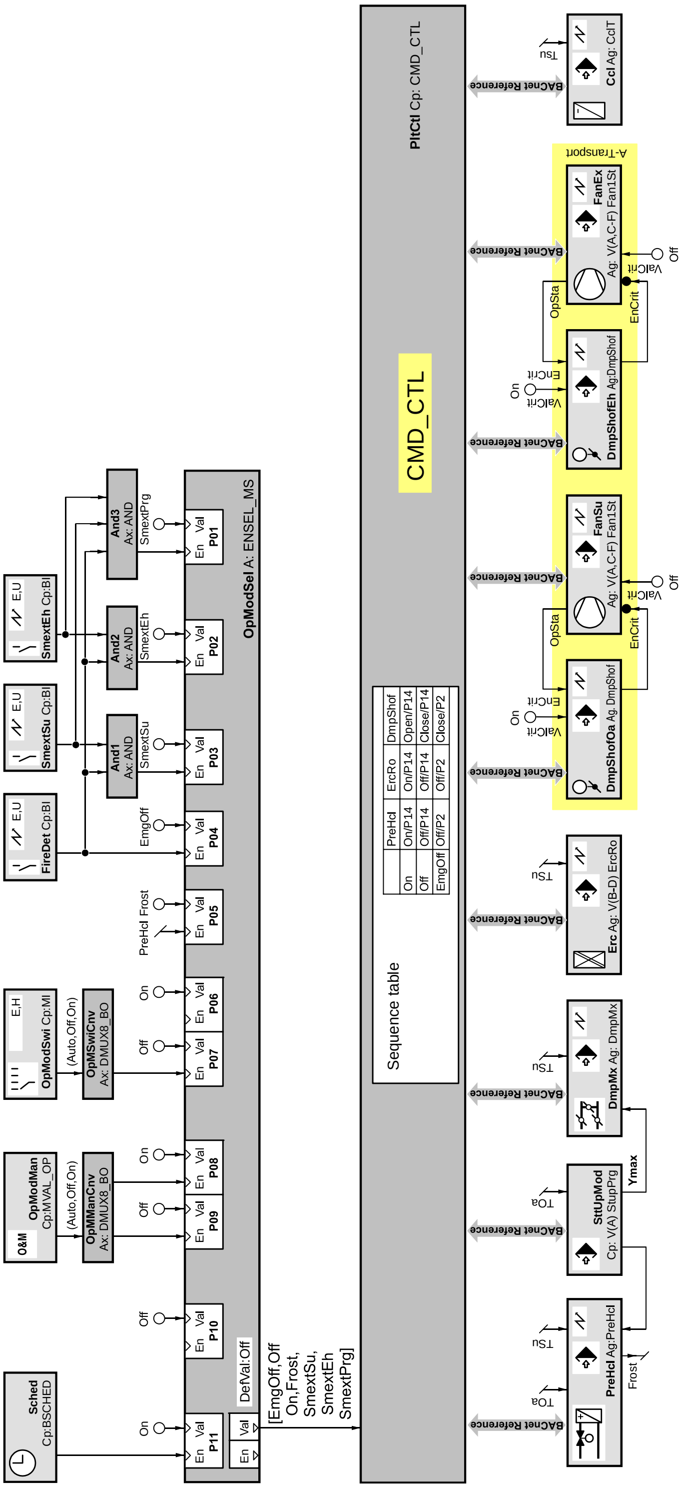


Figure 40: Structural overview: Sequence control for a ventilation plant

The block CMD_CTL controls and monitors output and value blocks mapped on BACnet. Communications is based on BACnet referencing rather than interconnections to optimize the costs of engineering. The following blocks can be used with CMD_CTL: AO, BO, MO and AVAL, BVAL and MVAL.

The sequence is determined in the CMD_CTL in a table. The command for the individual aggregates and the components can be determined based on the plant operating mode.

The main functionality of the block CMD_CTL is the sequential control of aggregates and components dependent on the preset plant operating mode [ValPgm]. For this purpose the switch-on sequence is defined by the order in the function table [FnctTb]. The switch-off sequence is the reverse of the switch-on sequence. Independent switch-on and switch-off sequences are not implemented in this block.

Switched on block can be monitored for their states. There is no monitoring of the OFF status.

Prior to switching on a block a test is made to see if the conditions for executing a command are given. The switch-on process is not even available for active switch on delay, minimum switch off times or a switch command with a higher command (for example, a maintenance switch). This Look Ahead mechanism is described in greater detail in this chapter.

This block does not contain interlocks of individual functional units within aggregates. These are implemented locally via the data flow between the relevant blocks.

Plant Control Editor

The block parameters are set in the Plant Control Editor.

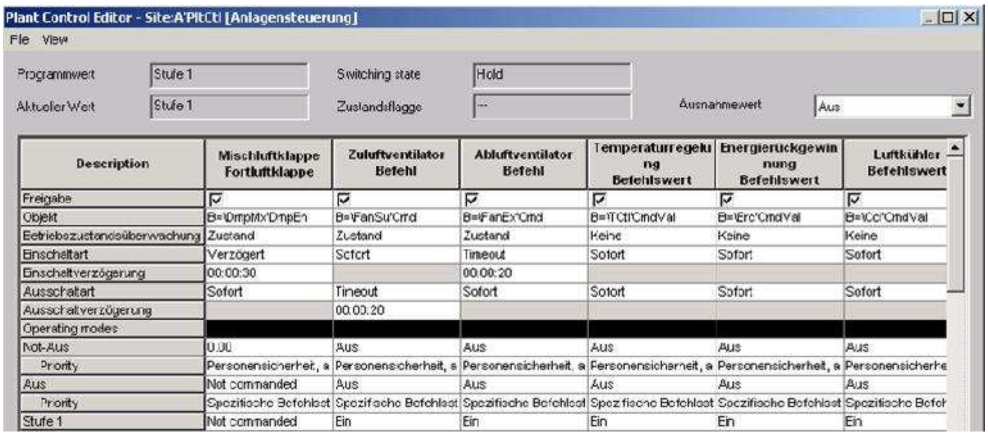


Figure 41: Plant Control Editor

The upper part of the dialog box serves primarily to provide a quick online overview of the present plant operating mode. You can also define exception value which become active as a plant operating mode during a plant fault.

The upper part of the table configures the sequences. The switch-on sequence of the objects, the monitoring mode and the switch on and off types for the sequence controllers can be defined here.

The lower part of the table is used to define the plant operating modes. You can define what command at what priority is command per plant operating mode for each sequence element.

The following priorities for commanding are available:

- Priority 2: Life safety, automatic
- Priority 5: Plant safety, automatic
- Priority 14: Specific command object
- Priority 16: System control

You can enable a command priority with the value Not command for plant operating modes where the local control is intended to assume control of the aggregate.

[DefVal] applies when the [PrioArr] for the corresponding block is empty, that is, not active recognition set, at that time.

Function workflows in CMD_CTL

A series of safety, monitoring and switch actions are conducted for each change to the plant operating mode in block CMD_CTL. The following table includes an overview of function workflows:

Stage	Function	Action
1	Safety function	Check AllLifeSafety plant operating modes.
2	Preview	Checks if the aggregates in question can be switched.
3	Abort sequence	Incomplete sequences are interrupted.
4	Reset sequence	Switch off unneeded aggregates.
5	Step-up sequence	Switch on the newly needed aggregates.
6	Monitor switch-on states	Start monitoring of countdown of delay period.

Table 18: Function workflows

Step 1: Safety function AllLifeSafety

If all switch commands for a given plant operating mode have the priority Life safety, it is referred to as the AllLifeSafety plant operating mode.

A pending AllLifeSafety plant operating mode in the [ValPgm] is executed immediately in all cases and maintained regardless of previously existing and newly occurring faults in the plant – human life takes precedence over plant safety.

If the AllLifeSafety mode includes switch-on commands, then the preset delay times (Delay and Timeout) will be observed. However, in the case of the Timeout setting, the switching sequence will continue even in the absence of any feedback signal. Interlocks cannot therefore be guaranteed, with the exception of local interlocks implemented via Priority 1 (life safety, manual).

Priority 1 (life safety, manual) cannot be overwritten in the AllLifeSafety.

Step 2: Preview Look Ahead

Before changing to a different plant operating mode, in which referenced blocks are to be enabled, block CMD_CTL checks to ensure that all the aggregates can actually be enabled. For this purpose, the entries in the priority array [PrioArr] for the switching sequence blocks are checked in advance. If switch commands of a higher priority are found to be active (for example, a minimum switch-off time or the OFF-command of a repair switch), then CMD_CTL waits to implement the new plant operating mode until the full switching sequence can be implemented. Only referenced blocks, for which a switch-on command exists in the new plant operating mode, are checked, and only if the operating-state monitoring feature has been enabled.

The following priorities are checked:

- Priority 1 [EnSfty/ValSfty], life safety, manual.
- Priority 7 [EnSwi/ValSwi], manual operation, for example, manual switch.
- Priority 8 [EnOp/ValOp], manual operation, operating unit, for example, PXM20.
- Priority 6 [TiMinOff], minimum switch off time.

Priority 6 is checked only for a switch on command to determine whether the aggregate is still within the minimum switch off time. In this case, it waits until the switch off time expires and only then switches on.

There is no Look Ahead for Desigo 7.

Priority 4 (plant safety, manual [EnCrit/ValCrit]) is not considered during the check, since local mutual locking via data flow interconnection, such as depicted in the figure *Cross-aggregate interlocking of damper/fan*, would change this value during the switch-on process.

The present operating mode remains until it is certain that all impacted aggregates with active operating state supervision can be switched to the new set state. A process alarm is triggered in CMD_CTL of a monitored block is not switched on. The exception value [EcptVal] is active as the new plant operating mode in this case. The online diagnostics for the Plant Control Editors determines which element is the cause of the fault.

Step 3: Abort sequence

On-going switch sequences are aborted when delay times are still active. Exception: An alarm is generated when a fault occurs as part of internal monitoring of the block. The demanded plant operating mode is determined in this cased by the exception value [EcptVal]. If the switch sequence is active, but not completed, it is NOT aborted, but rather is completed.

Step 4: Ramp-down sequence

The ramp-down sequence is started first for the new plant operating mode. This shuts down all aggregates that must be switched off per the new plant operating mode. The shut down takes place in the table sequence from right to left, in other words, the last aggregate in the switch sequence is the shut down first. The parameterized times for the time off delay are active during ramp down to off. The time off delay can be activated using a fixed delay time or a maximum timeout or deactivated using the immediate option. The length of the delay for timeout depends on the switch off state of the monitored sequence elements. Transition to the next sequence occurs as soon as it reports switched off, that is, the process value of the block [PrVal] = Off. It switches after the timeout time expires when the shut-down message is not sent.

If a sequence element with a life-safety or plant-safety priority is switched off, the preset delay times will be ignored.

Step 5: Step-up sequence

The step-up sequence is then started for the new plant operating mode. The remaining aggregates are switched on per the data in the function table. The switch on takes place in the table sequence from left to right, in other words, the first aggregate in the switch sequence is the switched on first.

The parameterized times for the time on delay is active during step-up.

The step-up delay can be activated using a fixed delay time or a maximum timeout or deactivated using the immediate option. The length of the delay for timeout depends on the switch on state of the monitored sequence elements. Transition to the next sequence occurs as soon as it reports switched on, that is, the process value of the block [PrVal] <> Off. It switches after the timeout time expires when the switch on message is not sent.

When a sequence element with a life-safety or plant-safety priority is switched on, the preset delay times will take effect first.

Step 6: Monitoring switch on state

A process alarm (off normal) is generated when the monitored aggregate is not switched on after the sequence delay time expires.

The current switch sequence is immediately aborted when the current plant operating mode is not AllLifeSafety and the exception value [EcptVal] is selected as the operating mode.

If, however, the exception value [EcptVal] is already the plant operating mode, the switch sequence is not aborted and the plant operating mode does not change.

Switch on aggregates

The following figure shows the switch response and monitoring mechanism for block CMD_CTL.

The system initially checks if the new plant operating mode is an AllLifeSafety mode. The Look Ahead check takes place in the second step, followed by the check and abort of on-going sequences. The next step is to run the shut-down series, where objects 8 and 4 are switched off to the extent they have not yet be shut down. The sequences are then switched on one after the other in the follow-on switch on series.

Sequence 1 → Sequence 2 → Sequence 3 →

Object nr.	1	2	3	4	5	6	7	8
State monitoring	**State**	**None**	**State**	**None**	**None**	**State**	**State**	**None**
Switch-on mode	**Immediate**	**Immediate**	**Timeout**	**Immediate**	**Delayed**	**Immediate**	**Immediate**	**Timeout**
Switch-on delay			00:30		01:00			02:00
Switch-off mode	**Delayed**	**Immediate**	**Immediate**	**Delayed**	**Immediate**	**Delayed**	**Immediate**	**Immediate**
Switch-off delay	02:00			01:00		00:30		
Operating states								
Stage X	**On**	**On**	**On**	**Off**	**Not cmd**	**On**	**On**	**Off**
Priority	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd

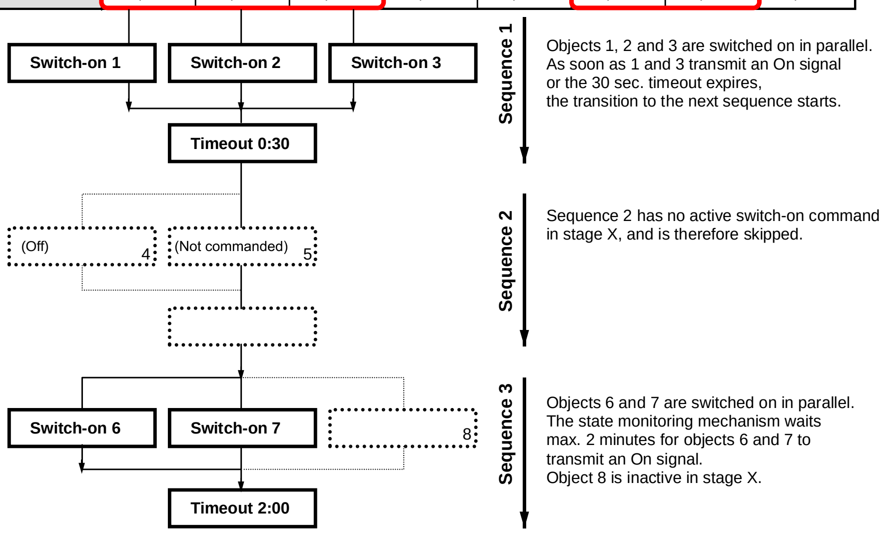


Figure 42: Switch on from Off to Stage X

The set time (delay or timeout) marks a switch on or off sequence that may consist of one or more objects. The times apply for the entire sequence and take effect, when a switch on or step up command or a switch off or ramp down command is demanded.

Switch on occurs in parallel per sequence. A check of the switch on state occurs only in the switch on type timeout. The next sequence is only started after either all monitored objects report a switched on state or the timeout period expires. Operating state monitoring of the objects for monitoring, as depicted in the following figure, only become active after the step-up process for a sequence is completed.

	Sequence 1			Sequence 2		Sequence 3		
Object nr.	1	2	3	4	5	6	7	8
State monitoring	State	None	State	None	None	State	State	None
Switch-on mode	Immediate	Immediate	Timeout	Immediate	Delayed	Immediate	Immediate	Timeout
Switch-on delay			00:30		01:00			02:00
Switch-off mode	Delayed	Immediate	Immediate	Delayed	Immediate	Delayed	Immediate	Immediate
Switch-off delay	02:00			01:00		00:30		
Operating states								
Stage X	On	On	On	Off	Not cmd	On	On	Off
Priority	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd

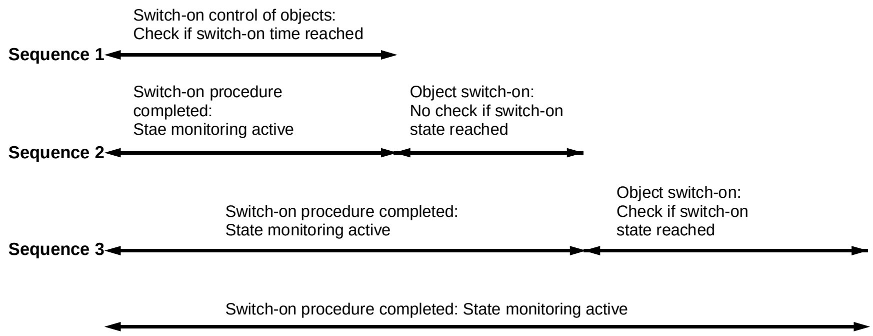


Figure 43: Switch on of blocks and status monitoring

Operating status monitoring is optional and monitors only blocks in a Switched on state. If a referenced block is found to be switched off during active operating state monitoring, but that the block should have been in the state Switched on, a process alarm is generated and the plant operating mode changes to exception value [EcptVal].

The momentary alarm state is visible from the state flag [StaFlg].

	Sequence 1			Sequence 2		Sequence 3		
Object nr.	1	2	3	4	5	6	7	8
State monitoring	State	None	State	None	None	State	State	None
Switch-on mode	Immediate	Immediate	Timeout	Immediate	Delayed	Immediate	Immediate	Timeout
Switch-on delay			00:30		01:00			02:00
Switch-off mode	Delayed	Immediate	Immediate	Delayed	Immediate	Delayed	Immediate	Immediate
Switch-off delay	02:00			01:00		00:30		
Operating states								
Stage X	On	On	On	Off	Not cmd	On	On	Off
Priority	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd

Figure 44: Operating state monitoring

Monitoring is active from the point when the corresponding sequence successfully completes the switch on process, that is, the process value for block [PrVal] is not equal to Off and the transient state is completed [TraSta] = No.

The [PrVal] of the block will be monitored. Hence, only those events which affect [PrVal] can be detected, that is:

- Local fault shut down using interconnection of fault [Dstb] to enable safety, manual [EnSfty].
- Local shut down of the block in a higher priority application program.
- Switch-off by manual operation of the output module if the I/O module returns the manual setting value.
- Block switched off via HMI operation or manual switch in control panel

Command control is only in a position to recognize fault-related deviations and act accordingly when the interconnection of all relevant faults [Dstb] occur locally on a monitored output of value block to [EnSfty]. Its default value [DefVal] becomes the process value [PrVal], if a referenced output or value block is out of service [OoServ]. The state monitoring of the plant cannot operate correctly, since [PrVal] no longer reflects the actual state of the aggregate.

To reduce the frequency with which aggregates are switched on and off, it is possible to define a minimum switch-off time [TiOffMin] in the aggregates. The look-ahead mechanism in the CMD_CTL block prevents the switching of the whole sequence if the minimum off-time in one aggregate with active state-monitoring has not yet expired. The output [TraSta] shows the transitional state and [PrVal] remains unchanged, at the last value. The new plant operating mode will be implemented only when all the aggregates to be enabled in the switching sequence can actually be enabled.

A minimum off-time should always be set for aggregates incorporating a rotating mass (for example, fans).

Operating mode changeover

The following figure shows a changeover from operating mode Stage Y to Night cooling.

All objects were switched on in Stage Y. During the changeover to Night Cooling, the system initially checks whether the new plant operating mode is an AllLifeSafety mode. The Look Ahead check takes place in the second step; followed by the check and abort of on-going sequences.

In the next step, the switch off series is conducted where the sequence elements of switch off sequence 1 are switched off in parallel. It transitions to the second sequence after the delay time expires. Object 5 is commanded to Off with plant safety, priority 5. For plant safety or life safety (priority 2), the delay times or timeouts have no effect. The transition to switch-off sequence is immediately since object 4 is already switched on.

Sequence 1 Sequence 2 Sequence 3

Object nr.	1	2	3	4	5	6	7	8
State monitoring	State	None	State	None	None	State	State	None
Switch-on mode	Immediate	Immediate	Timeout	Immediate	Delayed	Immediate	Immediate	Timeout
Switch-off delay			00:30		01:00			02:00
Switch-off mode	Delayed	Immediate	Immediate	Delayed	Immediate	Delayed	Immediate	Immediate
Switch-off delay	02:00			01:00		00:30		
Operating states								
Night cooling	On	Off	Off	On	Off	Off	Off	Off
Priority	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd	Spec. cmd

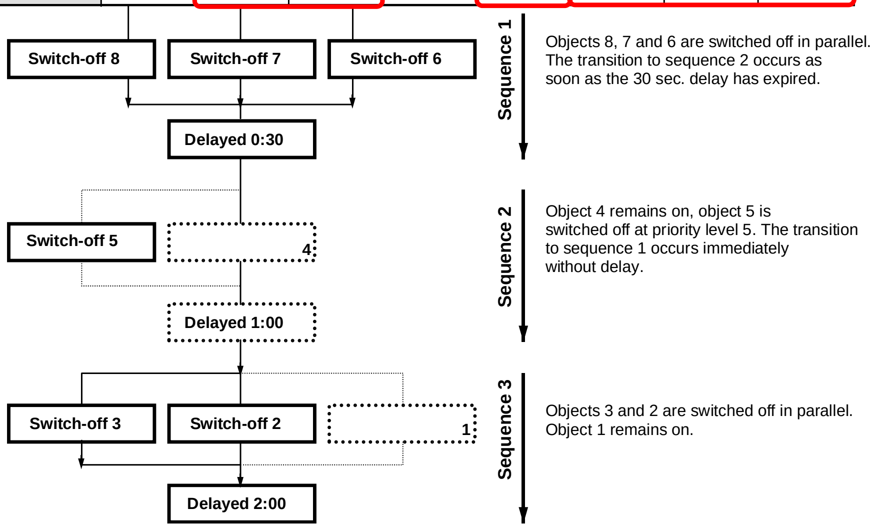


Figure 45: Block switch-off

Objects 3 and 2 are switched at the same time as object 5. Object 1 remains switched on.

Alarm management

Block CMD_CTL is alarmable and differentiates process from system alarms.

A process alarm occurs, when:

- One of the monitored aggregates is not switched on.
- One of the referenced aggregates cannot be switched on.

The exception value [EcptVal] becomes the present plant operating mode as a reaction to a process alarm. In addition, an alarm is sent.

A system alarm occurs for the following configuration efforts:

- A referenced aggregate is not available.
- A referenced aggregate is not a commandable object.
- Impermissible priorities are used (priorities 2, 5, 14, 16 are allowed).
- [ValPgm] or [EcptVal] are outside the permissible range.
- The referenced aggregates have a different number of operating modes.

The command control attempts for a system alarm to enable all referenced blocks for local control. The four commandable priorities are commanded – in other words enabled to Not commanded: Life safety (2), plant safety (4), specific command control (14) and system control (16).

The response of the block to an alarm can be defined. The following mechanisms have been incorporated to prevent hunting in the plant.

- Basic and standard: When the block goes into alarm, the exception value [EcptVal] is switched. When all the aggregates are ready for switching again, CMD_CTL automatically tries to implement the present plant operating mode [PrVal]. If all the aggregates are ready for direct switching immediately after implementation of the exception value [EcptVal], hunting is likely to occur. In this case, CMD_CTL prevents any further switch-on attempt, and the required plant operating mode [PrVal] must be changed.
- Extended: When the block goes into alarm, the exception value [EcptVal] is switched. The alarm has to be reset by the user, and there is therefore no risk of hunting.

The block is not alarmable for Desigo 7.

Out of service

The block can be taken out of commissioning using [OoServ]. The following occurs when switching [OoServ] to On:

- Immediately abort of switch on and off sequences and monitoring.
- All objects are commanded with a release of the priorities: Life safety (2), plant safety (4), specific command control (14) and system control (16)

Superposed power control PWR_CTL

The power control function block PWR_CTL is used for control and monitoring of the performance of a number of energy producers (multiple boiler systems, refrigeration machines, etc.). As is the case for command control CMD_CTL, the data is exchanged bilaterally between power control and the individual energy producers (boiler, refrigeration aggregate, among others), via referencing. Since the energy producers are generally implemented in the form of logical aggregates, and contain local logic, the PWR_CTR block communicates only with MVAL blocks.

The control strategy is based on the use of tables and is designed for multi-stage energy producers. Additional energy-producer stages are connected or disconnected in accordance with the actual power demand. For modulating energy producers, a stepped output is converted into a proportional output within the aggregate. This makes it possible to handle the full power range (0…100%) in one stage, or to divide the power range into several stages (for example, Stage 1: 0…20%; Stage 2: 20…40%; etc.).

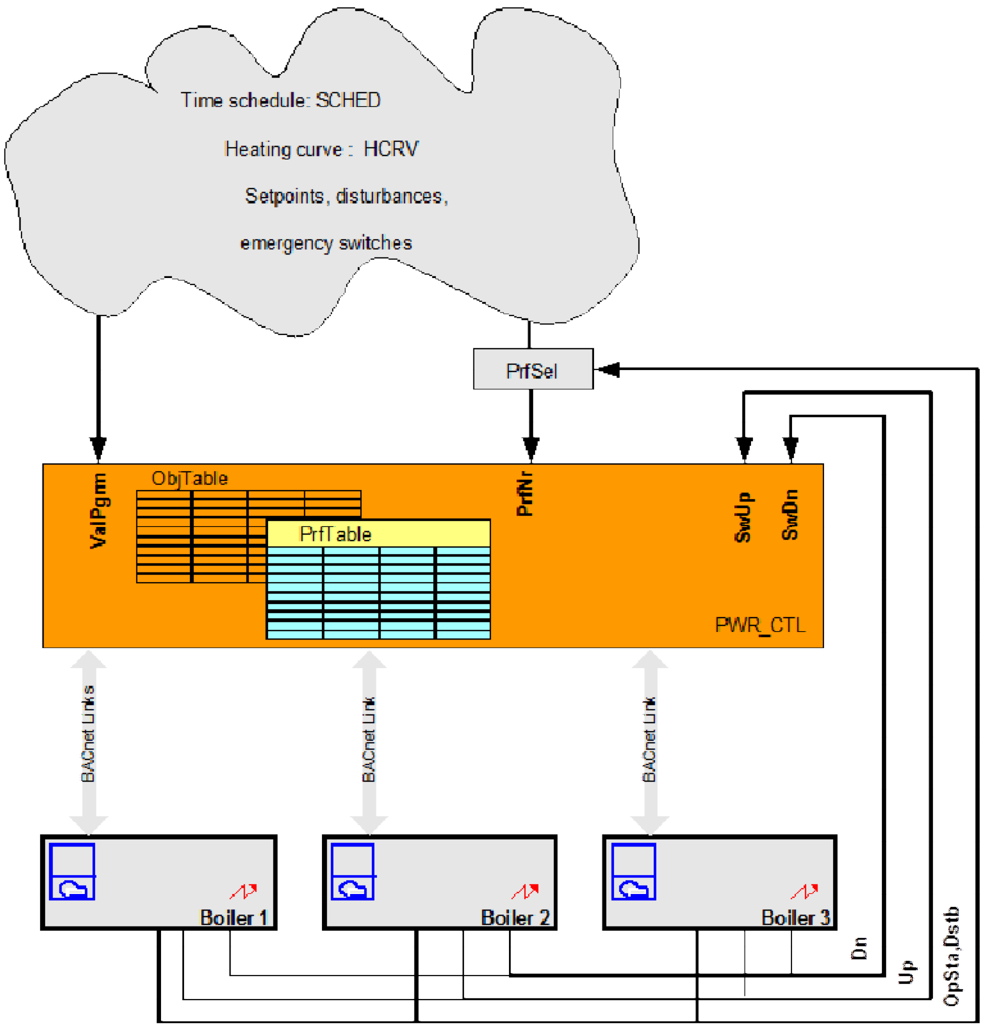


Figure 46: Overview of PWR_CTL for control and monitoring of energy producers

Plant Control Editor

The block parameters are set using the Plant Control Editor.

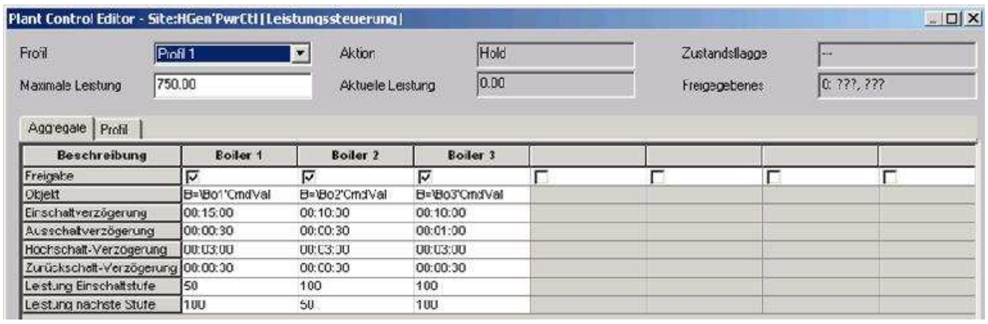


Figure 47: Plant Control Editor Aggregate tab

The upper part of the dialog box serves primarily to provide a quick online overview of the block. The maximum power controlled by the block is set with the maximum power parameter [MaxPwr]. The value must be greater than 0 kW in order for the block to work. Any changes in this limit value have a direct effect in online mode. If no limit value is required, the maximum power must be set at an appropriately high value.

The Aggregates tab is used to set the control variables of the aggregates (boiler, refrigeration machine).

- Enable: Activation/deactivation of an entry if they are not released, aggregates in the Profile table will be ignored.
- Command object reference: Reference (relative addressing) to multistate value blocks [MVAL] of the relevant energy producer. During the configuration process, all MVAL blocks at the same and at lower hierarchical levels are displayed.
- Aggregate description: The reference to the value object provides access to (and hence, knowledge of) all information in a special dialog box via the referenced object in the control command.
- Switch-on delay: Delay time when switching from OFF to Stage 1.
- Switch-off delay: Delay time when switching from Stage n to OFF.
- Step-up delay: Delay time when switching from Stage n up to Stage n+1.
- Step-down delay: Delay time when switching down from Stage n to Stage n–1.
- Switch-on stage power: Power in [kW] at the lowest (that is, first) stage.
- Next power stage: Additional power at the next stage(s) in [kW].

The control sequences for the aggregates (boiler, refrigeration machine) are defined under the Aggregates tab. Each profile describes the order in which the energy producers are to be switched and the maximum stage in each case. A total of 8 profiles each with 15 sequence entries can be defined.

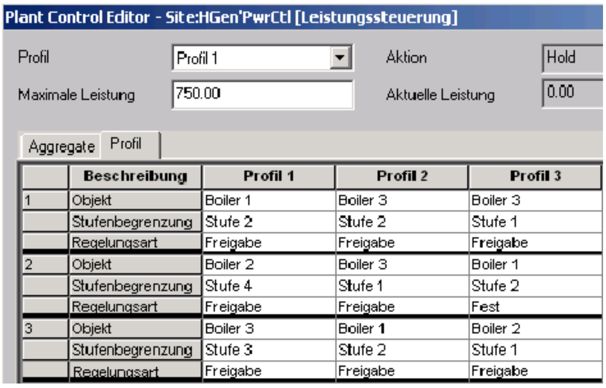


Figure 48: Plant Control Editor Profile tab

The active profile table is defined by entering the profile number [PrfNr] as an input parameter, or by selecting it from the Profile dropdown list in the Plant Control Editor. This input parameter can be interconnected, so that the profile can be changed as a function of other events (faults, summer mode, boiler operating hours, etc.). If the profile is changed during operation, the power output [PrPwr] is switched in accordance with the power profile in the new profile table.

The profile definition determines the order in which individual aggregates are to be switched on or off. The following information must be entered for every sequence entry:

- Object: Selected from the previously referenced aggregates.
- Stage limitation: Limit up to which the aggregate may be enabled.
- Control type: Specifies whether the enabled stages are to be switched permanently or released to the control system.
  - Fixed: The total power provided by a given switch stage is switched on or off permanently. This option can be used, for example, for a specific base load which is required to be present at all times. The command is implemented with Priority 14.
  - Enable: The power actually required from the released switch stage is determined by local control of the aggregates. The command is implemented with Priority 16.

For each sequence step, the function block only ever releases the last aggregate marked Release to the control system. It displays this released object [RlsObj], with the released object stage [RlsObjSt], at the output. All other aggregates are fixed at the released stage value. If none of the aggregates is marked Release, the aggregate of the current sequence step is released to the control system.

On/Off switching of PWR_CTL

When PWR_CTL is switched on [ValPgm = On], the first step in the sequence of the current profile is executed immediately. In this case, the switch-on delay is not valid. If the trigger for default power is on [PwrTrg = On], the aggregate is switched directly to the default power level [DefPwr].

A switch-off command [ValPgm = Off], disables all the energy producers defined in the profile table with Priority 14.

Out of service

If the PWR_CTL function is taken out of service [OoServ = On], then all referenced aggregates are switched OFF with Priority 14, without taking account of delay times. The monitoring of the aggregates is disabled.

Demand signals

The current power demand is determined locally in the energy producers. In the event of a power deficit or surplus, the aggregate will send the appropriate demand signal to the PWR_CTL block. The demand signal from the aggregate can be generated, for example, on the basis of the boiler setpoint deviation and the primary flow. The demand signals of the separate aggregates are combined and transmitted to the [StepUp] or [StepDn] input of the PWR_CTL block. After expiry of the relevant delay times, the block executes the appropriate sequence step to increase or reduce the power, as necessary.

When both [StepUp] and [StepDn] demand signals are present simultaneously, [StepDn] takes priority.

Direct switching of a load

In cases where the power is to be increased or decreased without observing the delay times, the default-power trigger input [PwrTrg] can be used to switch to a defined default power level [DefPwr]. From the current profile, and taking account of the current power output, the PWR_CTL block determines the sequence steps required to cover the power demand and implements them directly.

Power display

The block has two outputs at which it displays the current total power of the energy producers. This consists firstly of the controlled power output [CtldPwr]. This output represents the total power switched by the PWR_CTL block.

The other output, the present power output [PrPwr], shows the additional power output of energy producers that are not directly switched by PWR_CTL. To do this, PWR_CTL evaluates the priority array [PrioArr] of the MVAL blocks. In this way it can detect, for example, that an energy producer has been switched manually [Prio8] to a given stage.

Configuration error

The entries in the two configuration tables are checked cyclically for validity.

- A fault alarm is generated under the following circumstances:
- Aggregates no longer accessible from PWR_CTL, owing, for example, to retrospective modifications to the technical hierarchy, affecting the references of the energy producers
- Retrospective changes to the stage-limit value in the aggregate, making the value configured in the profile table too high
- No multistate value object
- Reference block no longer available: For example, deleted with delta download
- Several references to the same block
- Empty profile table

In the event of a fault alarm, all aggregates still accessible by PWR_CTL are switched OFF permanently.

Alarm management

The PWR_CTL block in the system is an alarm-generating block with a configurable alarm class [AlmCl] and alarm function [AlmFnct].

An Offnormal process alarm is generated:

- When the step-up demand signal [StepUp] persists for longer than the monitoring time deviation [TiMonDev], and there are no further sequence steps to increase the power.
- When the step-up demand signal [StepUp] persists for longer than the monitoring time deviation [TiMonDev] plus the step-up delay time of the next sequence step, AND a step-up would cause the maximum power limit [MaxPwr] to be exceeded.

The process alarm is reset to normal:

- When a sequence step with an increase in power becomes possible again. Another sequence step with an increase in power becomes possible when the [MaxPwr] limit will no longer be exceeded, or when a further sequence step with a power increase is present.
- When there is no further [StepUp] demand signal

The text of process alarms can be defined to suit customer requirements.

For Desigo S7 the PWR_CTL block is not alarmable.

Switching alternatives

Various switching alternatives can be defined by entries in the profile table. Note that where one or more step-up sequence steps (intended to increase the power) would, in practice, result in a drop in the power output, all steps in the step-up sequence are enabled automatically until a sequence entry is reached, at which the power output actually does increase as required. See also the following example.

Beschreibung	Boiler 1	Boiler 2	Boiler 3
Freigabe	☑	☑	☑
Objekt	B=\Bo1'CmdVal	B=\Bo2'CmdVal	B=\Bo3'CmdVal
Einschaltverzögerung	00:15:00	00:10:00	00:10:00
Ausschaltverzögerung	00:00:30	00:00:30	00:01:00
Hochschalt-Verzögerung	00:03:00	00:03:00	00:03:00
Zurückschalt-Verzögerung	00:00:30	00:00:30	00:00:30
Leistung Einschaltstufe	50	100	100
Leistung nächste Stufe	100	50	100

Figure 49: Example of aggregate table

The power data in the object table and the sequence entries in the profile table in Figure *Example of aggregate table* together give the power profile illustrated in Figure *Example of profile entries with a drop in power (Profile 2)*.

Profile 1

In the main application of the PWR_CTL function, a new energy producer is added for each sequence entry in the profile table. For this purpose, an aggregate only needs to be entered in the sequence table once.

In the event of a power demand, which the boiler transmits to the PWR_CTL function in the form of the [StepUp] demand signal, a further boiler stage / sequence step is enabled when the step-up delay has expired. When a boiler reaches the stage limit, the function switches to the next boiler or boiler stage after expiry of the switch-on delay. The last-enabled boiler stage is released to local power control, while all other boilers are fixed at their current power output.

If the power needs to be reduced, this is transmitted to the PWR_CTL function via the [StepDn] demand signal. The sequence steps are then executed in reverse order, with the defined switch-off and step-down delay times.

Figure 50: Example profile table using a normal power profile

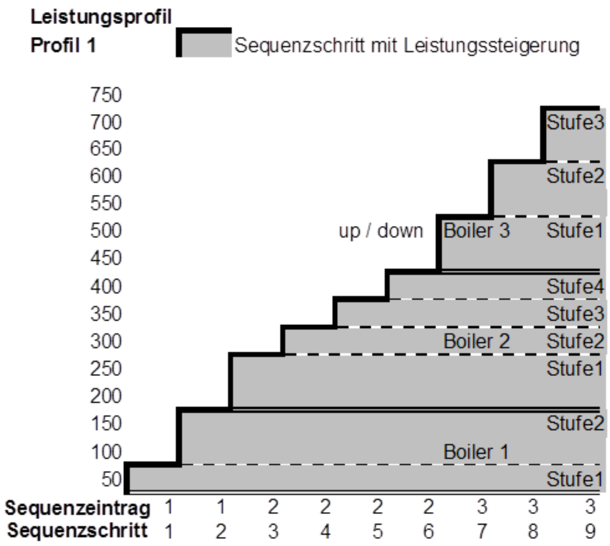


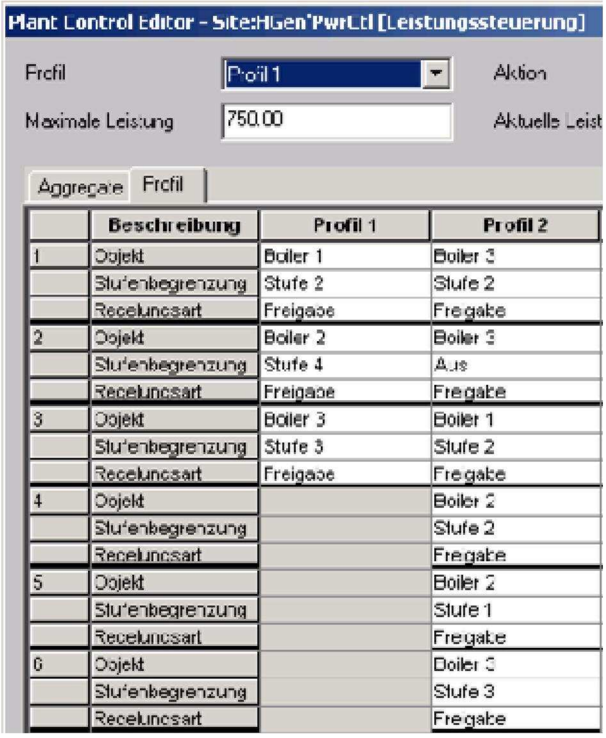
Figure 51: Example profile table using a normal power profile

Profile 2

Profile 2 shows that the order in which boiler stages are to be enabled has been changed, and that sequences which will cause a drop in the power output have been defined in the power profile. In the example illustrated, Boiler 3, which is currently delivering 200 kW, is switched OFF via sequence entry 2. Boiler 1, which could achieve a power output of 150 kW with its enabled stages, is defined as the next object in the sequence. This results in a drop in the power output, causing the function block to enable all sequence steps automatically until an actual increase in power is achieved.

In sequence entry 4, Boiler 2 is enabled up to stage 2, giving a further 150 kW output. Boilers 1 and 2 are thus enabled simultaneously up to stage 2, to prevent a drop in power. The effective delay time for the simultaneous switching process is determined the maximum delay time of the boilers concerned. Since it is Boiler 1 which has the longest delay (15 minutes), the simultaneous switching operation will be delayed for this period of time.

Sequence entry 5 would again result in a drop in performance, because stage 2 of Boiler 2 is no longer enabled. The block therefore switches straight to sequence entry 6, enabling Boiler 3 to compensate for the power deficit. In this case the effective switch-on time is based on the switch-on delay for Boiler 3 (10 minutes).



	Beschreibung	Profil 1	Profil 2
1	Objekt	Boiler 1	Boiler 3
	Stufenbegrenzung	Stufe 2	Stufe 2
	Regelungsart	Freigabe	Freigabe
2	Objekt	Boiler 2	Boiler 3
	Stufenbegrenzung	Stufe 4	Aus
	Regelungsart	Freigabe	Freigabe
3	Objekt	Boiler 3	Boiler 1
	Stufenbegrenzung	Stufe 3	Stufe 2
	Regelungsart	Freigabe	Freigabe
4	Objekt		Boiler 2
	Stufenbegrenzung		Stufe 2
	Regelungsart		Freigabe
5	Objekt		Boiler 2
	Stufenbegrenzung		Stufe 1
	Regelungsart		Freigabe
6	Objekt		Boiler 3
	Stufenbegrenzung		Stufe 3
	Regelungsart		Freigabe

Figure 52: Example of profile entries with a drop in power

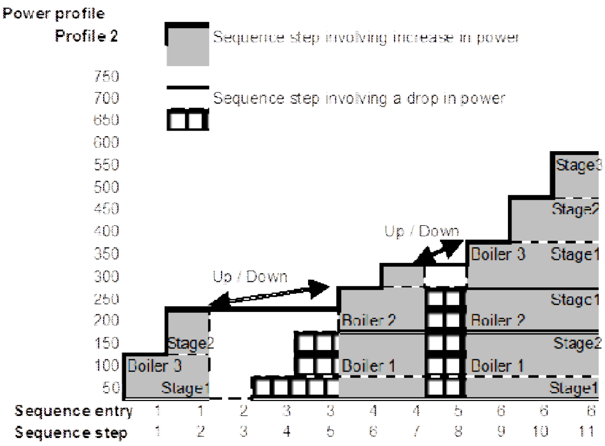


Figure 53: Example of profile entries with a drop in power

Online diagnostics

A diagnostics screen for the PWR_CTL block is available online in Xworks Plus (XWP).

Figure 54: Plant Control Diagnose

The following states are displayed:

- Present value: Operating state at the block output pin [PrVal]
- Action: Transient state [TraSta] depending on actual switching conditions: Up, down or hold

- Present power: Value at the block output pin [PrPwr]
- Status flag: In accordance with the BACnet definition, the value of [StaFlg] is always Overridden. Alarms may also be displayed here.
- Released aggregate or stage: This shows the current sequence entry, the released object [RlsObj] and the released object stage
- Last alarm/event message: Value at the block output pin [LstMsg]

4.4 Closed-Loop Control Strategy

Controller types

For closed-loop control purposes, two controller blocks are provided in the Desigo system, which cover the majority of requirements:

- [PID_CTR]
- [CAS_CTR]

PID_CTR stand-alone controller – Sequence controller

The PID_CTR block is used as:

- A universal stand-alone PID controller
- A universal PID controller with external tracking
- An individual sequence-controller element in a sequence controller or sequence cascade controller

The PID_CTR block integrates the following functions:

- Can be programmed for P, PI, PID or PD control action
- Gain, integral action and derivative action can be programmed individually
- Proportional control output with minimum and maximum limit control
- Programmable gain factor
- Programmable neutral zone
- Programmable offset (for P and PD controllers)
- Programmable initial integrator value (for PI or PID controllers)
- Programmable runtime for control variable (0 – 100%, 100 – 0%) and positioning speed
- Type of operation (direct acting or reverse acting) can be selected

A sequence controller can be implemented by interconnecting several PID_CTR blocks. The sequence linker SEQLINK can also be used, where appropriate. The only function of this block is to enable individual sequence elements to be deleted without the need to create new connections.

CAS_CTR cascade controller

The PID_CTR block is used:

- As the master controller in a sequence cascade control configuration (for example, room/supply air cascade).
- In temperature and humidity control loops

The following functions are integrated in the CAS_CTR block:

- Can be programmed for P, PI, PID or PD control action
- Proportional controller output with minimum and maximum limit control
- Setpoints for heating and cooling sequences, and for energy recovery
- Setpoint depending on type of operation, for energy recovery
- Initialization of integrator (initial value)

Universal PID controller

The PID_CTL block can be used as a universal stand-alone controller in a plant for the control of any control variables. For example:

- Temperature, temperature differential
- Pressure, pressure differential

- Velocity
- Absolute humidity, relative humidity

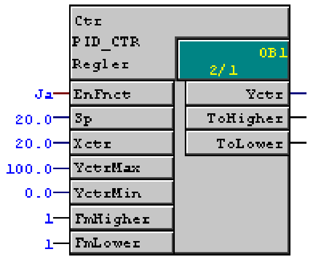


Figure 55: PID_CTR block

Control action

The PID_CTR block can be configured as a P, PI or PID controller. The following parameter settings are used to define the control action:

- Gain [Gain]
- Integral action time [Tn]
- Derivative action time [Tv]

As an option, the gain [Gain] can be influenced with the [GainFac] input. It can be useful to correct the gain factor in this way when controlling outside air dampers, for example, as the effect of the damper positions can depend on the outside air temperature. The correction factor is defined with the gain scheduling block ADAGAIN.

The actuator runtime can be set. Specifying the actual actuator run-times makes it possible to tune the controller more accurately to the actuator concerned, so improving the control quality of the control system.

Correcting range

The correcting range is limited by specifying the minimum and maximum output variable. In this process, the minimum of the two values is always set as the maximum value. In other words, the maximum value may be below the minimum value; there is no need to update the minimum value.

Neutral zone [Nz]

[Nz] is a zone on either side of the setpoint, within which the controller does not respond. As soon as the difference between the setpoint [Sp] and the measured value [Xctl] is less than half of the [Nz], the output is driven for a further 7 cycles, so that the measured value [Xctl] is as close as possible to the middle of the [Nz]. The output signal [Yctr] then remains constant. The output signal is only re-adjusted when the parameters move outside the [Nz] again.

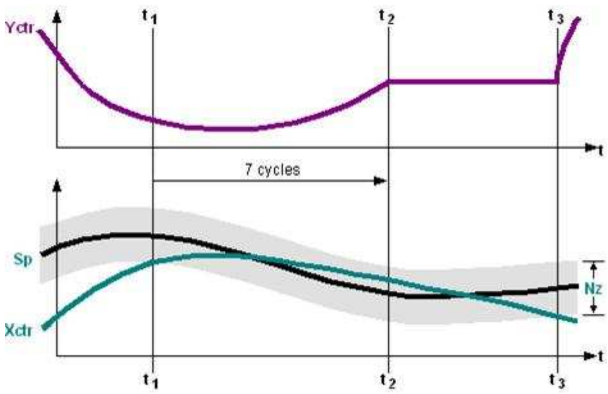


Figure 56: Controller response in the neutral zone

P/PD controller

If the PID_CTR block is configured as a P-controller or PD-controller, a calibration point (Offset) [YctrOfs] can be specified. For example, the P-controller can be calibrated so that the set point is maintained with a 50% load.

With a 0% or 100% load, the P-deviation is then half the amplitude of the proportional range [Gain].

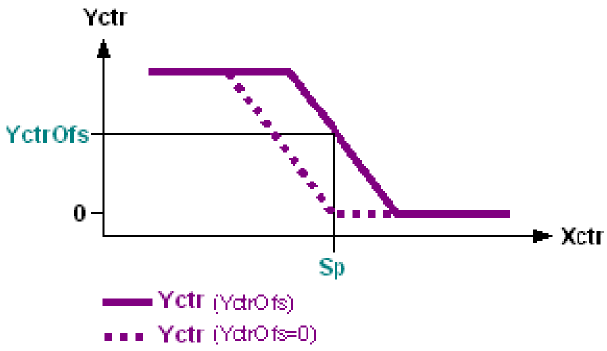


Figure 57: Calibration point (Offset) for P and PD-controllers

Tracking [Track]

[Track] is used, for example, where the PI(D) controller, operates as a limit controller, for example, acting on a valve or actuator via an intermediary minimum or maximum selector block. The tracking input ensures the availability of the controller during the period in which it is blocked by the minimum or maximum selector block. During this time, its integrator (and, hence, its output) is maintained at the value of the signal received, so that if the limit conditions are violated, it is able to respond immediately. [Track] is also used in conjunction with special actuators with positioning feedback.

Direct/reverse-acting control action [Actg]

[Actg] is a characteristic parameter of the controller and indicates the relationship between the setpoint deviation and the change in energy flow. A distinction is made between direct action and indirect [Actg].

- Direct control [Actg]: As the controlled variable rises, the controller output increases, and as the controlled variable falls, so the controller output decreases.

  Example: Cooling or dehumidification – as the measured value rises above the setpoint, so the flow of energy is required to increase.
- Indirect control [Actg]: As the controlled variable decreases, the controller output decreases.

  Example: Heating or humidification – as the measured value falls below the setpoint, so the flow of energy is required to increase.

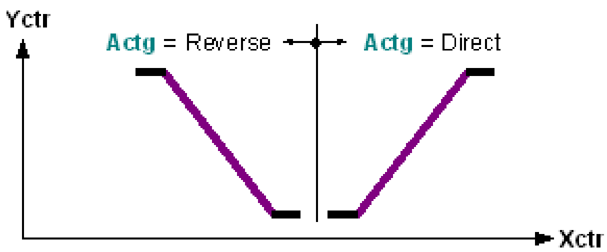


Figure 58: Control action [Actg] with P controller

Inversion [Inv]

[Inv] of the output signal is required, for example, for air dampers. The outside air and exhaust air damper must close in response to an increasing heating demand. The inversion of the manipulated variable affects only the output signal [Yctr] and not the action of the controller.

Sequence controller

Sequence controllers are used primarily in ventilation and air conditioning systems to control the temperature and humidity. Other applications are also possible, for example, in heating systems.

Each controlled aggregate functional unit incorporates a universal PID controller function block, PID_CTR, as a sequence-controller element.

The statements made about the universal PID controller also apply to the use of the PID_CTR function block as a sequence-controller element.

The sequence-controller elements coordinate their own interaction independently. Interaction is coordinated with coordination signals [FmHigher] and [ToLower], which are mutually exchanged by adjacent sequence-controller elements. This is the only link between the sequence-controller elements. This process allows the setting of individual parameters for each individual controller or aggregate, and hence effective optimization of the entire plant.

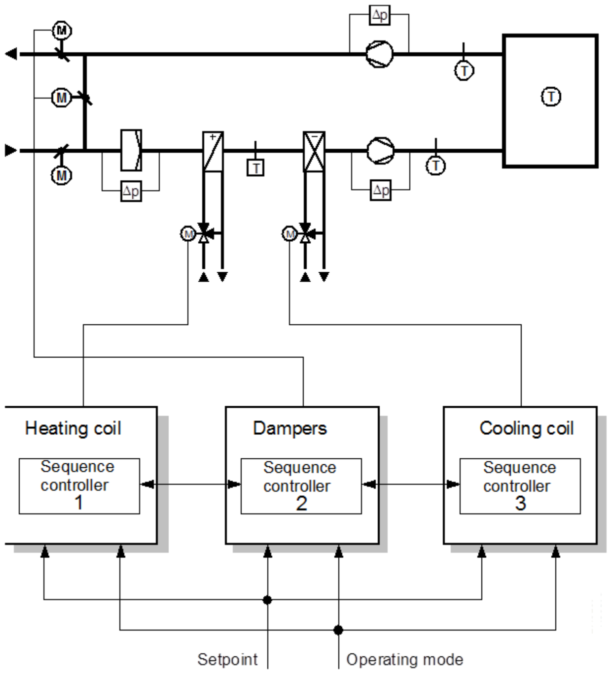


Figure 59: Example of a sequence control

Properties and design of sequences and sequence controllers:

- Each sequence may include any number of elements
- The setpoint for each element of a sequence can be defined separately, but set points must not be allowed to decrease in the direction from the heating sequence to the cooling sequence.
- The setpoint for energy recovery can be selected and is either at the midpoint between the setpoint of the first heating element and that of the first cooling element, or (depending on the method of energy recovery currently possible), it may be equivalent to the setpoint of the first heating element (if the extract air temperature is higher than the outside air temperature) or equivalent to the setpoint of the first cooling element (if the extract air temperature is lower than the outside air temperature).
- The gain of each sequence element can be influenced individually. In this way, for example, the amplification factor (gain) of the energy-recovery element varies as a function of the difference between the extract air temperature and the outside air temperature, in order to achieve an almost constant loop gain.
- For each element, P, PI, PID, PD or on/off control can be selected. The control parameters for each element (controller gain, integral action time and derivative action time) can be adjusted individually.
- If all the sequence elements have the same parameter values, the sequence responds in exactly the same way as a single PI(D) controller whose output variable is distributed to individual aggregates within the plant.
- The controller output and the integrator of the sequence element is limited in the range [YctrMin] to [YctrMax]. For this purpose, the high limit of the last enabled sequence element of the heating and cooling sequence is limited with an anti-windup strategy (limitation of I/portion on manipulated variable limits). All other limit values are controlled by straightforward selection of the minimum or maximum value.

- The rate of change of the output of each sequence element is limited to the speed of the connected actuator. This helps improve control quality.
- The type of operation of each element (heating/cooling or humidification/dehumidification) can be selected individually for each element.
- Only one element of the sequence can have a controlling function. When the output of a controlling sequence element reaches [YctrMin] or [YctrMax], control is transferred to the nearest adjacent active element ("ON").

Naming convention

The term higher is applied to sequence elements that correspond to higher set points in the sequence diagram (normally cooling or dehumidification).

The term lower is applied to sequence elements that correspond to lower set points in the sequence diagram (normally heating, energy recovery or humidification).

Configuration of a sequence controller

Essentially, the sequence controller consists of individual PID_CTR blocks. with each PID_CTR block acting as a sequence-controller element for an aggregate.

The PID_CTR blocks are connected (from "Low" to "High") in the same order as the control sequences (1…n) of the sequence controller. Accordingly, the connection of the PID_CTR blocks must take account of the intended operating range (for example, for heating) and the order of switching.

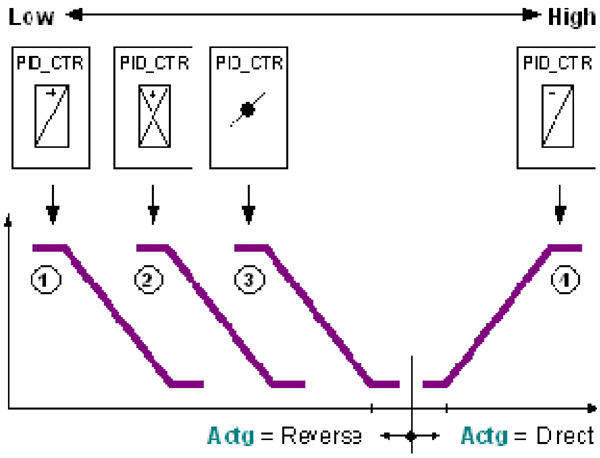


Figure 60: Control action [Actg] of the sequence-controller elements

For example, aggregates:

1 = Re-heater, 2 = Pre-heater, 3 = Dampers, 4 = Cooling coil

Control series for heating: 3 ---> 2 ---> 1

Cooling control sequence: 4 ---> …

The lowest sequence-controller element (Low) corresponds to control sequence 1, and the highest (High) to control sequence n.

The lowest sequence-controller element controls a reverse-acting aggregate (if used).

The type of operation may also be reversed during normal operation, (for example, for energy recovery) but the order of the sequences must not be affected.

In the sequence controller, the set points [Sp] of sequence-controller elements (1…n) must increase incrementally:

$[Sp]_1 \leq [Sp]_2 \leq [Sp]_3 \leq ... \leq [Sp]_n$

In the transition from one control sequence to the next, continuous control is maintained if all the control sequences with the same type of operation (direct or reverse acting) also have the same setpoint.

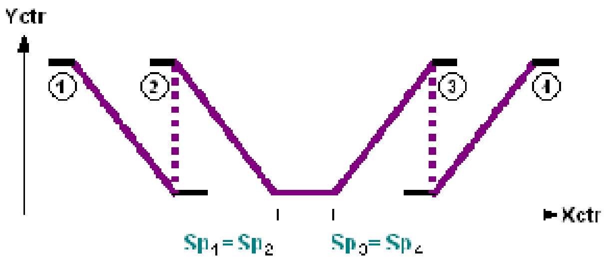


Figure 61: Setpoints of the control sequence elements

When the type of operation changes, the neutral zone is defined by the set points (for example, heating setpoint / cooling setpoint).

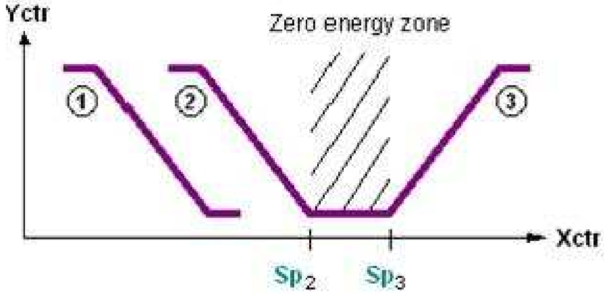


Figure 62: Zero energy zone

Options for connecting sequence controller elements

The PID_CTR blocks can be connected to form a sequence controller via:

- Direct connection
- SEQLINK connection

Direct connection

The individual PID_CTR blocks are connected directly with each other. The [ToLower] pins are connected to the [FmHigher] pins, and the [FmLower] pins are connected to the [ToHigher] pins.

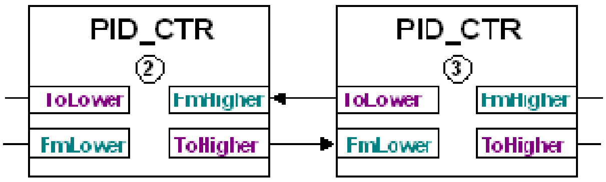


Figure 63: Direct connection of the PID_CTR block

SEQLINK connection

With this method, the individual PID_CTL blocks are connected via the SEQLINK block. The sequence linker block SEQLINK is a wiring block with no function other than that of connecting other blocks.

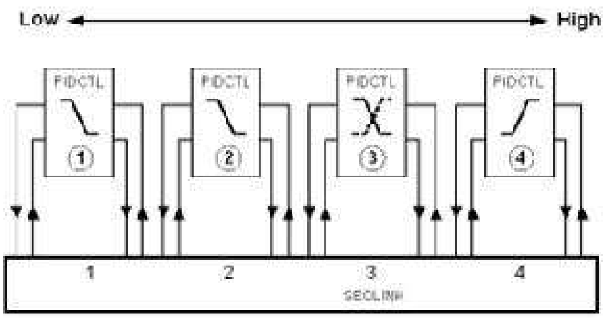


Figure 64: Connecting a sequence controller using [SEQLINK]

The connection is made between the pins of block PID_CTL and a location on the SEQLINK block. The order in which the PID_CTR blocks are connected must be the same as that of the sequence. The connections to the SEQLINK block need not be continuous: connected pins and unused pins may be interspersed.

For example, 1 = Re-heater, 2 = Pre-heater, 3 = Dampers, 6 = Cooling coil.

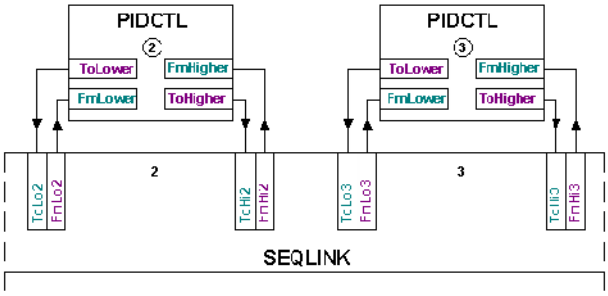


Figure 65: Connection details with interface names

This method of connection is used to interconnect PID_CTR blocks on different charts, or in cases where individual project-specific sequence-controller elements or aggregates are to be deleted from an off-the-shelf solution (CAS library).

Communication between one sequence controller element and another flows via the pins [ToLower] → [FmHigher] and [ToHigher] → [FmLower].

The block recognizes configuration errors and shows these at the Token State output [TknSta]. If, for example, the control action [Actg] of an individual sequence-controller element is incorrectly set, the associated sequence controller element is disabled and an error message is displayed.

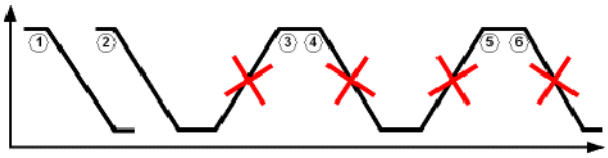


Figure 66: Example: Output from elements 4 and 6 [TknSta] = HEL_CSEQ Output from elements 3 and 5 [TknSta] = CEL_HSEQ

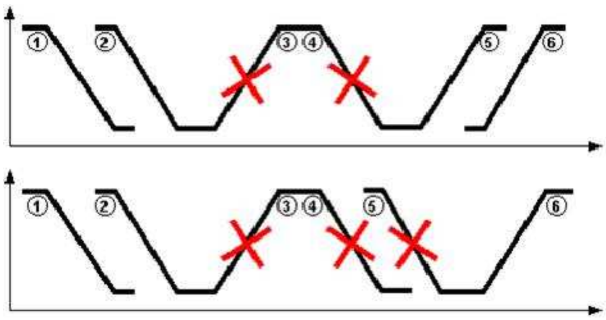


Figure 67: Examples of automatically deactivated sequence elements

In all the examples illustrated, several aggregates are deactivated. This is a precaution, as the sequence elements cannot determine which of the aggregates has incorrectly set parameters. For this reason, the aggregates are disabled one after the other until there is a clear transition to the next sequence.

Cascade control

The CAS_CTR block integrated into the Desigo system is a PI master controller for room supply air cascade control. It delivers three supply air set points on the basis of the difference between the measured room temperature and the room setpoint.

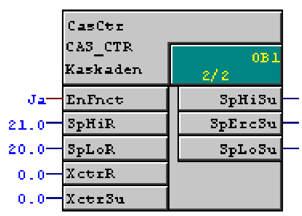


Figure 68: CAS_CTR block

The following functions are integrated into the block:

- Facility to select P or PI control
- Gain and integral action time (can be configured)
- Low supply air setpoint for the reverse-acting part of the sequence
- High supply air setpoint for the direct-acting part of the sequence
- Supply air setpoint for energy recovery
- Min/Max setpoint limit control (supply air setpoint)
- Selection of type of operation for heat recovery
- Initial value for the integrator can be defined

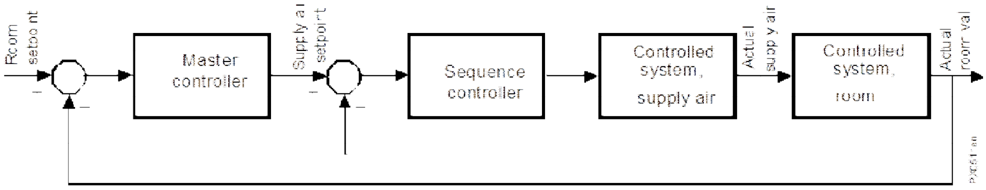


Figure 69: Basic cascade control structure

Compared with control without a cascade, for example, cascade control improves the dynamics of the control process.

If the temperature in a ventilated room is below the setpoint, for example, the supply air temperature must be increased, at least for a brief period, in order to raise the temperature to the room setpoint. This can be achieved by measuring and controlling not only the room temperature, (that is, the value which actually concerns the user), but also the supply air temperature, whose setpoint depends on the difference between the room setpoint and the room temperature.

If the room temperature is lower than the room setpoint, the supply air setpoint is adjusted in proportion to the room control differential, and the supply air temperature is increased via the supply air control loop.

The master controller generates the setpoint for the auxiliary variable (for example, the supply air temperature) on the basis of the difference between the primary setpoint and the primary controlled variable (for example, the room setpoint and the room temperature).

The master controller must include an integrator function (I component), because even under static conditions (that is, when the measured value and the setpoint are equal) there is generally a negligible control deviation, which means that the controller output must be at a different operating point. For improved control dynamics, a P-component should be connected in parallel with the integrator. This is why the master controller in this case has a PI control structure.

Even when the primary controlled variable (room temperature) is identical to its setpoint, the auxiliary controlled variable (supply air temperature) must generally be at a value other than 0, (that is, setpoint ≠ 0). This is only possible if the output of the master controller is not equal to 0, even if the P component = 0. In other words, the master controller must have an I-component which remains constant when the control differential = 0. This is why the master controller has a proportional and an integral component. It is a numerical PI controller for use as a master controller in a room/supply air cascade.

To save energy in the ventilation plant, various room set points are selected for different types of air handling (heating/cooling and humidification/dehumidification). The master controller in the cascade must therefore be able to generate different supply air set points, depending on how the kind of air treatment (heating/cooling or humidification/dehumidification).

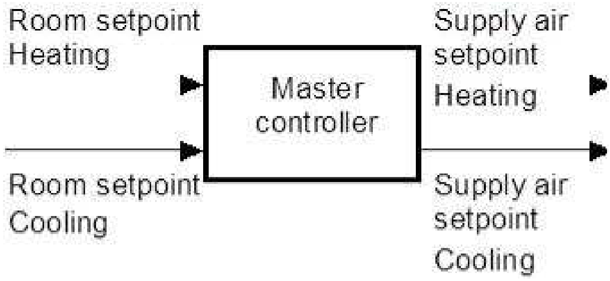


Figure 70: Supply air setpoints

The supply air controller must determine whether the heating or cooling sequence is to be activated and the decision-making strategy does not affect the calculation of the two supply air set points. Within the cascade control loop, the supply air set points always move parallel to each other, and their offset is determined by the integral component.

If the air handling plant includes an energy recovery aggregate, this aggregate may be either reverse-acting (for example, heating) or direct-acting (for example, cooling) depending on the relationship between the condition of the outside air and the condition of the exhaust air.

To avoid external calculation of the energy recovery setpoint, this, too, is done by the master cascade controller, and made available to the energy recovery aggregate, if there is one, at a separate output pin:

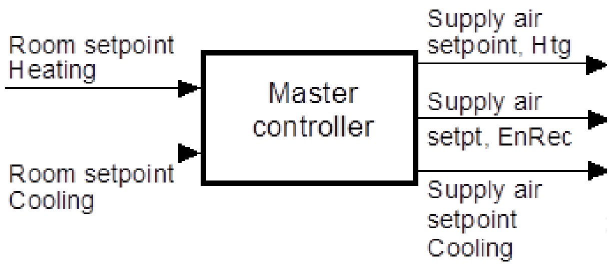


Figure 71: Setpoint for energy recovery

In a humidity control system with various physical control variables, the initial value of the integrator should be predefined.

Example:

If the humidity of the supply air is measured with an absolute humidity value [g/kg], while the room air humidity is measured in terms of relative humidity [%Hu], an initial value must be defined for the I-component, otherwise the mean value from [SpLoR] and [SpHiR] will be used as the initial value. If the room set points are expressed in terms of relative humidity, then the initial value for the integrator will start at a numerically high value, and decrease as a function of the preset integral action time [Tn]. The result of this can be that even if the room needs to be dehumidified, the humidifier is enabled in the controller start-up phase until the integrator reaches its correct value.

To prevent this, the current measured supply air humidity value is linked to the initial value of the integrator, or a fixed parameter value is defined for the integrator.

If control accuracy is critical (for example, no deadband or zero-energy control zone), then the current measured value is linked to the initial value of the integrator, or a fixed parameter value is defined for the integrator.

4.5 Desigo Room Automation

Multiple mechanical and electrical installations (referred to as technical installations in this chapter) come together in one room. These typically are HVAC, lighting, and blinds. Each technical installation is automated and operated optimally from its perspective. For Desigo Room Automation, coordination of the individual technical installations must be optimized while considering that the same type of installation may exist several times in one room.

Room featuring:

1. HVAC zone (blue)
2. Lighting zones (yellow)
3. Shading/blinds zones (green)

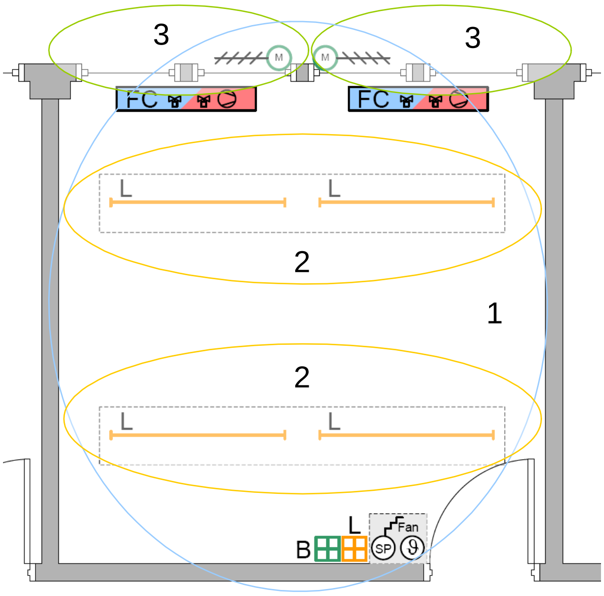


Figure 72: Room application sample with different mechanical and electrical installations

HVAC zone

The room typically is considered 1 HVAC zone influenced via a common automation and control strategy regardless of number and type of installed HVAC plant components (for example, radiator, chilled ceiling, fan coil unit).

Lighting zone

All lamps operated/automated together are grouped into a lighting zone regardless of number and type of the installed lamps. A room typically has one or several lighting zones.

Shading zone

All shading products (blinds) operated/automated together are grouped into a shading zone regardless of number and type of the installed shading products. A room typically has one or several shading zones.

Desigo Room Automation and room coordination

Application function structure

Specific functionality is set up for each zone of each technical installation: The application functions. For Desigo Room Automation, this is supplemented by a room-wide function coordination called room coordination.

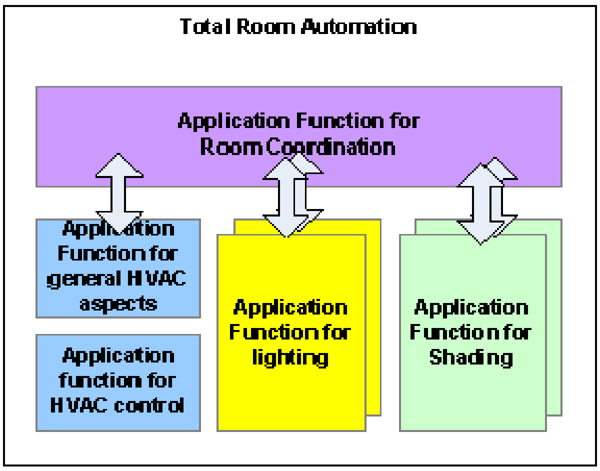


Figure 73: Overview of Desigo Room Automation application functions

Room coordination basically has two application functions:

- Cross-technical installation coordination to ensure smooth functional interplay of the various installations
- Centralized, room-wide access point to operate and monitor a room

Cross-technical installation coordination

The application functions of the individual technical installations contain functionality required for technical installation-specific control. Additional functionality assuming coordination with other technical installations is part of room coordination. As a result, project-specific Desigo Room Automation requests and changes can be carried out without changes to technical installation-specific application functions.

Examples for coordination functions are coordination of HVAC and shading functions and coordination of shading and lighting functions.

Centralized, room-wide access point

Room coordination offers a centralized, room-wide access point to operate and monitor a room. This allows users to enter common data for several technical installations only once and retrieve them as a group.

Examples:

- Predefinition of the room operating mode (across all technical installations)
- Predefinition of a scene for the entire room
- Queries for general occupancy
- Common alarm for system alarms

The room coordination default solution influences the following functions:

Room operating mode

Various sources influence and determine the room operating mode:

- Centralized commands from scheduler programs or manual intervention
- Local commands from presence detectors or scheduler program override

Room coordination offers a centralized, room-wide access point to operate and monitor a room operating mode. The individual technical installations separately acquire all relevant information.

Scene

Scenes are defined to command several or all technical installations in a room via one single command: For example, brightness of a lighting zone, or blinds positions in each shading zone can be defined for each scene. Room coordination:

- Controls a scene as per the predefined values
- Changes the predefined values

Both are carried out by the room user.

Thermal room load analysis

Room coordination supports room temperature control via blinds control. The various HVAC data is analyzed to determine the thermal room load and the associated signal definition for blinds control:

- Load if energy must be supplied to the room via the blinds position
- Unload if no additional energy must be supplied to the room via the blinds position

Blinds control determines the optimal blinds position in dependence of room occupancy and solar position (thermal radiation and glare).

Green Leaf (RoomOptiControl)

Manual room user manipulations (for example, manual lighting and shading commands, or manual changes to the room temperature setpoint) can result in inefficient energy operation. Each zone and each technical installation is checked for inefficient definitions to be pointed out to the room user. Room coordination then summarizes the results and visualizes them on the room operator unit. The room user can then reset all manual entries (which lead to inefficient plant operation) by one single pressure of a button.

Room common alarm

One common alarm is set up for each room to keep down the number of set up system alarms. To this end, room coordination acquires status information (normal/alarm) for each zone and each technical installation, and determines the room-wide alarm state as a common alarm.

HVAC room control

HVAC plants and their HVAC devices in the room influence the climate in closed rooms.

HVAC plants in rooms are used to:

- Maintain a temperature range suitable for building occupancy
- Control other control variables such as humidity and air quality
- Efficiently operate HVAC plants in the room

HVAC plants in the room are grouped into plant families differentiated by mechanical design and functioning:

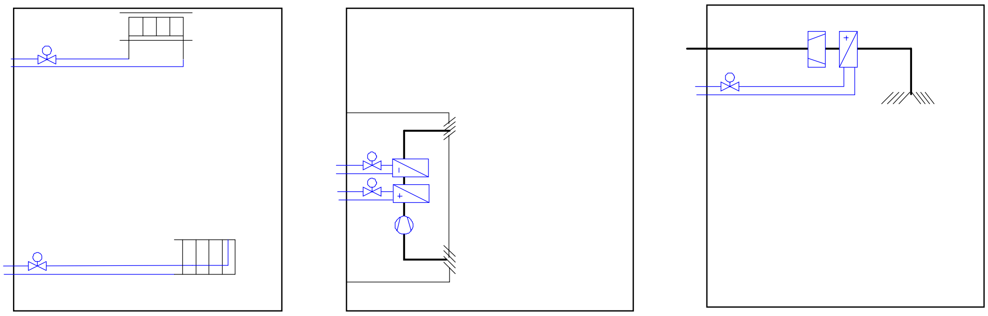


Figure 74: Examples for HVAC plant families in a room: radiators (right), Fan coil units (center), VAV (left)

The members of the related HVAC family differ only marginally:

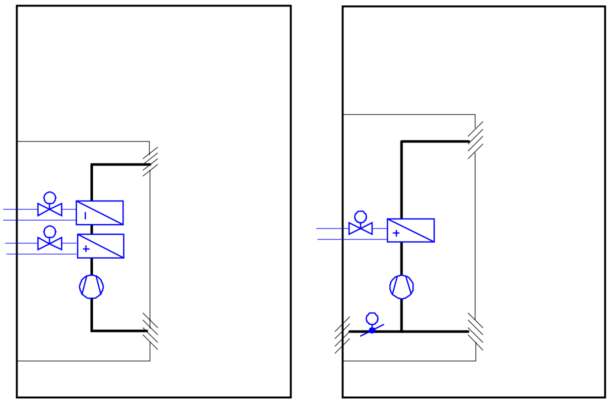


Figure 75: Examples for members of the fan coil family

HVAC supply chain requirements

HVAC plants in a room consume energy. The supply chains outside the room supply air, water, or electricity to the room. Linked existing energy sources and consumers are called supply chain. An air supply chain or a water supply chain thus is an HVAC system with a supply/consumer relationship to the HVAC plant in the room.

The supply equipment typically supplies more than one room, and the HVAC plant in the room often is a consumer of multiple supply chains.

HVAC control basically has the same objectives as the entire HVAC plant:

- Maintain the room temperature in the selected comfort range
- Adapt the room temperature range to room user needs
- Supply, extract, and recirculated air to satisfy air quality and comfort needs
- Adapt the air flows to room user needs

Energy saving requirements:

- Devices for sequential control of a heating and cooling sequence and thus:
  - Preventing sequence overlap (simultaneous heating and cooling)
  - Using the most efficient energy source
- Reducing the temperature as soon as comfort mode no longer is needed
- Reducing ventilation as soon as it is no longer needed

Coordination of the HVAC supply chain:
- Operation of supply chain equipment as per user demand
- Optimization of operating levels (temperature, pressure) of the supply plant
- Prevention of damages to HVAC equipment

HVAC control structure

An HVAC control application in the room is connected to the following:
- HVAC plant in the room via sensors and actuators
- Room coordination application
- Centralized coordination application for HVAC supply chain(s)
- Building operator via BAC workstations
- Building automation and control functions for scheduling
- Room user

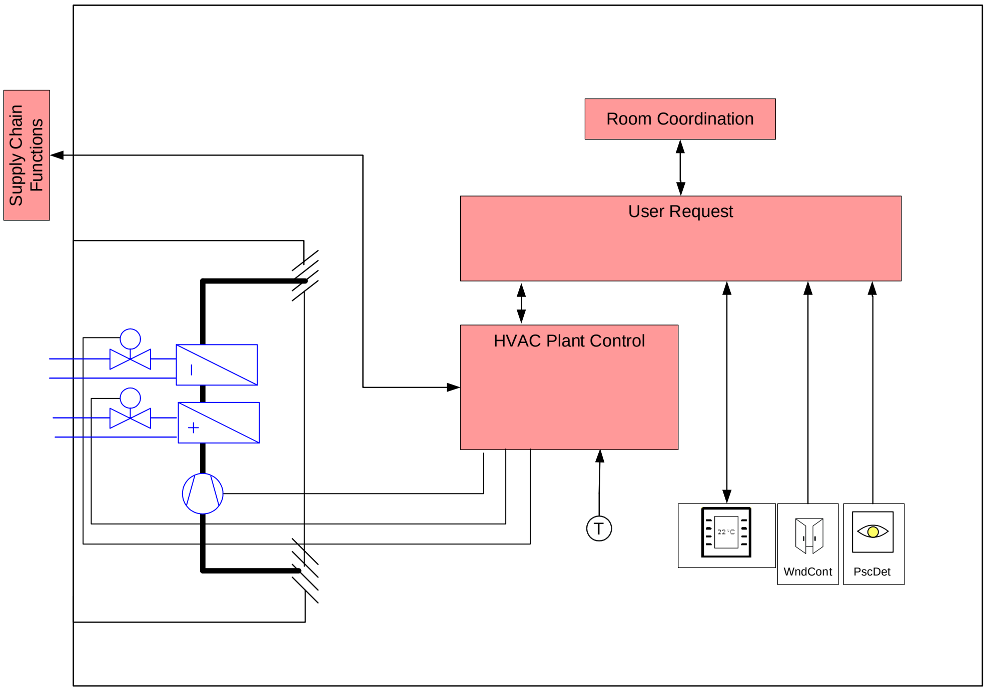


Figure 76: HVAC control structure

The HVAC control application in the room consists of two parts:
- Application function for user requirements
- Application function for HVAC plant control

The HVAC plant control contains a control module (CFC) that implements the control functions associated with the HVAC device.

Control concepts

The physical room conditions are controlled by a combination of control methods (setpoints by operating mode).

Sequence control

Algorithms for room temperature sequence control operate the heating and cooling equipment within applicable limits. The algorithm for one single heating element is as follows (for example, radiator):

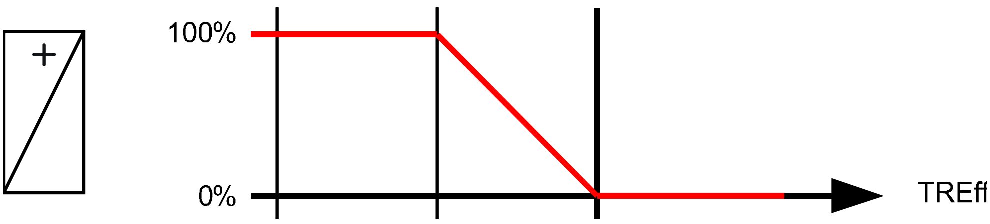


Figure 77: Control algorithm for heating element

Below is an illustration of the temperature control sequence for a more complex HVAC plant in the room. The charts show the segregation of heating and cooling control sequences and associated setpoints and sequencing of heat convection by fan air flow or associated switching stages.

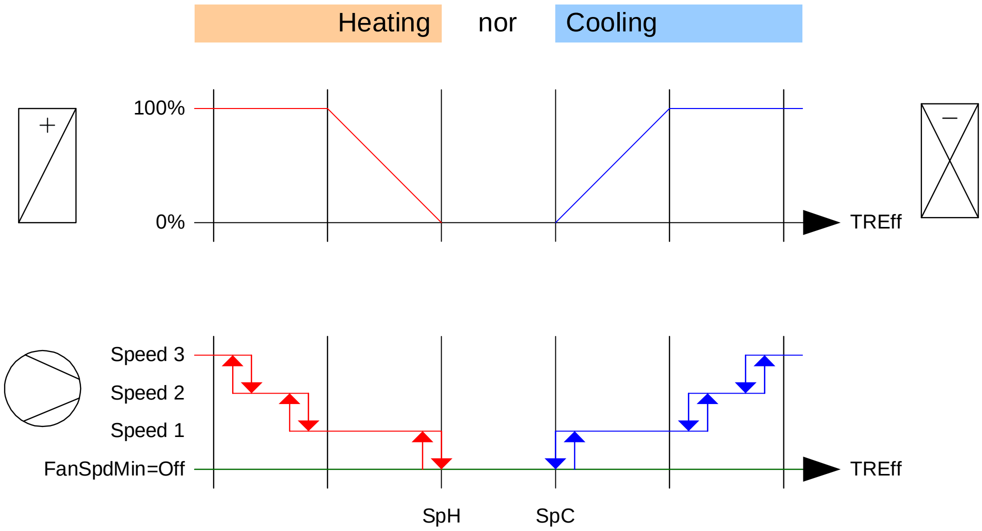


Figure 78: Temperature control sequence for complex HVAC plant

Individual temperature sequence controllers are assigned to each heating and cooling element. They intercommunicate to achieve required sequencing.

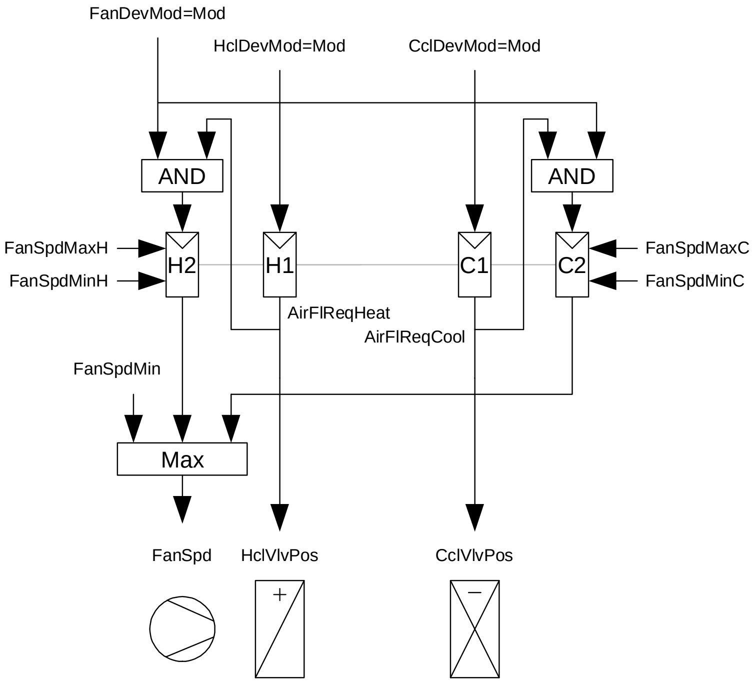
Open-loop control

Additional interactions between HVAC devices implemented via open-loop control functions are required in an HVAC plant in the room. The open-loop control functions feature two basic interactions:

- Support: Heating coil and cooling coil require the fan to run on the stage/speed required for their operation.
- Lock: The electric heating coil is locked to ensure that it cannot be operated without air flow.

Open-loop control and sequence controller are used together to implement the above, typical control sequence.

The following display shows the connection between controller and actuating devices (this does not correspond to the actual program structure).



Room temperature control

Figure 79: Open-loop control and sequence controller

Operating modes

The HVAC plants in the room adapt to the room's comfort requirements. For example, ventilation is:

Active while the room is occupied

Off, as soon as the room no longer is occupied

The following illustrations show sequence control for an HVAC plant in the room for operating modes Comfort and Economy. Sequence control acts on heating and cooling equipment and a multi-speed fan.

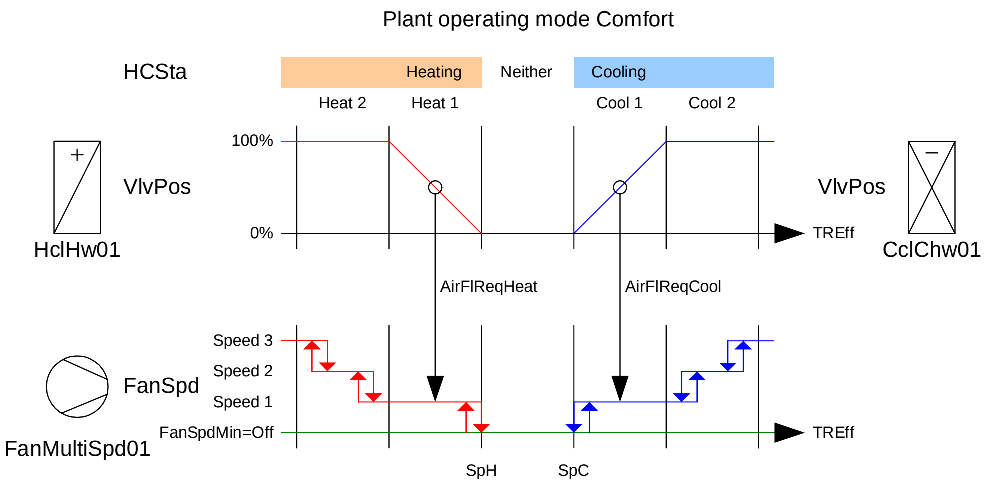


Figure 80: Control sequences in the Comfort operating mode

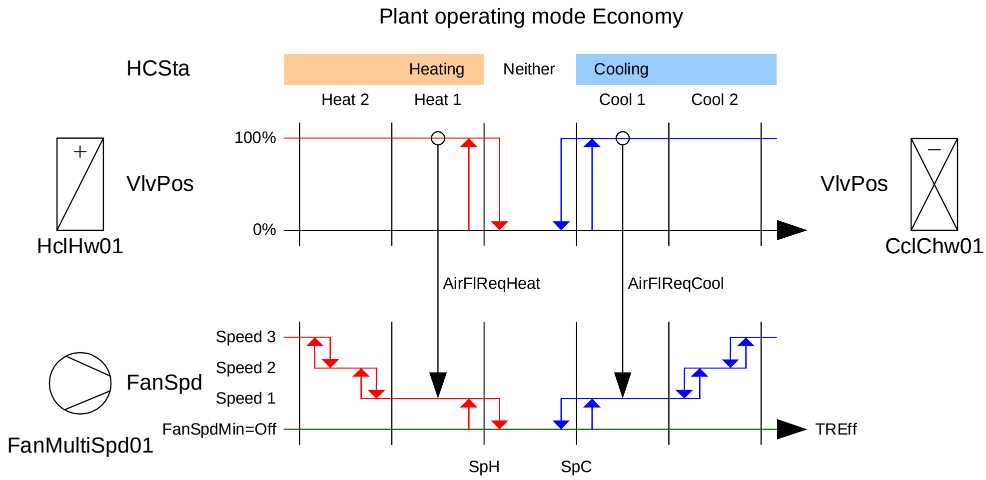


Figure 81: Control sequences in the Economy operating mode

The available operating modes determine both operation and basic control strategy in the automation and control system at three different levels:

- The room operating modes determine the operation of HVAC equipment in a room in terms of current use by the user. The room operating modes defined for the room are available in all HVAC control applications in the room.
- The HVAC plant operating modes determine the operation the HVAC plant in the room with regard to existing, physical plant processes. The HVAC plant operating modes are defined specifically for 1 HVAC plant in the room.
- The device operating modes determine the operation of the HVAC devices in a room by predefining their tasks and implementation method. The device operating modes are defined specifically for each individual HVAC device.

The following table shows the plant and device operating modes of a plant with heating coil, cooling coil, and fan. Project-specific adaptations of both plant and device operating modes can be implemented by adapting the operating mode table.

Plant operating mode	Fan operating mode	Heating coil operating mode	Cooling coil operating mode
Off	Off	Off	Off
Comfort	Modulating	Modulating	Modulating
PreComfort	Modulating	Modulating	Modulating
Economy	Modulating	Two-position	Two-position
Protection	Modulating	Two-position	Off
Heat up	Modulating	Two-position	Off
Cool down	Modulating	Off	Two-position

Table 19: Plant and device operating modes

In addition, setpoints and setpoint limits define room and device operating modes. They can vary depending on the selected HVAC plant operating mode. Four different setpoints are provided for heating and cooling in the room.

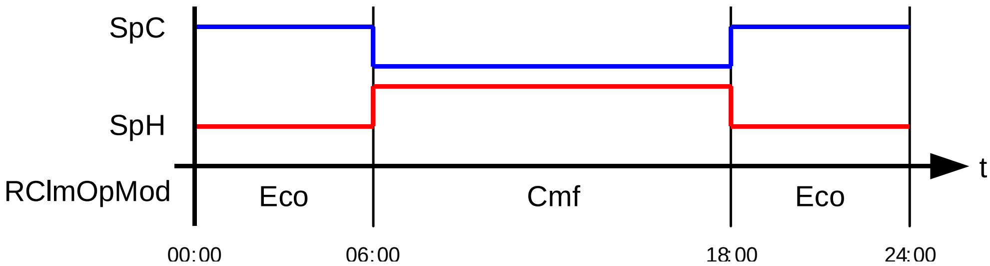


Figure 82: Setpoints for room heating and cooling

The HVAC control applications in the room dynamically enable and disable the setpoints to achieve the desired combination of energy-saving Economy and demand-based Comfort operating mode.

Command priorities

An HVAC control application simultaneously achieves several goals. Functions with different objects may conflict when they are implemented. In this case, the command priority determines which command value has priority in the priority array of the BACnet objects.

HVAC control applications in a room are programmed to accept commands at many different levels, including operating mode variable level. As a result, HVAC control applications control the controlled output objects at a priority commensurate with the active priority of the operating mode variable. The following figure shows how commands and priorities are passed in the application.

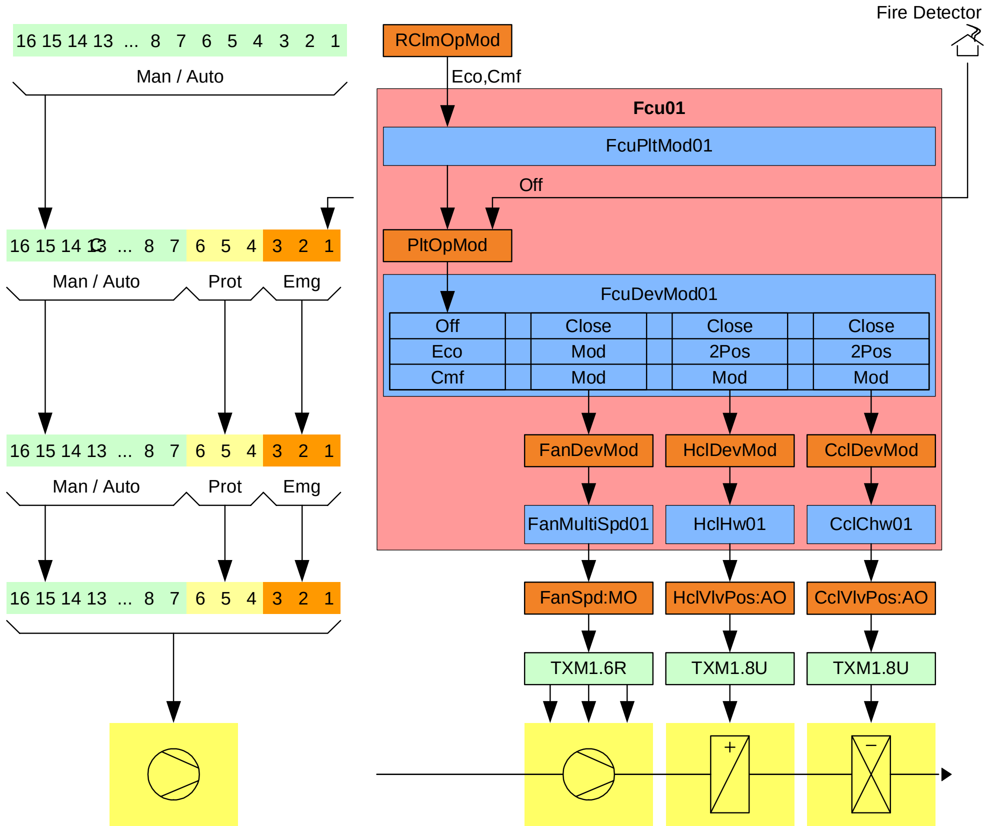


Figure 83: Application commands and priorities

The BACnet objects in the system support 16 priority levels. The HVAC control applications apply these levels as follows:

Priority	Purpose assigned to the level	Use in HVAC library
Emergency mode 1	Manual commands related personal safety	None
Emergency mode 2	Automatic commands related to personal safety	Propagated response to Emergency mode commands
Emergency mode 3	Unassigned - additional level for commands related to personal safety	None
Protection mode 4	Manual commands to avoid damage to equipment	None
Protection mode 5	Automatic commands to avoid damage to equipment	Programmed response to equipment safety conditions
Minimum On/Off 6	Commands to avoid damage by short cycling equipment	None
Manual operating 7	Manual commands through switches on equipment	None
Manual operating 8	Manual commands through BAS workstation	None

Priority	Purpose assigned to the level	Use in HVAC library
Automatic control 9	Unassigned - commands for comfort and energy conservation	None
Automatic control 10	Unassigned - commands for comfort and energy conservation	None
Automatic control 11	Unassigned - commands for comfort and energy conservation	None
Automatic control 12	Unassigned - commands for comfort and energy conservation	None
Manual operating 13	Manual commands through room unit	Programmed response to inputs from occupants
Automatic control 14	Unassigned - commands for comfort and energy conservation	None
Automatic control 15	Typical automatic commands for comfort and energy conservation	Typical automatic commands
Automatic control 16	Unassigned - commands for comfort and energy conservation	None

Table 20: Priority levels

Adaptation to another HVAC plant

An HVAC control application comprises several different members of an HVAC room family. It contains application-specific components (CFC) matching existing HVAC devices in the room. Components no longer matching existing HVAC devices in the room are either added, removed, or replaced to control a slightly different HVAC plant with different HVAC devices.

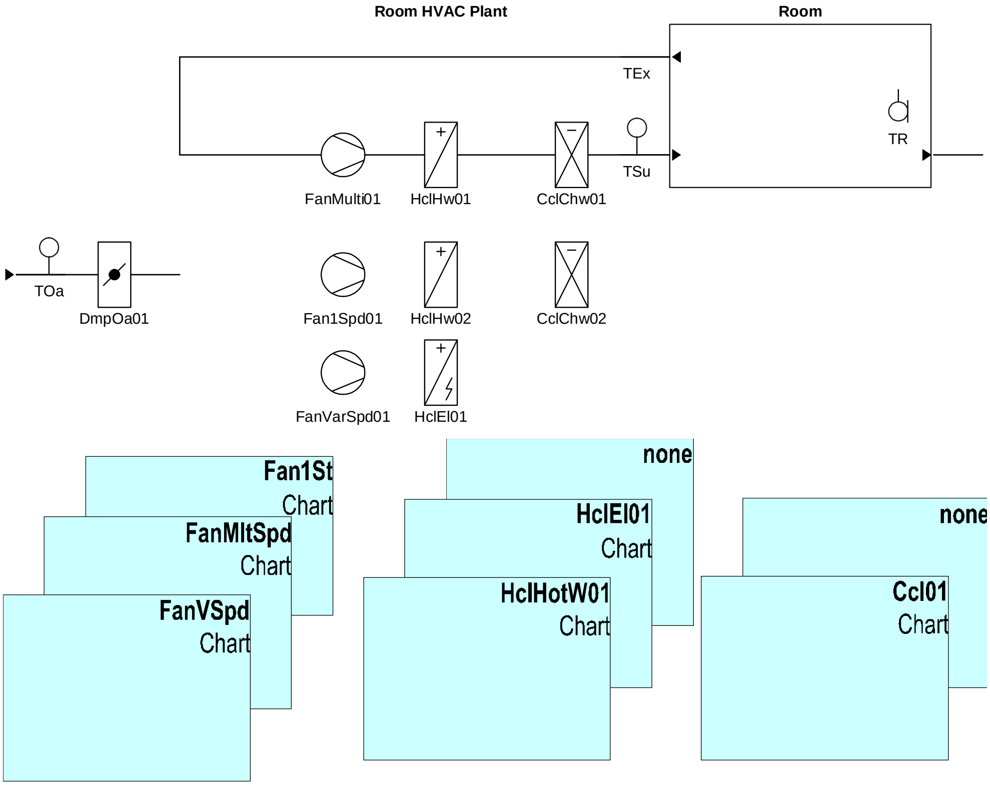


Figure 84: Adaptation of an HVAC plant

Often, more must be done than merely adding or removing components (CFCs). If, an HVAC device, for example, is to be added, the following must be added or removed:

- Information in the operating mode table
- Corresponding BACnet objects to operate the new device

Shading control

Products and requirements

Suitable façade products and intelligent control allow for optimum satisfaction of various requirements for shading.

Façade products and their control required to protect against environmental influences or to make use of the same are the primary issue:

- Shading to protect against glare
- Using daylight
- Using solar energy for heating
- Shading to protect against overheating
- Protection against rain

Other requirements may be:

- Intrusion protection
- Protection of privacy

Façade product control in addition must protect persons and equipment against the façade products themselves. Examples:

- Drive up blinds in case of fire to open an escape route
- Protect against collision (for example, in the event of outward-opening doors)

Façade control protects the façade products and their functionality against environmental damages caused, for example, by rain, wind, or frost.

The market knows many different façade products such as roller shutters, blinds, awnings, etc. to satisfy the various requirements. The different properties of the products are included in the respective control functions. The following figure shows a few typical façade products (from left to right):

- Horizontal blinds
- Roller shutter
- Vertical blinds
- Drop-arm awning
- Vertical awning
- Sliding-arm awning

Figure 85: Typical facade products

Influences on blinds control

Blinds control requires much information on environmental influences and user interactions to be able to best satisfy requirements.

The blinds control can be influenced by, for example:

- Smoke, fire alarm
- Maintenance switch
- Wind, rain, humidity, temperature
- Intrusion alarm
- Date/Time

- Solar radiation
- Geographical position
- Horizon limitation
- Presence detector
- Local operator
- Saving and retrieving scenes
- Central operation (operation, scenes, override)
- Management station
- Commissioning/Test

Blinds position on a building, room purpose, and allocation of rooms to an organizational unit determine the type of information acting on blinds control. Example:

- Wind speed monitoring acts on all blinds of a building or building wing
- Automatic shading acts on all blinds of façade or part of a facade
- A scheduler program acts on all rooms of a renter
- Local manual operation acts on all blinds of a room, or on a single blind

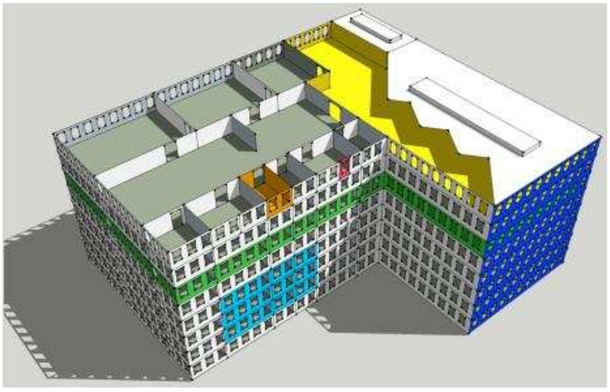


Figure 86: Grouping of blinds

Color key:

- Gray: Complete building
- Blue: Façade or part of a facade
- Green: Rooms of a renter, for example, one floor
- Orange, red: Local, manual operation

The functions are grouped into local and central functions depending on whether the function acts on one or multiple blinds in a room, or on an entire group of blinds, for example, on all blinds of a facade. The following table shows the grouping by local and central functions for the examples from the figure above.

	Local manual operation	Automatic shading	Wind speed monitoring	Scheduler program
Central function	n/a	Determination of optimal shading position in dependence of sun position	Measuring of wind speed Monitoring of wind speed Commanding of wind protection position	Commanding of a position in dependence of daytime
Local function	Commanding of manual position Positioning of blinds	Decision on which position is commanded automatically Positioning of blinds	Positioning of blinds	Positioning of blinds

Table 21: Grouping into local and central functions

Control concept

The control concept is based on the following:

- Grouping into autonomous functions determining a set position for the blinds
- Priority assignment to individual functions
- Evaluation of all functions and decision in favor of specific blinds position based on priorities

The following table provides an overview of autonomous functions to control blinds. Priorities depend on plant requirements. The table shows the typical priorities in ascending format.

Function	Description
Automatic shading	Automatic determination of optimum blinds position based on current room use, solar radiation, outdoor brightness, solar position, and HVAC status. In simple terms, this function prevents glare in occupied rooms and uses solar energy for heating in unoccupied rooms, or protects the building against undesired heat-up.
Manual operation (room, central)	Manual operation allows users to themselves determine the blinds position via buttons. If manual operation overrides a lower-priority function, a scheduler program or local presence information will reactivate the function.
Presence-based influence (room)	Locking of automatic operation upon entering a room, and activation of automatic operation upon leaving a room. The presence-based function generally acts on the same priority as manual operation.
Scheduler program	A scheduler program opens, closes blinds at specific times, or commands them to a specific shading position. Furthermore, automatic operation can be activated or deactivated via scheduler program. Another priority may need to be commanded depending on purpose. If, for example, automatic operation should be activated at noon, manual operation must be overridden by allowing the scheduler program to act on the priority for manual operation. If the blinds are to be closed at night without allowing for manual operation, a higher priority must be commanded.
Automatic shading at high priority	For example, to prevent overheating it may be necessary to use automatic shading at higher priority, which limits or prevents manual operation in certain situations.
Manual operation at high priority (room, central)	Manual operation at high priority allows for positioning blinds and overriding low-priority functions. For example, local operation can be overridden during, for example, a presentation. Or it can be ensured that neither automatic shading nor a scheduler will drive the blinds up or down at an undesired time.
Product protection, local	Risks impacting a blind only, for example, protection against collision with a service door opening outward, are included in local product protection.
Product protection, central	Environmental influences impacting a group of blinds are included in the central functions for product protection. A common function in this category is protection of blinds against damage from strong winds.
Maintenance position, central	For maintenance or cleaning, blinds are commanded or blocked to a specific position at high priority enabling staff to carry out all required work without risking injury due to moving blinds.
Protection, central	Blinds can be moved/driven up to provide escape or access routes for emergency personnel in the event of a fire.

Table 22: Autonomous functions

A very simple control contains just one or two functions; a complex plant may use many or all available functions. In addition, the response of individual functions may require parameterization depending on the requirements. The following figure shows an example of a plant including all functions.

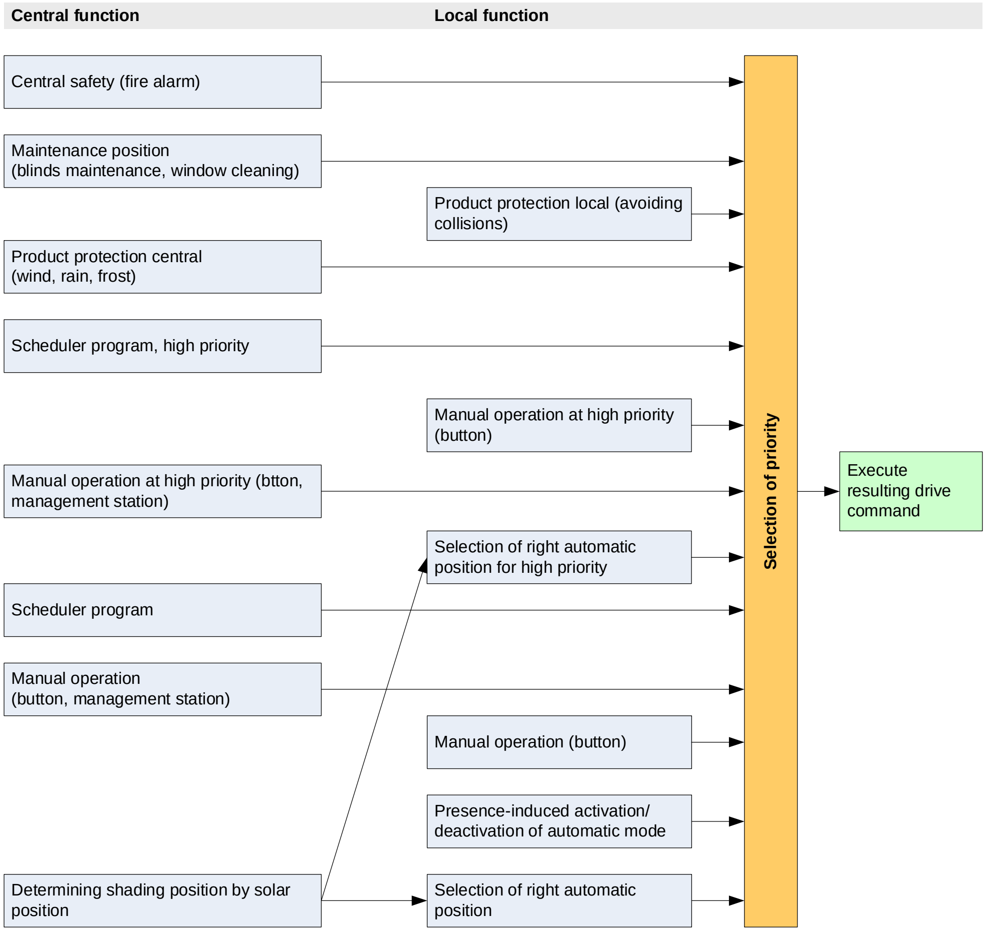


Figure 87: Control concept shading

Lighting control

Products and requirements

Suitable lighting products and intelligent control allow for optimum satisfaction of various requirements.

Lighting products and their control are the primary means to create optimum lighting conditions for building users:

- Optimum workspace conditions (bright or darkened rooms)
- Optimum lecturing/teaching conditions (presentation)
- Comfort in living spaces
- Mood lighting in entertainment spaces (restaurants, bars, etc.)

Other requirements may be:

- Energy savings
- Lighting of objects, products
- Façade lighting
- Intrusion protection

Lighting products control in addition must ensure the safety of persons. Examples:

- Switching on lights in case of fire
- Escape route lighting

A multitude of different lamps exists to satisfy the various needs, such as:

- Incandescent light bulbs
- Halogen lamps
- Fluorescent tube lamps
- Compact fluorescent tube lamps

- Metal halide lamps
- LEDs

For comprehensive information on lighting products and their application, see the e-learning module *Lighting basics* (B_B01RA).

Influences on lighting control

Blinds control requires much information on external influences and user interactions to be able to best satisfy requirements. The following figure shows an overview of the influences that may be considered as part of lighting control.

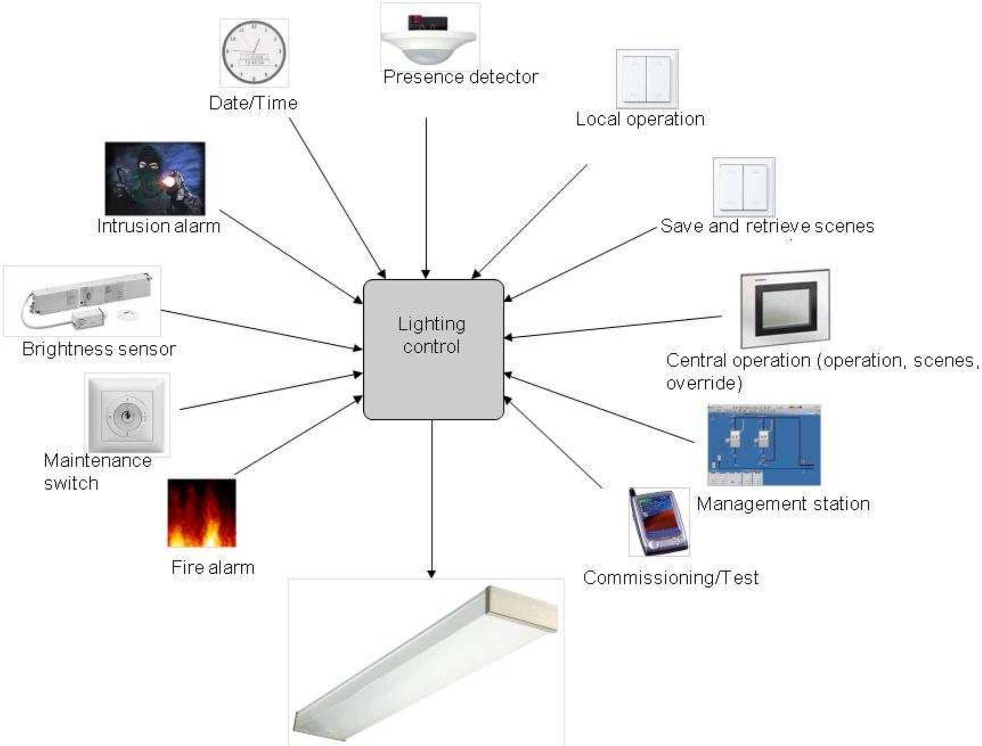


Figure 88: Lighting control influences

Lighting product positioning in a building, room purpose, and allocation of rooms to an organizational unit determine the type of information acting on lamp control. Example:

- A fire alarm acts on the entire building
- A scheduler program acts on all rooms of a renter
- Local manual operation acts on all lighting of a room, or on individual lamps

Gray: Complete building

Green/yellow: Rooms of a renter, for example, one floor

Orange: Local, manual operation

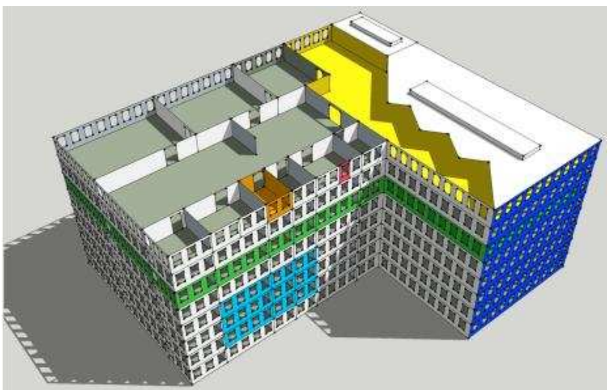


Figure 89: Lighting groups

The functions are grouped into local and central functions depending on whether the function acts on one or multiple lamps in a room, or on an entire group of lamps, for example, on all lamps of a renter. The following table shows grouping by local and central functions for the examples from the figure above.

	Local manual operation	Fir alarm	Scheduler program
Central function	n/a	Fire alarm reception Commanding of On-command	Commanding of On/Off command in dependence of time
Local function	Commanding of manual brightness Adapting lighting	Switching on lighting	Switch on/off lighting

Table 23: Local and central functions

Control concept

The control concept is based on the following:

- Grouping into autonomous functions determining a command for lighting
- Priority assignment to individual functions
- Evaluation of all functions and decision on the state of lighting based on priorities

The following table shows autonomous functions to control lighting. Priorities depend on plant requirements. The table shows the typical priorities in ascending format.

Function	Description
Automatic control	Automatic switch-on/switch-off based on brightness, constant lighting control. In simply terms, this function achieves optimum lighting conditions automatically in occupied rooms, and switches off lighting when rooms are unoccupied.
Manual operation (room, central)	Manual operation allows users to themselves determine brightness via buttons. If manual operation overrides a lower-priority function, a scheduler program or local presence information will reactivate the function.
Presence-based influence (room)	Automatic switch-on when dark upon entering a room, and automatic switch-off when leaving a room. The presence-based function generally acts on the same priority as manual operation.
Scheduler program	Lighting can be switched on/off at specific times using a scheduler program. Furthermore, automatic control can be activated or deactivated via scheduler program. Another priority may need to be commanded depending on purpose. If, for example, automatic control should be activated at noon, manual operation must be overridden by allowing the scheduler program to act on the priority for manual operation. If lighting is to be switched off at night without allowing for manual operation, a higher priority must be commanded.
Manual operation at high priority (room, central)	Manual operation at high priority allows for influencing lighting blinds and overriding low-priority functions. For example, this function allows for ensuring that neither motion detectors nor scheduler programs can switch on/off lighting at the wrong time during a lecture/presentation.
Maintenance, central	For maintenance or cleaning, lighting is switched on/off at high priority enabling staff to carry out all required work without risk of injury or being interrupted.
Protection, central	Lighting can be switched on in the event of a fire alarm to light escape routes or support emergency crew access.

Table 24: Autonomous functions

A very simple control contains just one or two functions, A complex plant may use many or all available functions. In addition, the response of individual functions may require parameterization depending on the requirements. The following figure shows an example of a plant including all functions.

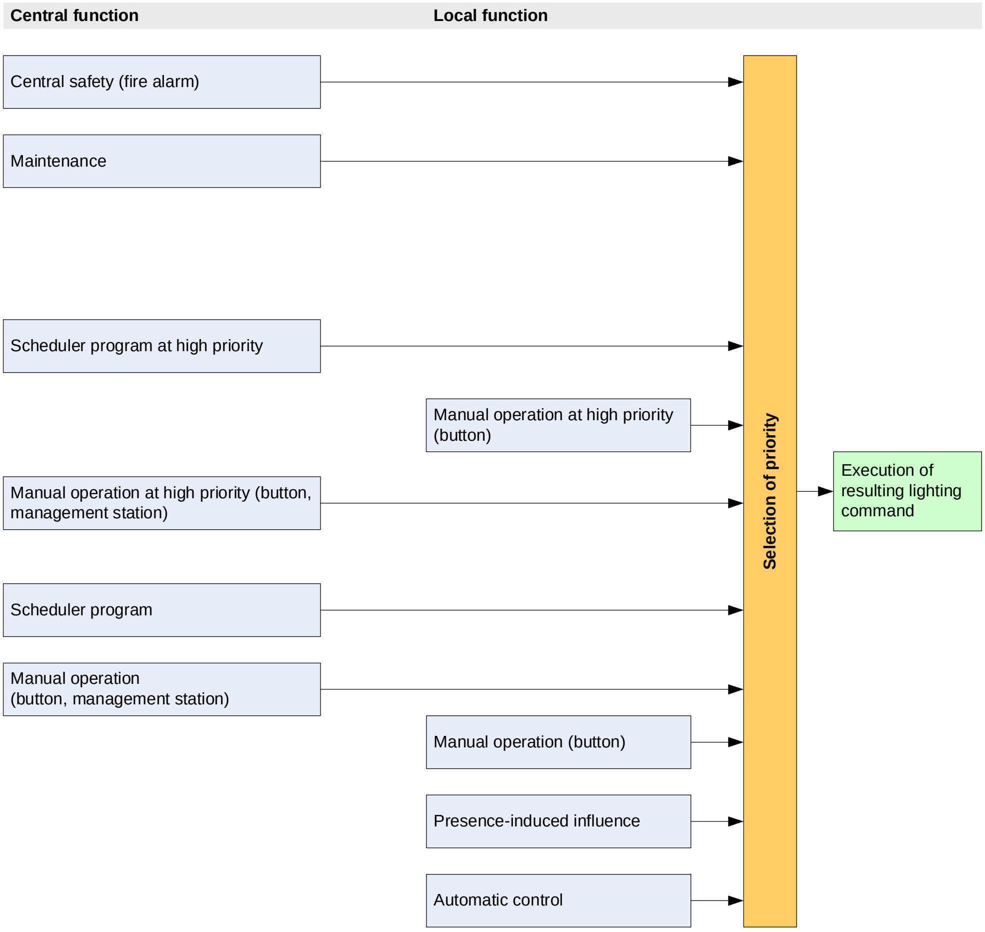


Figure 90: Control concept lighting

5 Technical View

The technical view illustrates the technical building services equipment, such as HVAC systems and associated elements, in the building automation and control system.

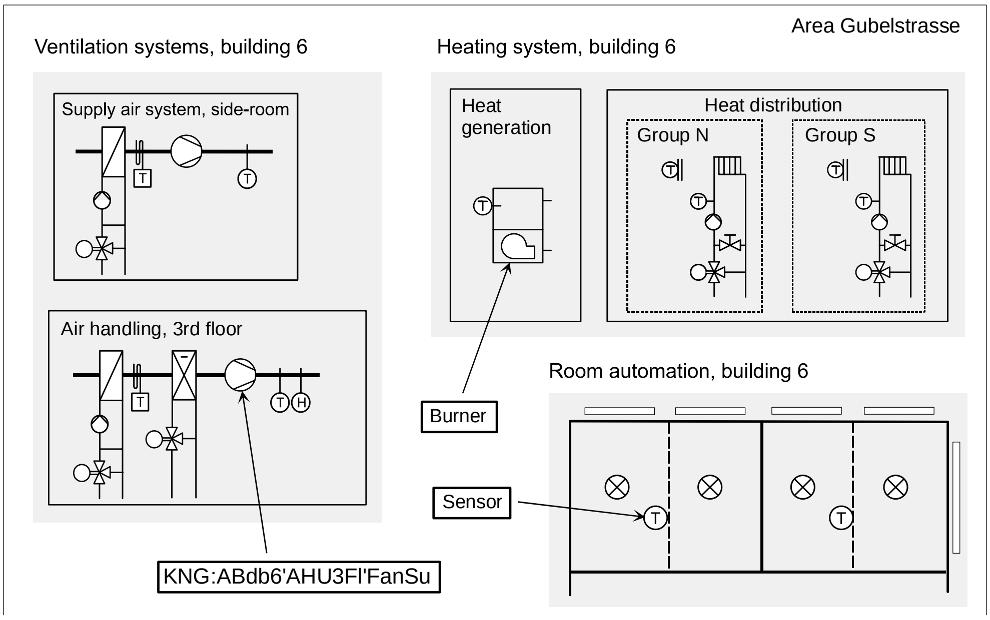


Figure 91: HVAC plants and their associated elements

The technical view helps organize measured and controlled physical variables from specific, technical installations in a building. The technical view is modeled with structure objects. The structure of the technical view represents the hierarchy of the technical installations. Objects representing variables, such as setpoints or operating modes supplement the view.

Plant types

The technical view contains all the conceptual objects in the system. The following plant types have been defined for descriptions and categories:

- *Primary plant*: All physical plants that are directly controlled from the automation level, for example, heating systems, ventilation systems, etc.
- *Room automation*: Individual room controls.
- *Global objects*: Data objects which exist simultaneously in several automation stations at the automation level, for example, an exception calendar for the time schedules of all plants. These objects are combined as a virtual plant in a global area and can be invoked as such (global data).

The technical view can be used for other disciplines integrated via PX Open. The technical view and the associated technical designations can be set up in the compounds library.

5.1 Standard Plant Structures

To display different plants in a uniform manner, a standard hierarchical plant structure has been created for each plant type.

Primary plants with Desigo PX

Structure

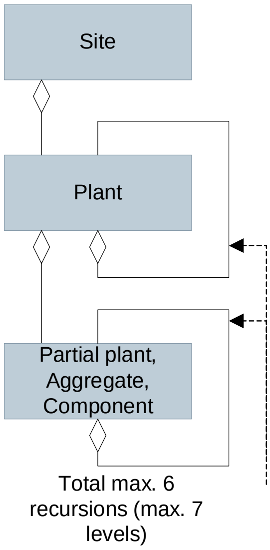


Figure 92: Structure for primary plants

Elements

Site: A site is a self-contained area in terms of location, function and organization, usually a building or a group of buildings (facility). A site can comprise several plants. Example: Building 6

Plant: A plant consists of partial plants, aggregates and components. A plant can comprise several partial plants. Aggregates and components can be directly subordinate to a plant. Example: Ventilation system, heating system

Partial plant: A partial plant can comprise various aggregates. Components can be directly subordinate to a partial plant. Example: Central supply air treatment, air distribution, hot water supply (one or more boilers)

Aggregate: An aggregate can comprise various components. Example: Exhaust air fan

Component: A component can comprise several components, which can comprise several components themselves. Example: Pumps (motors), dampers, valves, sensors, detectors, limit switches, contactors, selector switches, remote/local switches

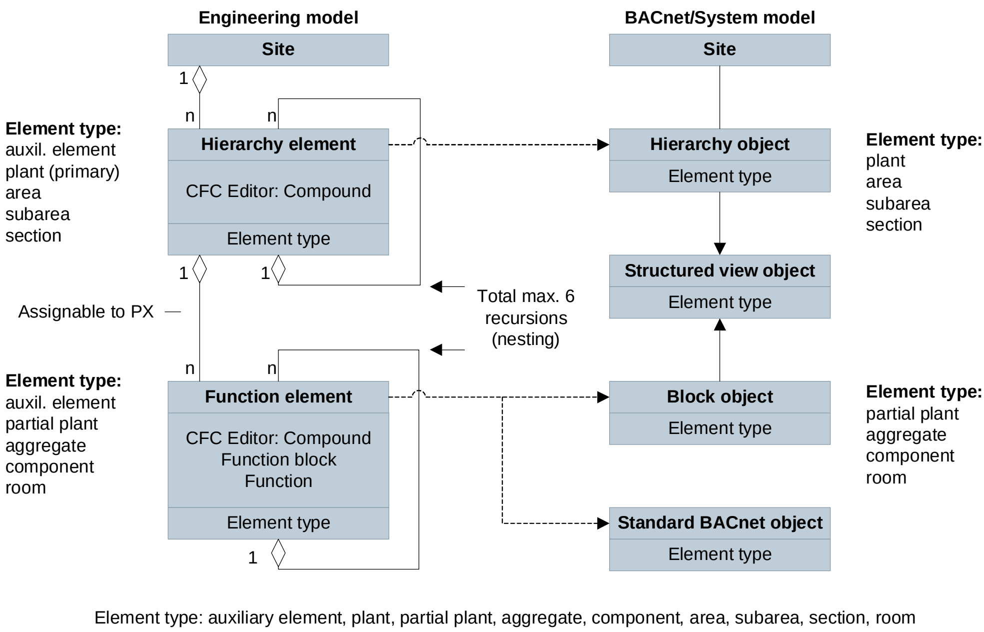


Figure 93: Primary plant with Desigo PX

Example: Ventilation VB Zug

Site: Site [Site]

Area: A [Ventilation system]

Plant: Ahu03 [Ventilation VB Zug]

Aggregate: FanEh [Exhaust air fan]

Component: DPMon [Differential pressure]

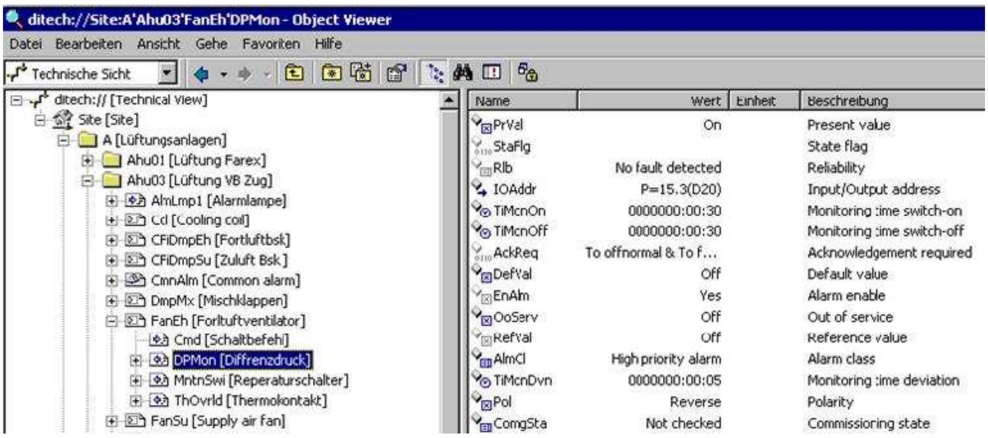


Figure 94: Technical view of the Ventilation plant VB Zug

Global objects

Structure

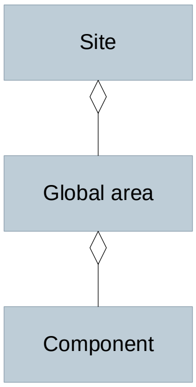


Figure 95: Structure for global objects

Elements

Site: A site is a self-contained area in terms of location, function and organization, usually a building or a group of buildings (facility). Example: Building 6

Global area: The global area contains all the global components of the site. There is one global area per site.

Global objects are data objects which exist simultaneously in several automation stations at the automation level, for example, an exception calendar for the time schedules of all plants. These objects are combined as a virtual system in a global area and can be invoked as such.

Component: A global area may contain several components, such as 3 calendars, 18 notification classes for alarm distribution. Each component is present on all automation stations of the site. For operation, however, each component is visible only once.

Room automation with Desigo RX

Structure

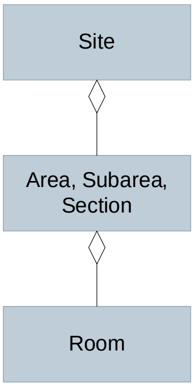


Figure 96: Structure for room automation with Desigo RX

Elements

Site: A site is a self-contained area in terms of location, function and organization, usually a building or a group of buildings (facility). A site can comprise several plants. Example: Building 6

Area: An area is typically a building, and can comprise subareas, sections, components and subcomponents. Example: Building

Subarea: A subarea is typically the wing of a building and can comprise several sections. Rooms can be directly subordinate to a subarea. Example: Building wing, staircase

Section: A section is typically a floor in a building and can contain various rooms. Example: Floor

Software objects, which need to be displayed and operated even though they do not exist as physical elements in a real building, are also treated both as sections (for example, via grouping criteria, such as east facade or emergency group 12) and as components (for example, group object for distribution of centrally determined control variables to several rooms).

Room: A room is a section of a building that is delimited by walls, ceilings, floors, windows and doors. Example: Individual room, hall

Room automation with Desigo Room Automation

Structure

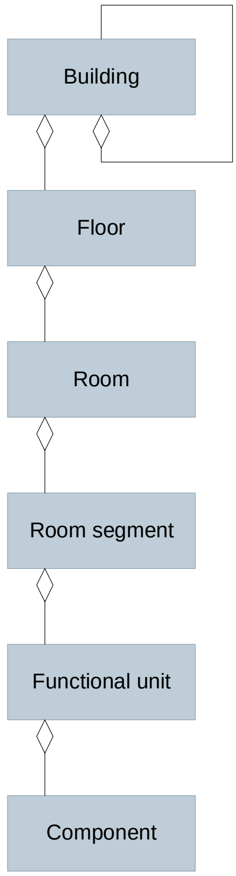


Figure 97: Structure for room automation with Desigo Room Automation

Elements

Building: A building is a locally, functionally and organizationally defined area. Example: Building 6

Floor: A floor in a building can contain various rooms. Example: Floor

Room: A room is a section of a building that is delimited by walls, ceilings, floors, windows and doors. Example: Individual room, hall

Room segment: A room segment is a subdivision of a room. A room can contain several room segments.

Functional unit: A functional unit is a logical component representing an encapsulated application unit which may be independently deployed to an arbitrary automation device. Example: Fan coil

Component: A functional unit can contain several components. Example: Awning

Example: Technical view of the Shd01 component

Building: BU33 [Building 33]

Floor: Fl3 [Floor 3]

Room: R01Segm01 [Room]

Components: Shd01 [Shading 01, venetian blinds or awnings]

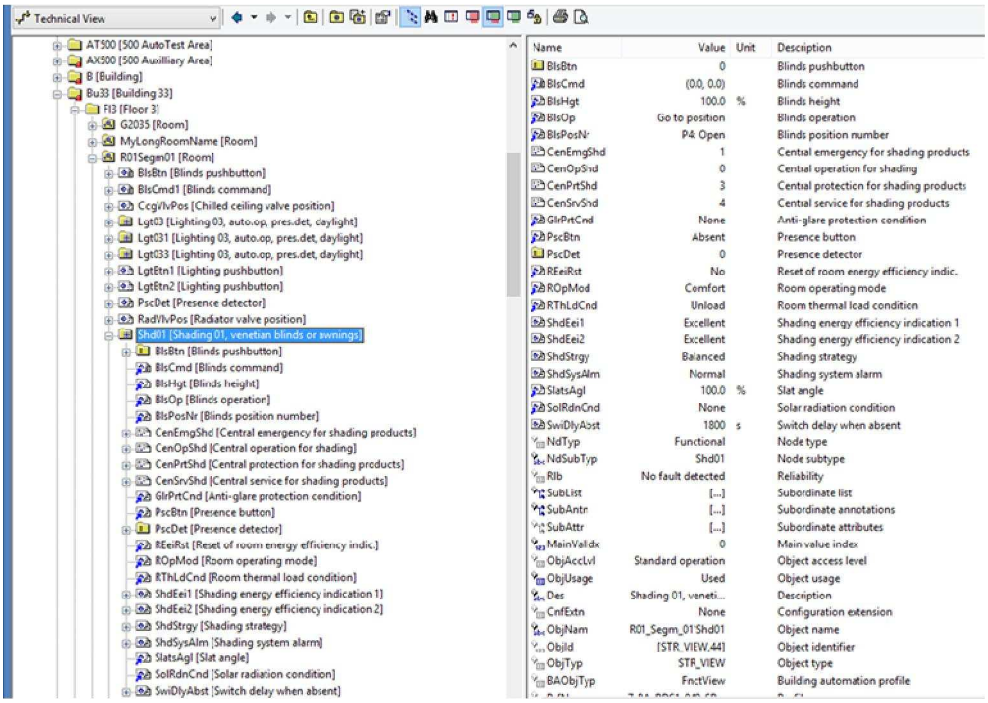


Figure 98: Technical view of the Shd01 component

5.2 Technical Text Labels

The Technical Designation (TD) is a technical identifier that is used to identify the plant and associated elements.

The structure of the TD is based on the hierarchical structure of the plant and its associated elements, z.B.:

- For primary plants with Desigo PX:
  Site / Plant / Partial plant / Aggregate / Component / Pin
- For room automation plants with Desigo RX:
  Site / Area / Subarea / Section / Room
- For room automation plants with Desigo Room Automation:
  Building / Floor / Room / Room Segment / Functional Unit / Component / Pin

The text is based on designations in abbreviated form that are customary within the industry, for example:

GUB:AGeb6'Ahu3St'FanSu = Gubelstreet facility / ventilation plans building 6 / Air handling third floor / supply air fan

Technical designations are linguistically neutral (mnemonic). They are based on mnemonic texts set up in the library, with additional project-specific details.

The TD is defined by Siemens. The User Designation (UD) can be defined by the customer.

Name&Description_Pair

Each element of the TD is called *ShortName*. A *ShortName* is a designation for an individual plant element within the automation station. A *ShortName* is always linked to a description. This pair is called the *Name&Description_Pair*.

TD rules

The following table shows the rules for the TD:

Item		Rule
Address structure		Comprises at least one hierarchical object and one function object Has a variable length (site + 1..8 hierarchy and function objects + pin name) Is independent of the automation station, that is, does not contain a designation for an automation station Must be unique for each site
Mnemonic		Based on the English terms Must not be translated Plant elements on the same hierarchy level are distinguished through different part names, for example, HG01/HG02.
Syntax	Site designation	Consists of upper and lower case letters, and numbers (must start with a letter): [a..z, A..Z, 0..9]. Is case insensitive, for example, *Imax* and *IMAx* are treated the same.
	Other partial designations	Consist of upper and lower case letters ([A..Z] and [a..z]) and/or numbers 0 to 9. Is case insensitive, for example, *Imax* and *IMAx* are treated the same.
	Max. number of characters	Site: 10 Object: 9 Pin: 8 TD: 80
	Separators	Colon (:) after site name Apostrophes (‘) for all other separations Period (.) in front of pin name

Table 25: TD rules

Function blocks and pins

A function block, that is, an object with pins, can represent an area, a partial plant, a sub-area, an aggregate, a section, or a component. Function blocks have attributes and function block pins have attributes.

The following figure shows a function block and its pins as they appear in the program view:

Figure 99: Function block in the program view

Function block attributes

The main attributes of the function block are:

- *Name*: Name of the function block based on the key of the TD. Example: ThOvrld
- *Description*: Additional description. For generic operation it is shown as text in an operator unit. Example: Thermoelectrical ovrld
- *Element type*: Block in plant-engineering terms. Example: Component
- *Main value*: Main value of the function block. It is set during engineering. Example: PrVal

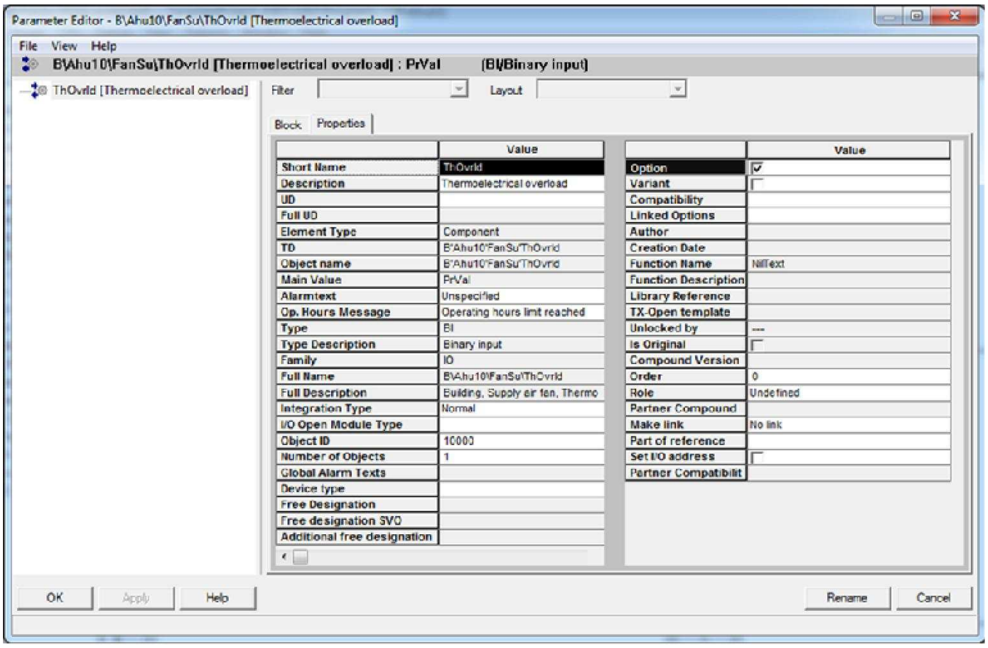


Figure 100: Attributes of the function block Thermoelectrical ovrld

Function block pin attributes

The main attributes of the pins are:

- *Name*: Pin name, based on the key of the TD. Example: PrVal
- *Description*: Description of the pin name. Example: Present value
- *Value*: Current value of PrVal. Example: Normal
- *Parameter Kind*: Application pin type. Example: Process input
- *Data Type*: Data type of the pin. Example: Multistate

For a complete list of attributes, see *CFC Online Help*.

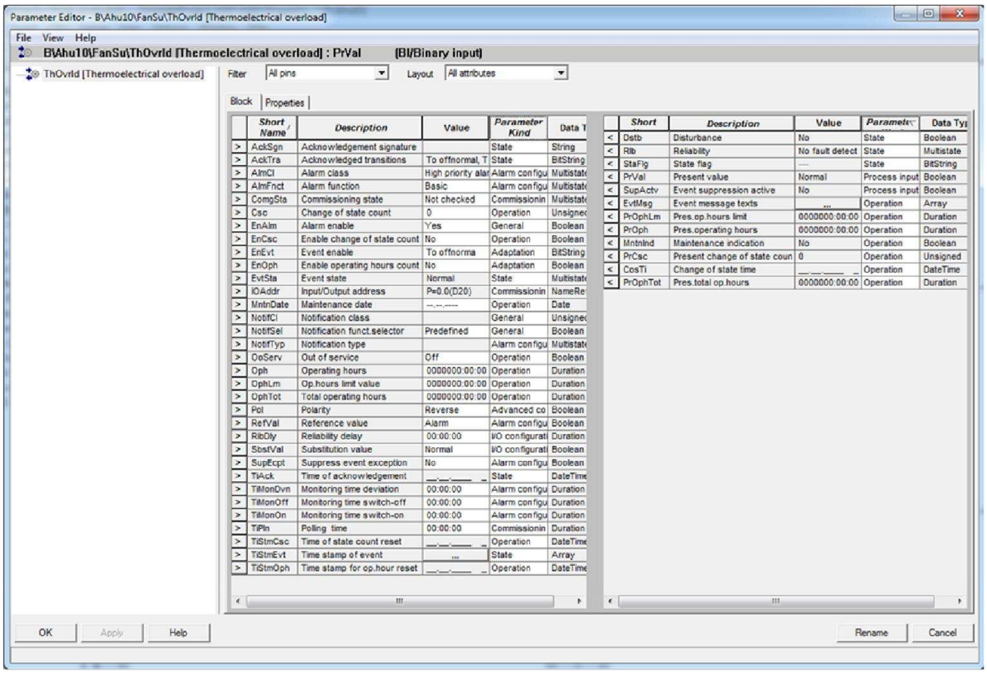


Figure 101: Pins of the function block ThOvrld

6 Global Objects and Functions

Every automation station contains all the data necessary for stand-alone operation, including, for example, date and time, calendar function blocks and Notification Class function blocks. The system functions of individual automation stations do not depend on a central server.

The System View and the Program View are based on the automation station, that is, each object (block, BACnet data object) belongs to a specific automation station. These objects are called local objects. This form of representation is adequate for most elements of a physical plant, for example, for the supply air temperature or the set point of a ventilation system.

However, certain data objects need to be visible in identical form in some or all the automation stations of a site. These objects are called global objects. Global objects let you centrally change parameters, which are then distributed to all automation stations.

Local objects

Local objects are individual and unique objects which exist only once on a particular automation station in the system. Most application-related objects are local objects. When local objects are required, such as the outside temperature in several automation stations, access to this data must be configured or programmed explicitly with function blocks (such as analog, binary and multistate inputs, or grouping in the room management system) and referencing.

Global objects

Global objects are data objects which exist simultaneously on each automation station at the automation level. Global objects are always global within a given site. Global objects are engineered in Xworks Plus (XWP).

Global objects are compiled in a global chart. There is exactly one global chart per site. You can modify global charts, save them in the tool's library folder, and copy them to other projects.

Global objects and functions are not supported in Desigo S7.

6.1 Ensuring Data Consistency

Primary copy

The primary copy procedure ensures that the global objects are consistent at all times. This means that all copies of a particular global object contain the same value and any modification of a value is transmitted to all copies.

Primary and backup server

Only one automation station per site acts as the primary server for all global objects of this site. All other automation stations of this site are backup servers. A client (PXM20 or management station) may only modify the values of the global objects on the primary server. The primary server then updates the copies of the modified global objects on all backup servers. A backup server accepts the modifications to global objects only from its primary server but not from a client.

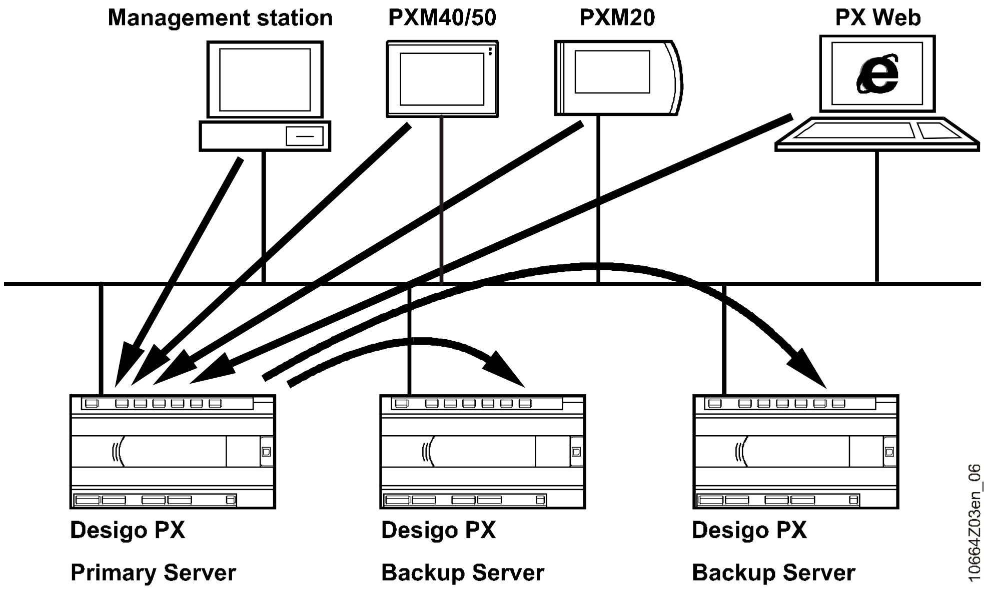


Figure 102: Primary copy procedure

Xworks Plus (XWP) and all BACnet clients can only modify the data of global objects in the primary server.

6.2 Roles in the System

Server/Function	Function and description
Primary server (Desigo PX)	One automation station of a site acts as the primary server. Make sure that only one primary server exists at any one time on a site.
Life check	The primary server monitors the backup servers and the third-party BACnet devices of a site. The primary server can monitor the TRA server.
Time synchronization	The primary server synchronizes the time of the backup servers and the third-party BACnet devices of the site. The primary server can synchronize the TRA server time.
Start-up	No coordinated start-up.
Replication	The primary server replicates the global objects and properties (device object) to the backup servers of a site. A backup server accepts changes of global objects only from the primary server.

Table 26: The role of the primary server

Server/Function	Function and description
Backup server (Desigo PX)	The other automation stations of a site must be backup servers.
Life check	The backup servers monitor the primary server of the site. Backup servers can monitor TRA servers.
Time synchronization	The backup server can synchronize the time of the TRA server and of the third-party BACnet devices.
Start-up	No coordinated start-up.

Table 27: The role of the backup server

Server/Function	Function and description
TRA server / Third-party BACnet device	The TRA server acts like a standard BACnet device.
Life check	The TRA server / third-party BACnet device is monitored by the primary server or the backup server.
Start-up	No coordinated start-up.
Replication	No global objects to be replicated.

Table 28: The role of the TRA server and third-party BACnet device

Server/Function	Function and description
Clients (management station, PX Web, PXM20)	A client can read global objects from the primary server or any backup server. A client may only modify a global object (for example, with WriteProperty) on the primary server. Each client must therefore recognize the primary server of a site. A client can query the identification of the primary server of a site. Replicated objects from backup servers which are not online or which are connected to the BACnet network at a later stage, are updated by the primary server as soon as the primary server becomes aware of them. This occurs after a restart of the automation station, after connecting it to the network or on expiry of the synchronization request period [SynReqp].

Table 29: The role of the clients

Server/Function	Function and description
Alternative primary server	If the primary server fails, no global objects can be modified. You can configure any backup server of the site to act as the primary server using a client or Xworks Plus (XWP).

Table 30: The role of the alternative primary server

6.3 Life Check

The life check checks if all devices of the site (primary server, backup server, TRA server or third-party BACnet device) work correctly, that is, if they are operating and if they are running their application.

- The primary server monitors if the backup servers / TRA servers are active.
- The backup servers monitor if the primary server is active.
- The primary server checks that only one primary server exists at any one time on a given site.

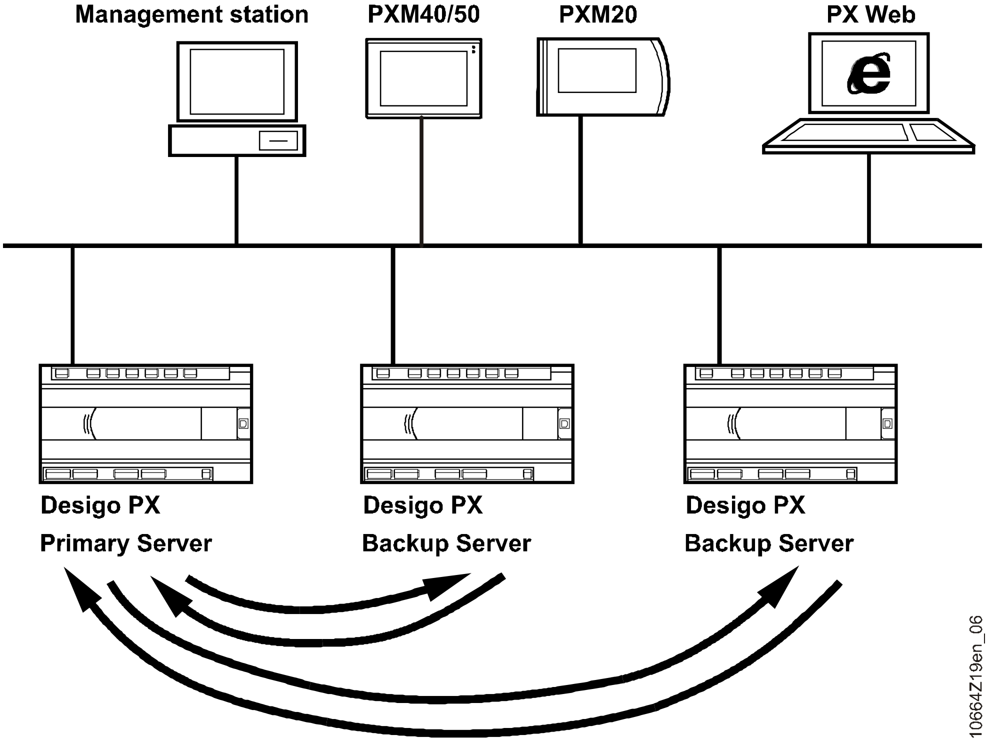


Figure 103: Life check

Add and delete devices

For life check and replication the primary server has a list [BckUpSrv] of all known devices of a site. The primary server automatically adds newly commissioned devices on the site to this list. Devices which are removed from the site must be deleted manually in Xworks Plus (XWP) from the list in the primary server.

The primary server performs a life check at regular intervals, to check that all devices of its site are online. The interval between life checks is defined by the

Check if all devices are online

synchronization request period [SynReqp]. During this period, the backup servers are checked one after the other in a cyclical process. The interval between two life checks can be calculated as follows: *t ≈ SynReqp / Number of backup servers*.

A short synchronization request period and a large number of backup servers may involve a substantial communications load. Take this into account when setting the synchronization request period in Xworks Plus (XWP).

If one or more devices are not online, the primary server generates an alarm signal. The alarm is reset as soon as all devices are online again and have been detected by the primary server. This ensures that problems, such as the failure of a device, the termination of the HVAC-application processing of a device, or faulty configuration (for example, two primary servers in one site) are detected.

Monitor if the life check checks the backup server

Each backup server monitors its own periodic life check by the primary server. If a life check fails, or if no primary server has ever carried out any life checks on this backup server, the backup server generates an alarm. The backup server resets the alarm as soon as the primary server carries out a life check.

6.4 Time Synchronization

Each automation station is assigned to a site.

The primary server is the time master. It represents the system time within a given site. The primary server synchronizes the time in the other automation stations at regular intervals.

If the primary server receives a time synchronization request which triggers a time change, the primary server synchronizes the time in the other automation stations.

The primary server transmits the time in UTC format (Coordinated Universal Time) to the other automation stations (backup servers) and in UTC format or local time format to the third-party BACnet devices.

The backup server then triggers time synchronization of its recipients configured in Xworks Plus (TRA server, third-party server, third-party BACnet devices). This can be in either UTC or local time format.

Periodic synchronization

The time synchronization interval is defined in the property TimeSynchronizationInterval [TiSynIvl] (default value: 150 minutes). The property can be configured in Xworks Plus (XWP) and adapted to the specific situation via a switchable [AlgnIvl] offset [IvlOfs]. How these three properties function is defined in the BACnet standard and implemented accordingly.

Add and delete devices

For time synchronization, the primary server has a list [TiSynRcp] containing the recipients configured in Xworks Plus (XWP) and all known backup servers of its site.

The primary server automatically adds newly commissioned backup servers on the site to the list [TiSynRcp].

Backup servers which are removed from the site must be removed manually from the primary server list in Xworks Plus (XWP).

Link the system time of a site with operator units

The network-capable operator units (management station, PX Web, PXM20) do not belong to a site. The primary server does not update the time in the operator units. The client can read and update the time, if required.

Daylight saving time changeover

The daylight saving time changeover does NOT take place in the primary server. Each automation station makes this switch independently.

The date of the daylight saving changeover is set as a parameter in the primary server. The primary server replicates the date on the backup server. The official (Central European) changeover date is set as default.

The local time in an automation station is a calculated variable. The calculation is based on the internal time in UTC format, the property UTC offset [UtcOfs] and the date of the summer and winter time changeover.

See *Desigo Insight, Management station operation* (CM110588) and *Desigo CC User Guide* (A6V10415471).

6.5 Examples of Global Objects

BACnet device object

Certain properties of the BACnet device object are defined as global, because from the perspective of the system, they are required to have the same value throughout the site. These properties are set in Xworks Plus (XWP). Examples:

Global properties

- Date and time for the summer and winter time changeover.
  Daylight savings time start date [DsavSdt] (Default: last Sunday in March)
  Daylight savings time start time [DsavSti] (Default: 02:00AM)
  Daylight savings time end date DsavEdt] (Default: Last Sunday in October)
  Daylight savings time end time [DsavEti] (Default: 03:00AM)
- UTC_Offset [UtcOfs]
  Difference between UTC and local Winter time in minutes. Default value: – 60 mins (Central Europe). In Summer, the effective difference [UtcOfs] is –60 mins (Central Europe: –120min).
- Synch.Request Period [SynReqp]
  Period between life checks by primary server The load on the communications system generated by the life check can be controlled with this parameter by adapting it to the site size. Default value: 1800 s.
- Name resolution interval [NamRI]
  Periodic repetition for the resolution of references across devices. Default value: 900 s.
- COV resubscription interval [CovRI]
  Time within which the automation station resubscribes to a subscribed value. Default value: 1800 s.

Local properties

Local properties which refer to the functionality of the life check / replication:

- Server type [SvrTyp]
  Defines if the device acts as a primary server or a backup server. Default: backup.
- Primary device [PrimDev]
  Device object ID of the primary server of the site or an invalid value if the primary server is not known (read-only, set automatically by the primary server).
- Last engineering time, global object [GOEngTi]
  Time stamp of the last structure modification of the global objects by Xworks Plus (XWP).
- Last online modification of global objects [GOChgTi]
  Time stamp of the last online modification of a global object in Xworks Plus (XWP) (modified by the primary server, read-only).

Notification class object

The Notification Class object is a standard BACnet object and defines the system response of alarms and system events.

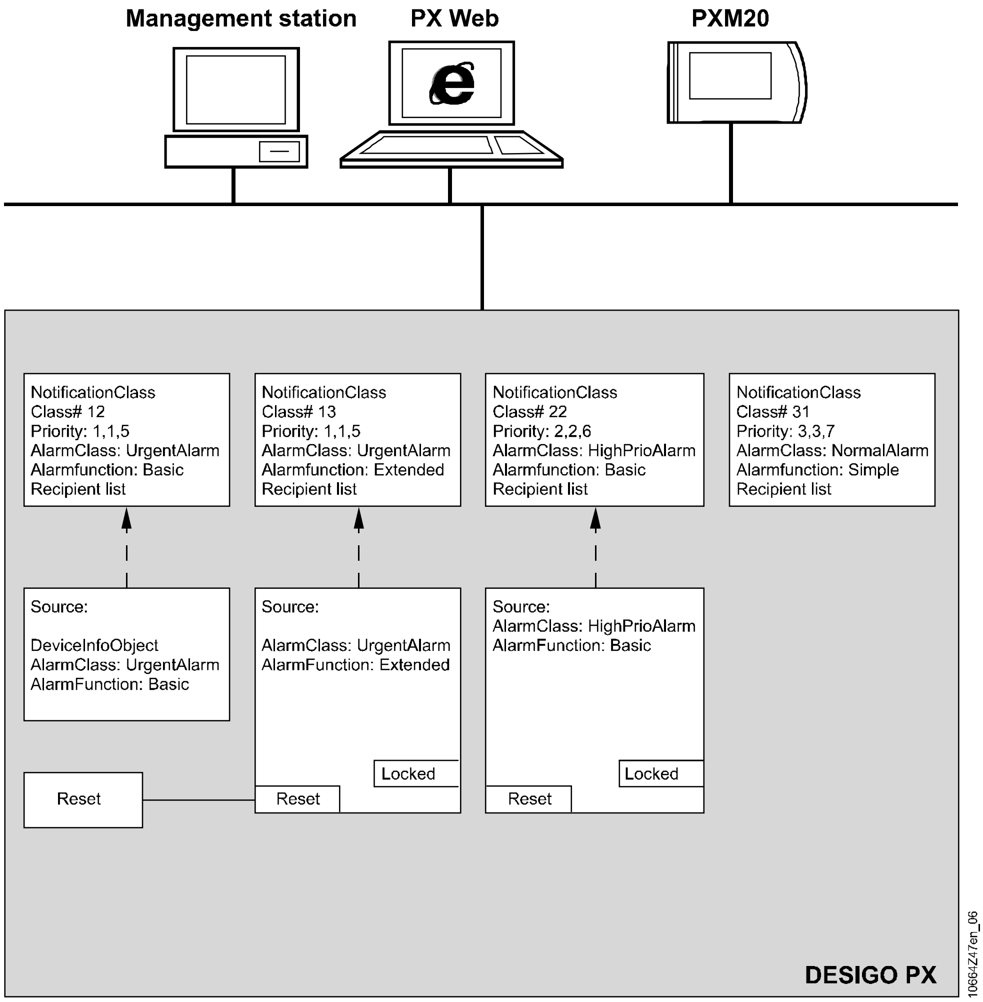


Figure 104: Distribution of alarms and events

There are local and global Notification Class Objects.

Global Notification Class Object: A logical object at site level that exists in identical form (as a replicated object) in every automation station on a site.

Local Notification Class Object: Individual object (unique object) that exists only on a particular automation station.

Reading of objects by a client: A client may read the global notification class objects from any automation station.

Reasons for replication: Keeping the setting parameters consistent for all automation stations of a site when modifications occur (adding or deleting configured recipients from recipient list, changing priorities).

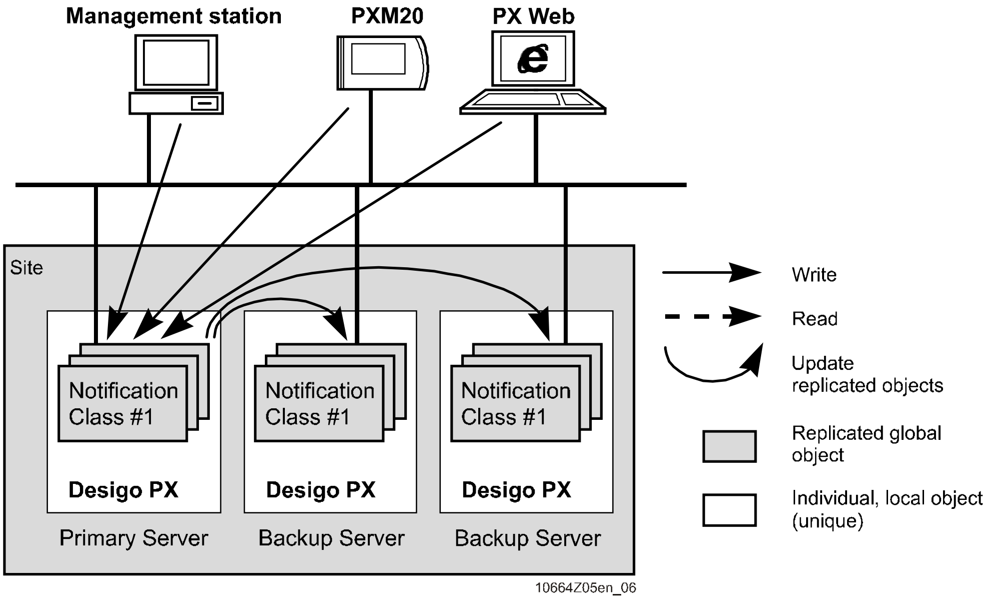


Figure 105: Global and local Notification Class Objects

The number of global Notification Class objects is limited to 18 (six alarm classes each with three possible alarm functions).

Calendar object

There are global and local calendar objects.

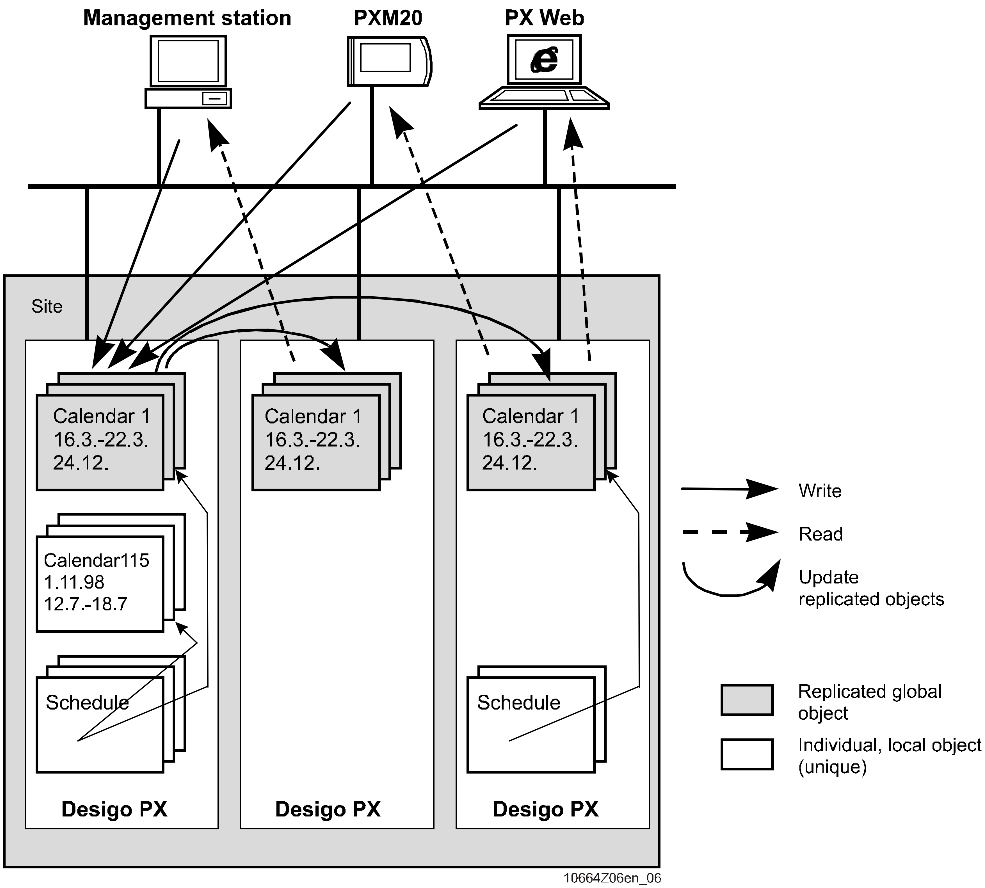


Figure 106: Global and local calendar objects

Global calendar object: A logical object at site level. It exists in identical form (as a replicated object) on each automation station of a site.

Local calendar object: Individual (unique) object that exists only on a particular automation station.

Local processing: Schedule objects in an automation station may reference the replicated calendar objects in the device. A client may read the global calendar objects from any automation station.

Reasons for replication: Global exceptions (bank holidays, general holidays, etc.) can be modified centrally in one location for the entire site. Ensures continuity of operation if the master fails.

User profile object

Global user profile object: A logical object at the site level. It exists in identical form (as a replicated object) on each automation station of a site. There must be at least one user profile object.

There are no local user profile objects.

Local processing: Access control is based on the replicated user profile objects in the automation stations (BACnet devices): No dependency on a server.

Reading of objects by a client: A client may read the global user profile objects from any automation station.

Reasons for replication: Replication is designed to maintain consistency of the access rights throughout the site, and to ensure continuity of operation in the event of the failure of the master.

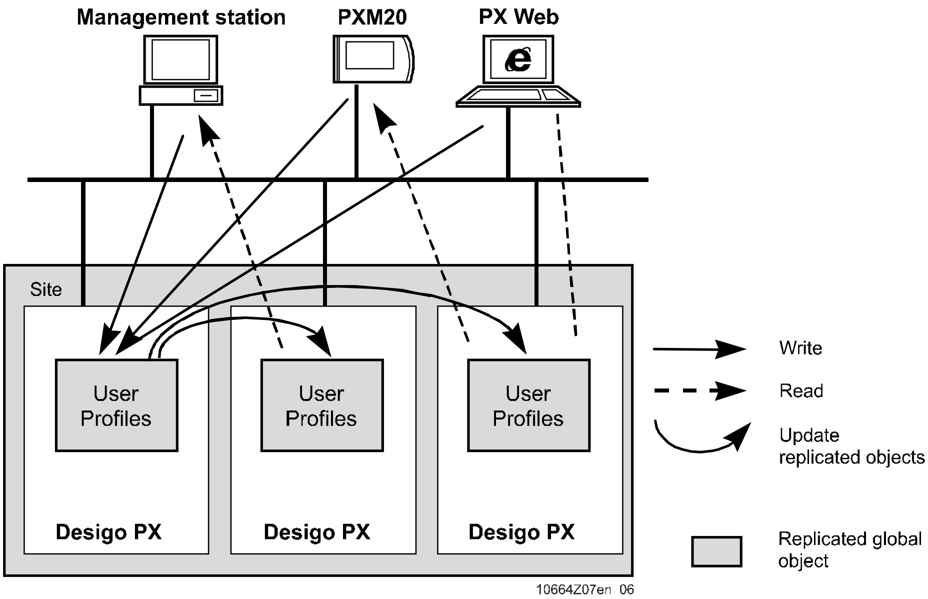


Figure 107: User profile objects

7 Events and COV Reporting

Events

System events are messages which inform a client (for example, Desigo CC) of specific events in an automation station, such as:

- Change in operating state of the automation station (STOP, RUN)
- Overflow of the operating hours counter built into certain I/O objects

Conceptually, system events are similar to alarms, however, they differ from alarms in some ways:

- System events have no memory, that is, they do not have a finite state machine.
- System events do not affect the status of a plant, that is, they can occur in any alarm state without influencing it.
- System events are displayed, but do not need to be acknowledged or reset.

System events are forwarded to clients using the same mechanism as alarms.

COV reporting

If a value of a specific process variable changes, the change is transmitted to other system components by means of Change Of Value (COV) reporting. Polling is used only in exceptional cases. COV reporting can be used to transfer value changes to several automation stations. A COV notification is issued only when the value of the process variable changes in comparison with the preset or default incremental value. There is no need to poll the process variables at regular intervals.

There are two roles:

- COV-Server: The automation station which reads the process variable and whose change of value is to be reported.
- COV-Client: The recipient of the COV notifications. This may be another automation station or a BACnet client (for example, PXM10/20/40/50, PX Web, Desigo Insight, Desigo CC).

7.1 Sources and Causes of System Events

The source of a system event is a function block (as with alarms). System events can originate from the same block types as alarms:

- Analog Input/Output/Value
- Binary Input/Output/Value
- Multistate Input/Output/Value
- BACnet Device Info Object (or Multistate Input Object for Desigo S7)

Every block type capable of generating a system event has a clearly defined set of system event triggers.

Event-generating block types	Description
Operating hours counter	The input, output and value objects of the Binary and Multistate types have an inbuilt operating hours counter. A system event is generated when the operating hours limit is exceeded or when the maintenance interval has expired.
BACnet Device Info Object	The BACnet Device Info Object detects the causes of system events which apply to the automation station as a whole. The following causes are detected: - Change of operating state (start and stop the program) - Restart after a power-up - Primary server has found a new backup server on the network - Backup server has found the primary server

Table 31: Event-generating block types

7.2 Routing System Events

System events are forwarded to clients using the same mechanism as alarms. They are forwarded to all temporary and configured alarm recipients in accordance with the settings in the associated Notification Class objects.

Comparison with the alarm strategy

System events cannot be acknowledged or reset. A Confirmed Event Notification message is sent to all alarm recipients. The Notify_Type data field in the message defines that the event is a system event and not an alarm. Each alarm recipient that receives the Confirmed Event Notification is required to respond with a SimpleAck. If the SimpleAck is not received, the same mechanism comes into operation as for alarms.

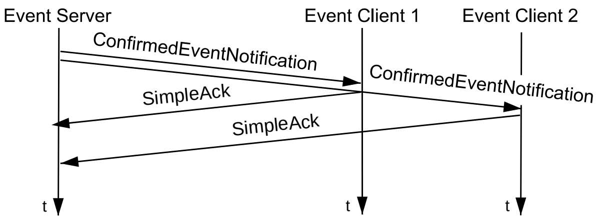


Figure 108: System event forwarding procedure

Event texts

Each system event has a message text assigned to it. For the system events related to the operating hours counter, a user-specific text can be set up in Xworks Plus (XWP). Predefined system texts are available for the other system events.

7.3 Sources and Causes of COVs

Process variables which can be mapped to standard BACnet objects are COV-capable.

I/O function block

Function blocks for Analog, Binary and Multistate Inputs, Outputs and Values are mapped directly to the associated BACnet object types. They are COV-capable and can establish COV connections with all COV clients.

Interface variables

Interface variables of compounds and function blocks whose data type is Analog, Binary, Multistate, Integer, Duration and DateTime are COV-capable and can be mapped to simplified BACnet value objects for operation and monitoring.

A COV is initiated when the value of the process variable [PrVal] of the BACnet object which represents it changes. A COV is also initiated when a status flag [StaFlg] (InAlarm, Fault, Overridden or Out of service) changes, for example, when a sensor open circuit (fault) occurs or when an I/O value is overwritten manually.

COV increment

For analog objects, a COV is not initiated for every minor change of [PrVal], but only when the value changes by an amount greater than a predefined increment. This increment is saved in the COV increment [COV] of the analog object, and can be defined in Xworks Plus (XWP) during engineering.

7.4 COV Reporting

Subscription

Each COV client must subscribe to every process variable from which it requires COV notifications. Each COV-capable object transmits COV notifications only to those COV clients which have subscribed to COV notifications. The subscription process is carried out using the BACnet service SubscribeCOV, transmitted by the COV client to the COV server. This message contains all the information that the COV server needs to send the COV notifications to the correct destination. It also includes a time period which determines the validity period of the subscription. The time period may be infinite.

For system limits, see chapter *System Configuration*.

COV notifications

The COV server reports every COV individually to each COV client which has subscribed to it. The BACnet service ConfirmedCOVNotification is used for this purpose. It contains the values of [PrVal] and [StaFlg]. The service is a Confirmed Service, which means that the COV client must acknowledge the notification (SimpleAck). This ensures that when a COV client ceases to be available, this will be recognized by the COV server. If no SimpleAck message is received, the transmitting device tries to send the information again (three times).

For system limits, see chapter *System Configuration*.

Connection terminated

If a COV client cannot be contacted, the COV server ceases to send COV notifications to that client. The transmission of COV notifications to a COV client is resumed when the COV client re-subscribes.

Checking the connection

To ensure that the COV service is maintained over a long period, a maximum time period without COV reporting can be set in the BACnet Device Info Object via the BACnet property COV Resubscription Interval [CovRI]. The client must subscribe with SubscribeCOV again before [CovRI] expires.

COV clients and COV servers

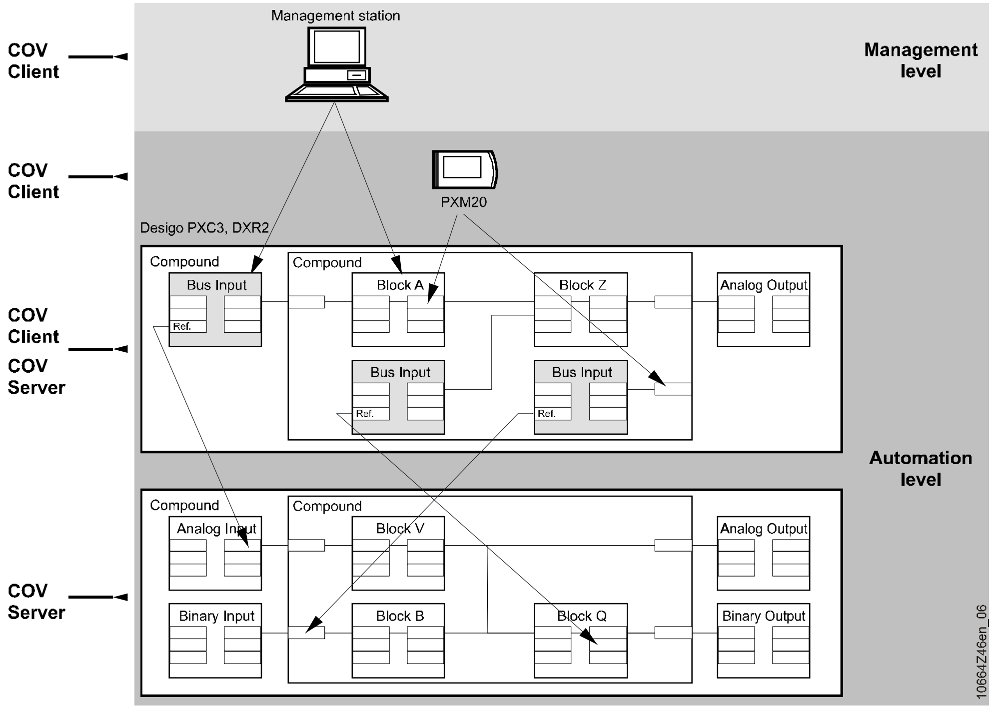


Figure 109: COV clients and COV servers

The local PXM10 operator unit is not a BACnet client and cannot, therefore, be used as a COV client.

See *PXM10 operator unit: User's guide* (CM110397).

COV reporting between COV client and COV server

COV mechanism

BACnet clients use the COV mechanism for continuous monitoring of process variables without putting an excessive load on the bus through continuous polling. They subscribe to the objects that they are monitoring. These COV connections must be maintained as long as the object is being monitored.

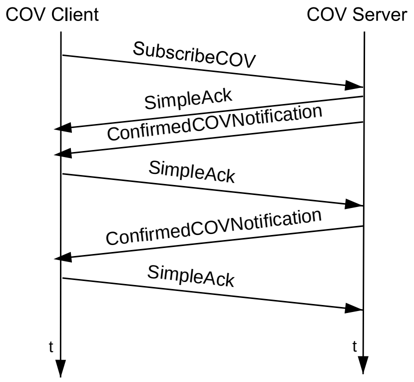


Figure 110: COV reporting between COV client and COV server

The BACnet client subscribes to the COV server as a COV client using the BACnet service SubscribeCOV. The server sends a SimpleAck acknowledgement. Immediately after the acknowledgement, the COV server transmits an initial ConfirmedCOVNotification. The COV client acknowledges receipt of the value with a SimpleAck acknowledgement. The COV connection between the COV server and COV client is now established, and ConfirmedCOVNotifications are sent whenever a trigger for the subscribed COV occurs.

The BACnet service SubscribeCOV includes a time limit for the COV connection. However, the COV client re-registers with the COV server before this limit expires, thus ensuring that the connection is maintained. A COV connection ends when the subscription period expires and is not renewed, or when the COV client can no longer be contacted, causing the COV server to stop sending notifications.

In addition to the SubscribeCOV service, a SubscribeCOV Property service is implemented, for example, for the operation of plant graphics in the management station. This enables the system to respond with appropriate speed to changes in the high or low limit.

COV reporting between automation stations

COV connections between automation stations are used to implement pre-engineered references, that is, for the exchange of process values between individual plant parts on different automation stations. In this case the receiver is an input function block of the relevant data type (Analog, Binary, Multistate). The input function block contains the technical designation of the required COV source in its input/output address parameter [IOAddr]. These COV connections must be permanently live. The COV mechanism enables a dropped COV connection to be re-established.

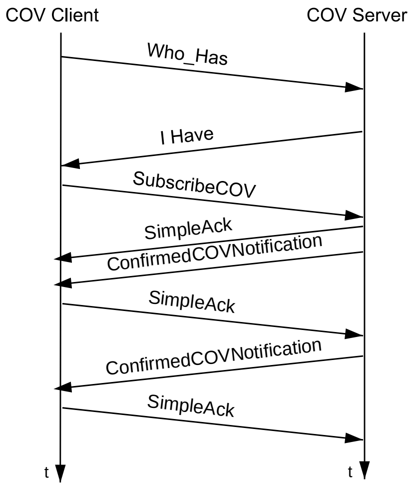


Figure 111: COV reporting between automation stations

When an automation station connects, the BACnet service WhoHas searches the entire network for the object referred to in the COV client. The automation station concerned responds to the COV client with the BACnet service IHave. If the COV client cannot find the COV server, it repeats the WhoHas request after the time period defined in the BACnet Device Info Object Property Name resolution interval [NamRI] until the COV server is found.

The COV client registers for a limited period as a COV client with the COV server using the BACnet service SubscribeCOV. The server sends a SimpleAck acknowledgement. The value is then sent to the COV client for the first time by the COV server, using the BACnet service ConfirmedCOVNotification. The COV client acknowledges receipt of the value with a SimpleAck acknowledgement. The COV connection between the COV server and the COV client is established from this point on. According to the global property COV renewal interval CovRI of the BACnet Device Info Object, the COVsubscription is renewed. The lifetime used for SubcribeCOV is twice the COV renewal interval CovRI. The COV connection ends when the subscription period expires and is not renewed, or when the COV client can no longer be contacted, causing the COV server to stop sending notifications.

8 Alarm Management

Alarms indicate faults in the HVAC plant and building automation and control system, and let you initiate corrective action, where appropriate. The management of alarms (generation, signaling, acknowledgement) is in compliance with the BACnet standard.

There are two alarm types:

- OFFNORMAL
- FAULT

OFFNORMAL

OFFNORMAL alarms (process alarms) occur when a process variable assumes an inadmissible value. What is inadmissible is determined during engineering. The relevant parameters are stored in all alarm-generating objects. An OFFNORMAL alarm always indicates a fault in a plant, while the automation system itself works properly.

Examples of OFFNORMAL alarms:

- Temperature in HTHW circuit is too high or too low
- Alarm generated by fire detection system
- A damper-motor feedback signal has not been received
- A time schedule cannot execute a command

FAULT

FAULT alarms are faults in the automation system itself (internal alarms). You cannot define the cause of a FAULT alarm during engineering. Nor is it possible for the user to suppress or otherwise influence the monitoring of FAULT alarms. FAULT alarms are intrinsically linked to the system. A FAULT alarm always takes precedence over an OFFNORMAL alarm from the same alarm source, because in the case of a FAULT alarm, there is some uncertainty about the reliability of the alarm source.

Examples of FAULT alarms:

- Faulty sensor (open circuit, short circuit, etc.)
- Buffer for storage of non-volatile data full
- Access to an I/O module failed
- Bus open circuit (RX integration)

Alarm detection procedure

Every alarm (OFFNORMAL or FAULT) can be uniquely allocated to a source. The alarm monitoring system is based on the principle of Intrinsic Reporting or Algorithmic Reporting as defined in the BACnet standard.

Intrinsic reporting

Intrinsic reporting means that alarm monitoring (target-actual comparison) takes place within the alarm-generating object itself (the alarm source). For this purpose, the function block contains the entire alarm state machine. Alarm detection does not require any function blocks with external functions. The alarm behavior of the object is defined by setting variables in the alarm-generating object (function block).

Algorithmic reporting

Algorithmic Reporting means that alarm suppression (target-actual comparison) occurs outside the alarm source. The alarm state machine is not located in the function block of the alarm source. For alarm detection, function blocks with external functions are required. The object's alarm response is not parameterized using variables of the monitored object (function block).

8.1 Alarm Sources

The following function blocks can be alarm sources:

- Analog Input / Analog Output / Analog Value
- Binary Input / Binary Output / Binary Value / Pulse Converter

- Multistate Input / Multistate Output / Multistate Value
- Event Enrollment
- Command Control object[2]
- Power Control object[2]
- Schedulers (Analog / Binary / Multistate Scheduler object)[2]
- AlarmCollection object
- Discipline I/O[1, 2]
- Trend Log / Trend Log Multiple
- Group[1, 2]
- Device Info object, which models the properties of an automation station as a complete entity
- Loop object

[1] Discipline I/Os, Groups, Time Scheduler and Trend Log Multiple support only system alarms, that is, only alarms of the FAULT type. Both function blocks can transmit more than one system alarm. The parameters [Rlb] and [MsgTxt] provide detailed information about the cause of the most recent alarm message. The messages are transmitted in the order in which they occur, irrespective of the importance of the alarm.

[2] These function blocks are not alarm sources in Desigo S7.

Only these alarm sources incorporate Intrinsic Reporting, and can thus generate their own alarms. If any other value of a function block needs to be monitored for an alarm (for example, the control signal for a controller block), an Event Enrollment object must be added.

Alarm-generating function blocks include a range of interface variables which can be set as parameters to determine the alarm response (Input Property) or to supply the relevant alarm state information (Output Property). These interface variables are described further below. Some of the interface variables are common to all alarm-generating block types, while others are specific to certain types of alarm-generating blocks.

Alarm state machine in an alarm-generating function block

Alarm state machine

The response in the event of an alarm is modeled by an alarm state machine. Each alarm-generating block incorporates an alarm state machine of this type. The alarm-related interface variables can therefore be used to define the response of this state machine, to simulate state transitions, or to represent the current status of the state machine itself.

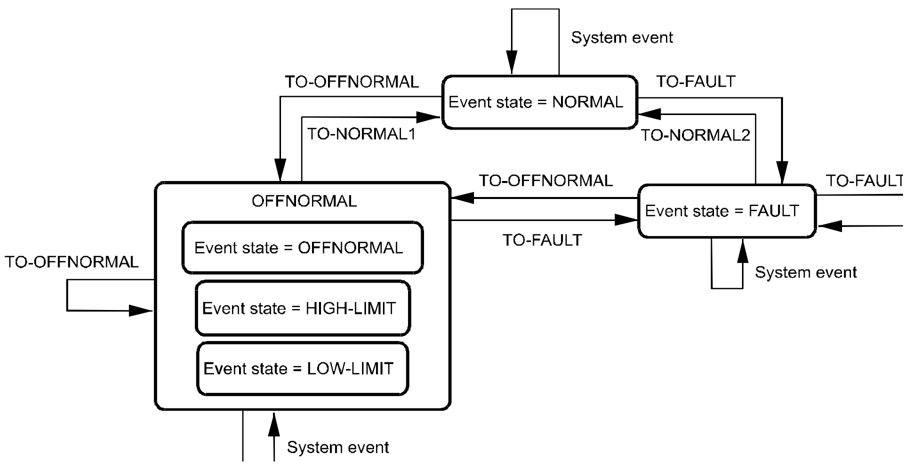


Figure 112: Alarm response with an analog function block

Alarm state event states

The alarm state machine can assume one of three basic states (event states [EvtSta]):

- NORMAL: There is no alarm condition present
- OFFNORMAL: Alarm caused by an OFFNORMAL condition
- FAULT: Alarm caused by a FAULT condition

With analog blocks, the OFFNORMAL state is explicitly subdivided into the sub-states HIGH LIMIT and LOW LIMIT, which are described in detail further below.

The current state of the alarm state machine in an alarm-generating block is displayed externally in the form of the output variable [EvtSta] (event state) of the block concerned.

State transitions

The following table shows the state transitions between the alarm states:

Transition	Trigger	Action / Event state
TO_OFFNORMAL	A new OFFNORMAL alarm condition has been detected.	OFFNORMAL
TO_NORMAL1	The current OFFNORMAL alarm condition has disappeared, and there is no other alarm condition present.	NORMAL
TO_FAULT	A new FAULT alarm condition has been detected.	FAULT
TO_NORMAL2	The current FAULT alarm condition has disappeared, and there is currently no other alarm condition.	NORMAL

Table 32: Transitions between the alarm states

System events may also occur within each alarm state. These message functions do not affect the alarm state.

Because FAULT alarms take priority over OFFNORMAL alarms, the state transition from FAULT to OFFNORMAL only occurs under very special circumstances.

If, while in the OFFNORMAL state, a FAULT alarm condition occurs, there is then a state transition TO_FAULT (because as stated above, FAULT takes priority over OFFNORMAL).

8.2 Alarm Example

What happens in the Desigo system when the V-belt of an extractor fan breaks?

The following figure shows the main information exchanged by the elements concerned, namely:

- Operator
- Ventilation system sensor/actuator (differential pressure monitor, maintenance switch and single-speed extract air fan)
- PXC program
- Desigo Insight plant graphic
- PXM20 operator unit
- PXM10 operator unit

See *PXM20 / PXM20-E operator unit User's Guide* (CM110754), *PXM10 operator unit* (CM110397), and *Web operation PX Web* (CM110757).

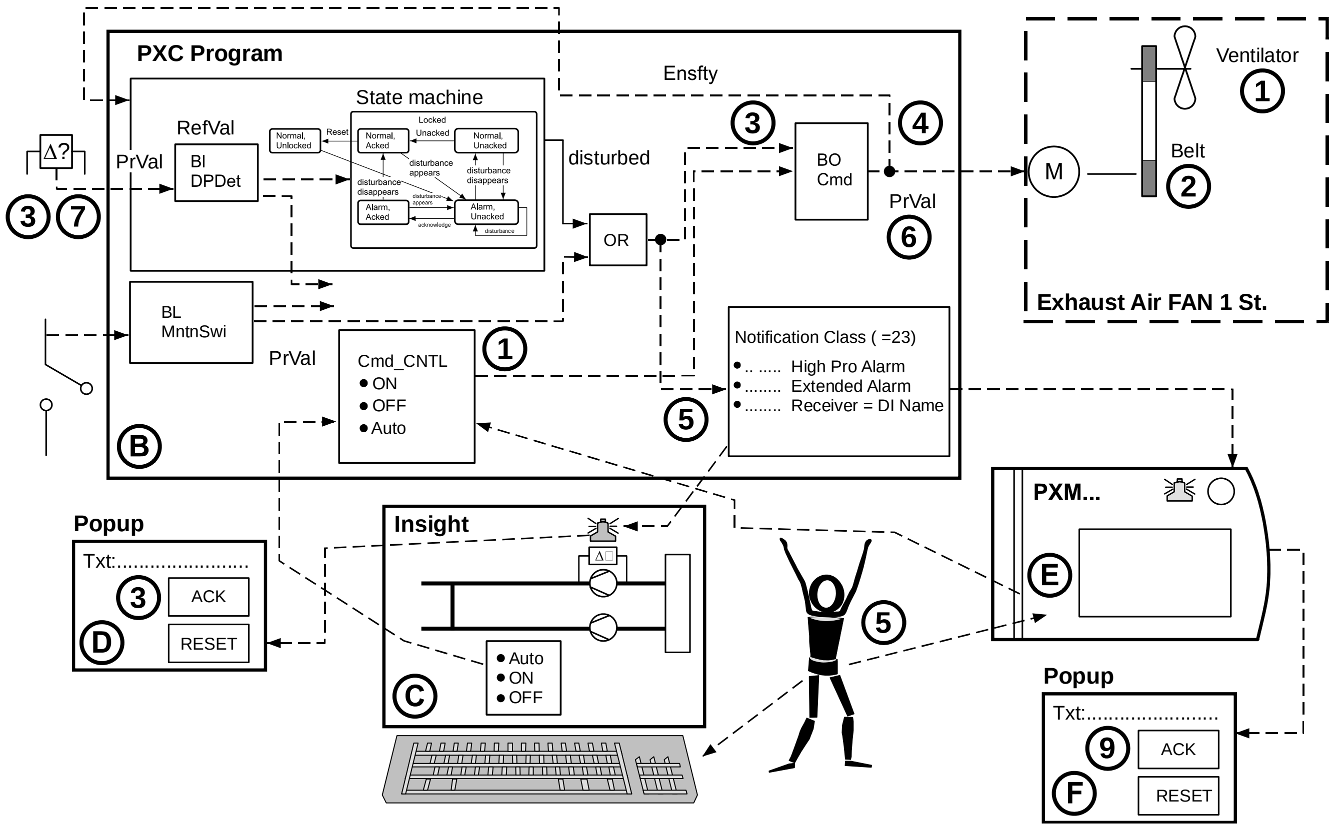


Figure 113: Information flow

Key:

A	State machine
B	CFC program
C	DI plant graphic page
D	DI popup
E	PXM… Values (in a PXM10 alarm handling is only possible for connected PXCs or PXRs)
F	PXM… Popup (in a PXM10 alarm handling is only possible for connected PXCs or PXRs)

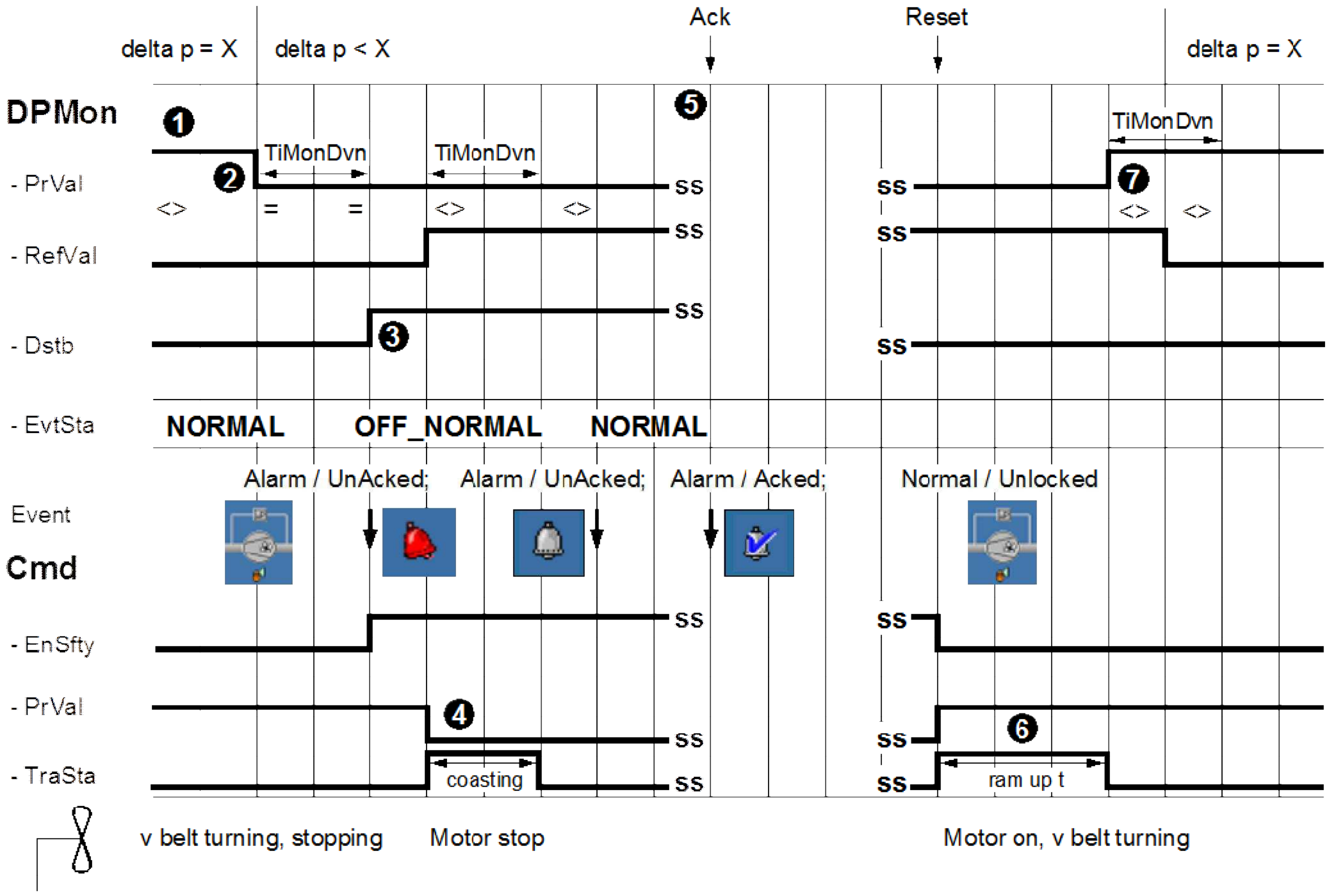


Figure 114: Time sequence in the example

1. Ventilation system on (for example, in automatic mode, Cmd.ValPgm = 1), single-speed extract air fan running, fan blades rotating
2. The V-belt breaks, the pressure drops, the differential pressure monitor responds (delta p < X) and DPMon.PrVal goes to zero. This activates the alarm monitoring function in the DP monitoring block, and the [TiMonDvn] timer starts counting down.
3. After expiry of the time [TiMonDvn], the DPMon block (BI) establishes that DPMon.PrVal (0) is still equal to DPMon.RefVal (0). This is equivalent to the OFFNORMAL state. DPMon.Dstb then goes to 1, and a TO_OFFNORMAL event is transmitted.

   An alarm pop-up window is then displayed, in which the alarm message reads Alarm, Unacked (Desigo Insight or PXM…, see figure below).
4. The motor of the single-speed extract air fan is disabled (that is, Cmd.PrVal → 0) because [EnSfty → 1 and Cmd.ValSfty=0, Prio1 Cmd Input]. As a result, DPMon.RefVal goes to 1, thereby activating the alarm monitoring function. After expiry of the time [TiMonDvn], the alarm monitoring function determines that [DPMon.PrVal (0) <> DPMon.RefVal (0)]. The state therefore changes to NORMAL and a TO_NORMAL event is transmitted.

   The alarm display now changes to Alarm = Normal, UnAcked.
5. The operator now acknowledges the alarm with Ack in the alarm pop-up dialog box. The alarm display now changes to Alarm = Normal, Acked. The operator sets the maintenance switch [MntnSwi] to Maintenance ON, replaces the fan belt, returns the maintenance switch to Maintenance OFF and resets the alarm with Reset.

   The alarm in the display changes to Alarm = Normal, Unlocked and DPMon.Dstb → 0.
6. The fault has been cleared. When DPMon.Dstb = 0, then Cmd.EnSfty → 0 and hence Cmd.PrVal → Cmd.ValPgm=1, that is, the fan motor is enabled. Then,

with Cmd.TraSta = 1 (transient state), the fan ramp-up time is allowed to expire, that is, DPMon.RefVal is held at 1 during the transient state. Only after expiry of the ramp up time does DPMon.RefVal revert to 0.

7. The ventilation system is already running (from step 6 on), that is, the fan blades start rotating, the pressure builds up and the differential pressure monitor detects delta p = X again, that is, DPMon.PrVal → 1. The alarm monitoring function is active again. After expiry of the time [TiMonDvn], this determines that there is no alarm condition present, because [DPMon.PrVal(0) <> DPMon.RefVal (1)]. The system then operates 100% correctly as described under step 1 above.

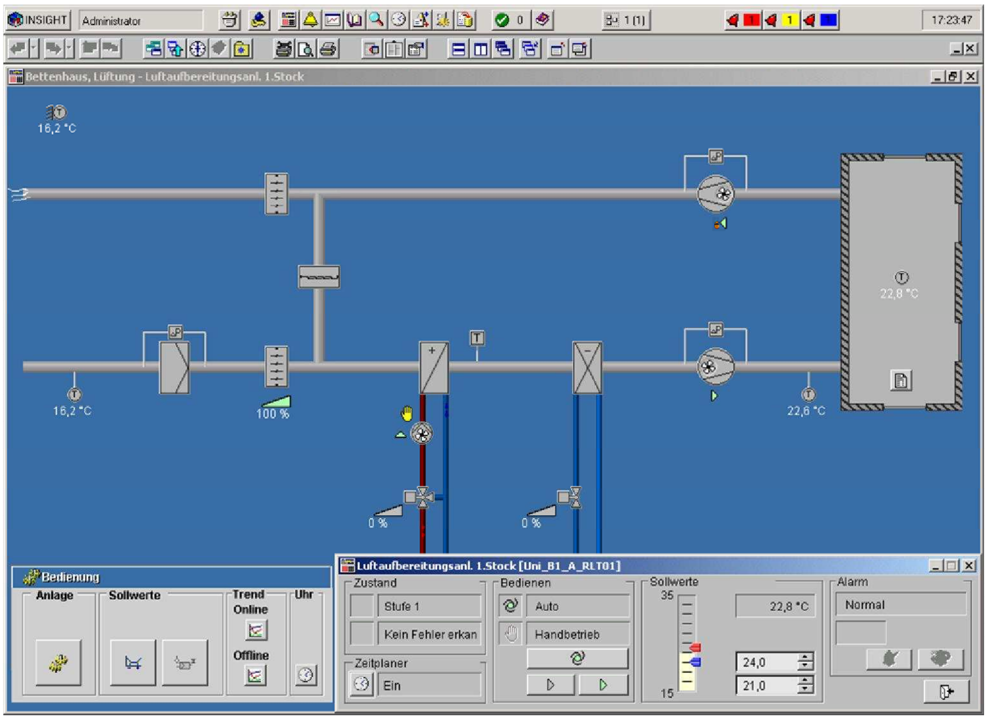


Figure 115: Plant graphics for the ventilation system in Desigo Insight

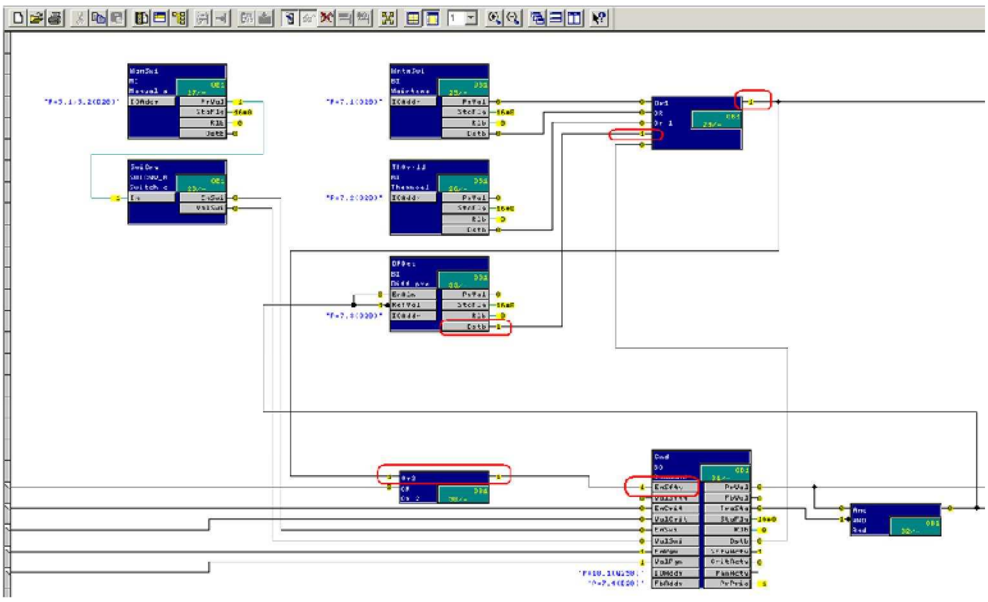


Figure 116: CFC chart for single speed fan Fan1St

To simplify the time chart shown above, the connection to DPMon.EnAlm has not been included.

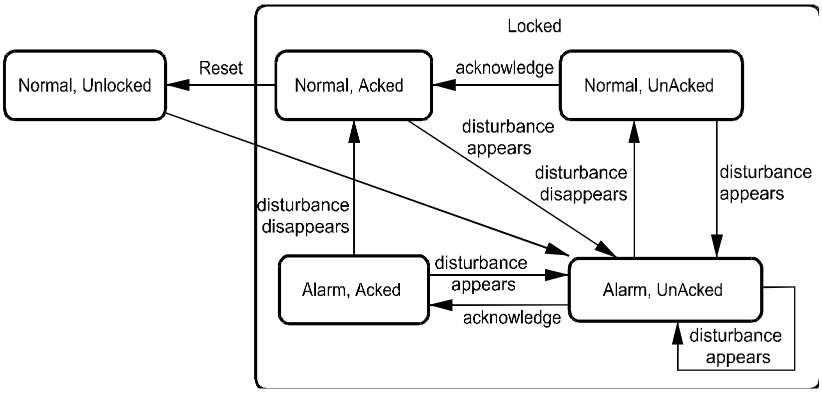


Figure 117: State machine

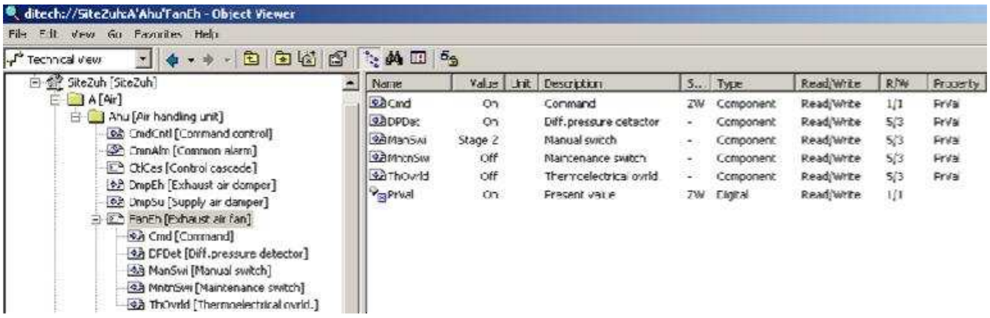


Figure 118: Object Viewer with ventilation system pane

8.3 Effects of BACnet Properties on Alarm Response

The following table shows which BACnet properties are present in which function blocks.

I = Input

O = Output

V = Value

SBT designations			BACnet property	Function blocks (BACnet objects)			
Long name	Ref.	Description		Other	Binary	Analog	Multistate
Alarm enable	EnAlm	Alarm enable	Alarm_Enable	Pulse Converter Event Enrollment	I / O / V	I / O / V	I / O / V
Event enable	EnEvt	Event enable	Event_Enable	Pulse Converter Command Control[1] Power Control[1] AlarmCollection Trend Logs Event Enrollment Loop	I / O / V	I / O / V	I / O / V
Event detection enable	EnEvtDet	Enable event detection	Event_Detection_ Enable	Event Enrollment			

SBT designations			BACnet property	Function blocks (BACnet objects)			
Long name	Ref.	Description		Other	Binary	Analog	Multistate
Event state	EvtSta	Event state	Event_State	Discipline I/O[1] Group[1] Pulse Converter Trend Logs Device-Info[1] Command Control[1] Power Control[1] AlarmCollection Event Enrollment Loop	I / O / V	I / O / V	I / O / V
Feedback value	FbVal	Feedback value	Feedback_Value		O	O	O
Upper limit	HiLm	Hi Limit	High_Limit	Pulse Converter		I / O / V	
Limit enable	EnLm	Enable limit	Limit_Enable				
Lower limit	LoLm	Low limits	Low_Limit	Pulse Converter		I / O / V	
Message text	MsgTxt/EvtMsg	Message text	Message_Text	Discipline I/O[1] Group[1] Pulse Converter Command Control[1] Power Control[1] Loop Event Enrollment	I / O / V	I / O / V	I / O / V
Deviation monitoring period	TiMonDvn	Deviation monitoring period	Time_Delay	Pulse Converter Power Control[1] Loop	I / O / V	I / O / V	I / O / V
Switch-off monitoring time	TiMonOff	Switch-off monitoring time	Time_Delay2		I / O / V		
Switch-on monitoring time	TiMonOn	Switch-on monitoring time	Time_Delay1		I / O / V		
Dead band or dead zone	Nz	Neutral zone	Deadband	Pulse Converter		I / O / V	
Out of service	OoServ	Out of order	Out_of_Service	Device-Info[1] Discipline I/O[1] Group[1] Pulse Converter Command Control[1] Power Control[1] AlarmCollection Event Enrollment Loop	I / O / V	I / O / V	I / O / V
Present value	PrVal	Present value	Present_Value	Pulse Converter Command Control[1] Power Control[1] AlarmCollection Loop	I / O / V	I / O / V	I / O / V
Reference value	RefVal	Reference value	Alarm_Value		I / V		
Reference values	RefVals	Reference values	Alarm_Values				I / V

SBT designations			BACnet property	Function blocks (BACnet objects)			
Long name	Ref.	Description		Other	Binary	Analog	Multistate
Reliability	Rlb	Reliability	Reliability	Device-Info Discipline I/O[1] Group[1] Pulse Converter Trend Logs Command Control[1] Power Control[1] AlarmCollection Event Enrollment Loop	I / O / V	I / O / V	I / O / V
State flag	StaFlg	State flag	Status_Flags	Device-Info Pulse Converter Command Control[1] Power Control[1] AlarmCollection Event Enrollment Loop	I / O / V	I / O / V	I / O / V
Suppress event algorithm	SupEvtDet	Event algorithm inhibit	Event_Algorithm_Inhibit	Event Enrollment			
Event time stamp	TiStmEvt	Event time stamp	Event_Time_Stamps	Device-Info[1] Discipline I/O[1] Group[1] Pulse Converter Trend Logs Command Control[1] Power Control[1] AlarmCollection Event Enrollment Loop	I / O / V	I / O / V	I / O / V
Notification function selector	NotifSel	Notification function selector [NotifSel]	Notification_Function_Selector	Device-Info[1] Discipline I/O[1] Group[1] Pulse Converter Trend Logs Command Control[1] Power Control[1] AlarmCollection Event Enrollment Loop	I / O / V	I / O / V	I / O / V

Table 33: BACnet properties

[1] Not in Desigo S7

Alarm enable [EnAlm]

[EnAlm] (Boolean type) is used to enable and disable the monitoring of OFFNORMAL alarms. OFFNORMAL alarms will only be detected if [EnAlm] is TRUE. This is equivalent to the standard BACnet property Alarm_Enable.

FAULT alarms are monitored independently of the value of the alarm enable property [EnAlm]. Monitoring is continuous and cannot be disabled.

If [EnAlm] is changed from TRUE to FALSE during operation, the timer for all deviation monitoring periods [TiMonDvn] will be reset to zero. As soon as the value of [EnAlm] reverts to TRUE, the associated [TiMonDvn] timer starts counting to its preset value again from zero.

The value of [EnAlm] can be modified via BACnet clients or using the CFC editor online. During operation, if [EnAlm] is changed from TRUE to FALSE while an OFFNORMAL alarm is still active, this will result in an immediate state transition to TO_NORMAL1. In other words, the existing OFFNORMAL alarm condition is seen as having cleared, and the alarm state of the alarm source is updated accordingly.

Enable event [EnEvt]

[EnEvt] (Boolean type) is used to enable and disable the transfer of OFFNORMAL and FAULT alarms. OFFNORMAL and FAULT alarms are only transferred if [EnEvt] is TRUE. This is equivalent to the standard BACnet property Event_Enable.

Enable event detection [EnEvtDet]

[EnEvtDet] (Boolean type) lets you turn the intrinsic/algorithmic reporting on/off. OFFNORMAL and FAULT alarms are only forwarded when [EnEvtDet] = TRUE. This is equivalent to the standard BACnet property Event_Detection_Enable.

Event state [EvtSta]

This variable denotes the current alarm state of the object. It can accept three values: NORMAL, OFFNORMAL (in the case of analog HIGH_LIMIT and LOW_LIMIT values) and FAULT. The value of the variables is updated immediately after the associated alarm state transition. This is equivalent to the standard BACnet property Event_State.

Feedback value [FbVal]

[FbVal] is a feedback signal input, configured at a physical input via a separate hardware address. This use of a physical input can also be the source of reliability errors. [FbVal] can be neither overridden nor commanded. If [FbVal] is not configured at a physical input, then, by definition, it will be equal in value to Present Value, in which case no OFFNORMAL alarms can be issued via the output object. This is equivalent to the standard BACnet property Feedback_Value.

Unlike the binary output and multistate output blocks, the analog output function block does not use [FbVal] as a criterion for OFFNORMAL alarm conditions. If [FbVal] is used, it can be a source of reliability errors and can result in FAULT alarms.

Hi limit [HiLm]

This parameter (data type Real) determines the high alarm limit. If [PrVal] exceeds the high limit value [HiLm] for longer than the period defined under [TiMonDvn], an OFFNORMAL alarm condition prevails, namely: HIGH_LIMIT.

Enable limit [EnLm]

This variable only exists in the BACnet view of analog blocks (for reasons of compatibility with the BACnet standard). It has exactly the same meaning as the alarm enable variable [EnAlm] and its current value is derived from the value of [EnAlm] (that is, [EnLm = EnAlm], Limit enable = Enable alarm). This variable is equivalent to the standard BACnet property Limit_Enable.

Low limit [LoLm]

This parameter (data type Real) defines the low alarm limit. If [PrVal] exceeds the high limit value [LoLm] for longer than the period defined under [TiMonDvn], an OFFNORMAL alarm condition prevails, namely: LOW_LIMIT. This is equivalent to the standard BACnet property Low_Limit.

Message text [MsgTxt]

For Desigo PX, the variable [MsgTxt] contains the message text of the last event notification associated with TO_OFFNORMAL, TO_FAULT and TO_NORMAL alarms.

As of Desigo V6.0 the [EvtMsg] variable provides the same function.

Deviation monitoring period [TiMonDvn]

This refers to a delay before generating the alarm if an alarm condition is detected without a prior change in switch command (that is, without a set point change). [TiMonDvn] is not an integrating function, that is, the condition causing a change in the alarm state must persist without interruption for a period of time at least equivalent to the duration of [TiMonDvn], before it has any effect. The BACnet standard only supports a [TiMonDvn] for a monitoring period and the associated alarm delay. This is equivalent to the standard BACnet property Time_Delay.

In certain applications, different end-switch monitoring periods are required for Open and Close commands and for the Idle state.

For this reason, the additional properties [TiMonOff] und [TiMonOn] have been introduced for the binary input, binary output, binary value and multistate output objects.

Switch off- [TiMonOff] and switch on monitoring period [TiMonOn]

[TiMonOff]

Delay time before an alarm is generated when there is a preceding set point enable command. This is equivalent to proprietary BACnet properties Time_Delay1 and Time_Delay2.

[TiMonOn]

Delay time before an alarm is generated in the event of a set point switch-off command.

Application: Control of fire protection dampers (see further below).

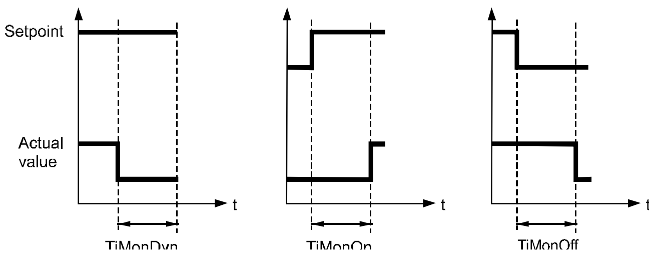


Figure 119: Monitoring period

The definitions of the set point and the measured value depend on the object type:

Object type	Set point	Measured value
Binary Input	invers [RefVal]	[PrVal]
Binary Output	[PrVal]	[FbVal]
Binary Value	invers [RefVal]	[PrVal]

Table 34: The set point and the measured value depend on the object type

Examples

The following example shows the use of the three time periods [TiMonDvn], [TiMonOn], [TiMonOff]. For another example, see Alarm Example.

It is assumed that a fire damper has two separate feedback mechanisms (end switches). This means that the damper is commanded via the commands Open and Close. The first end switch, the Open switch delivers the signals Fully open or Not fully open. The second end switch, the Closed switch delivers the signals Fully closed or Not fully closed. The following is an example of how to connect the BO (binary output for commanding and integrating the Open switch) and BI (the binary output for the closed switch):

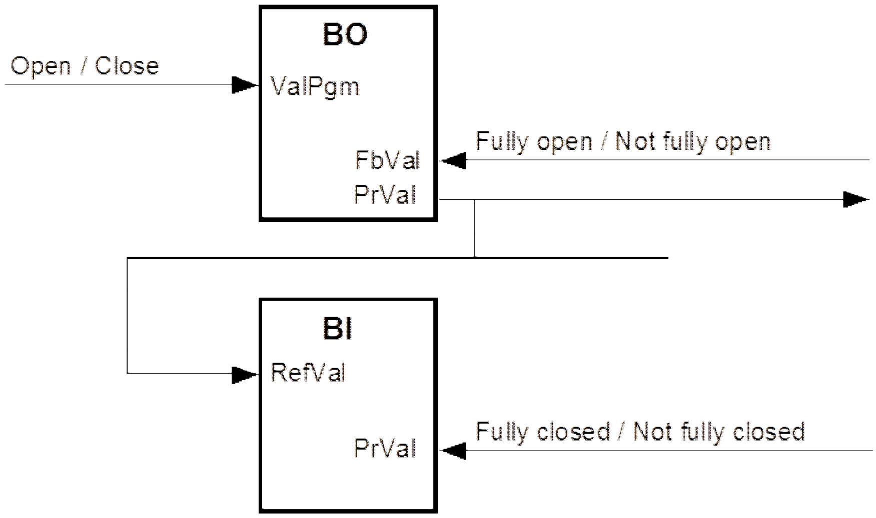


Figure 120: Fire protection damper with two end switches

Given the feedback signal [FbVal] Fully open, the Open and Close commands follow the time sequence shown below, making use of all three deviation monitoring times [TiMonDvn].

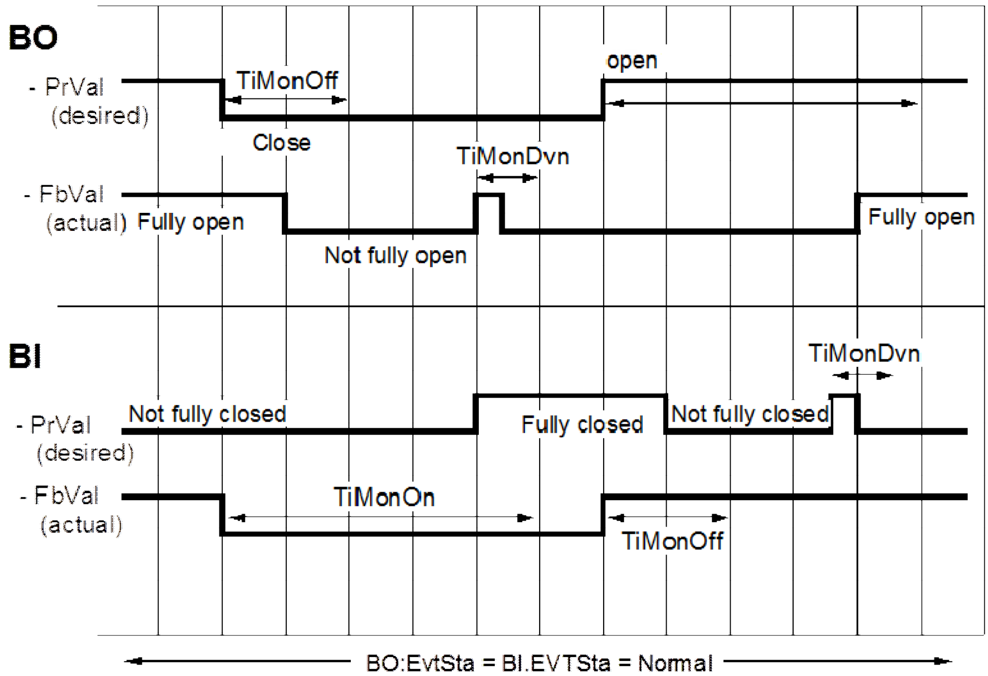


Figure 121: Time sequence

Since the BO block can handle the feedback of two different addresses, the fire-protection damper solution can be further simplified by direct connection of the Closed switch (Addr. 1) and Open switch (Addr. 2). In cases where both end switches are simultaneously On or simultaneously Off, the BO block treats the [FbVal] as invalid. Throughout this period, therefore, the alarm monitoring function will return the value Alarm = OFFNORMAL. The circuit and time sequence for normal and error conditions are as follows:

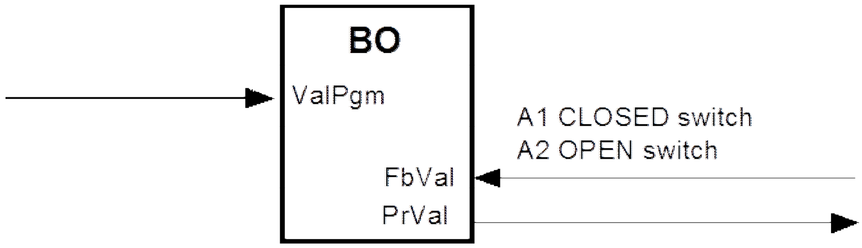


Figure 122: Circuit and time sequence for normal and error conditions

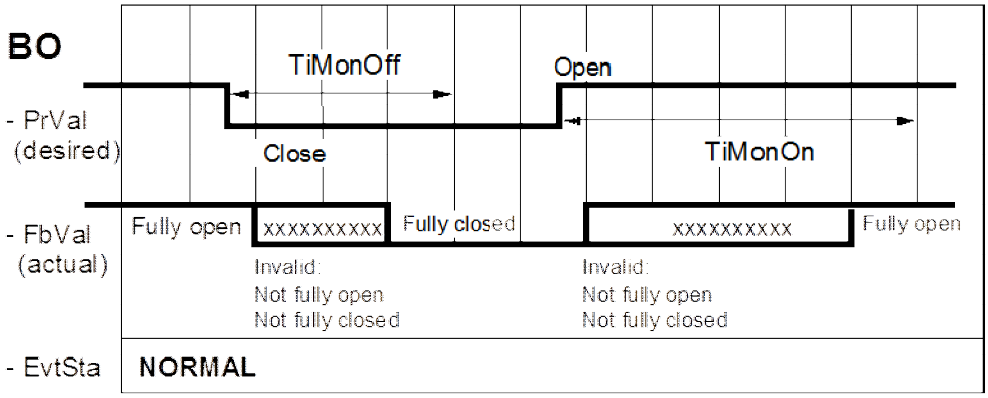


Figure 123: Fire protection damper timing with BO and two feedback addresses

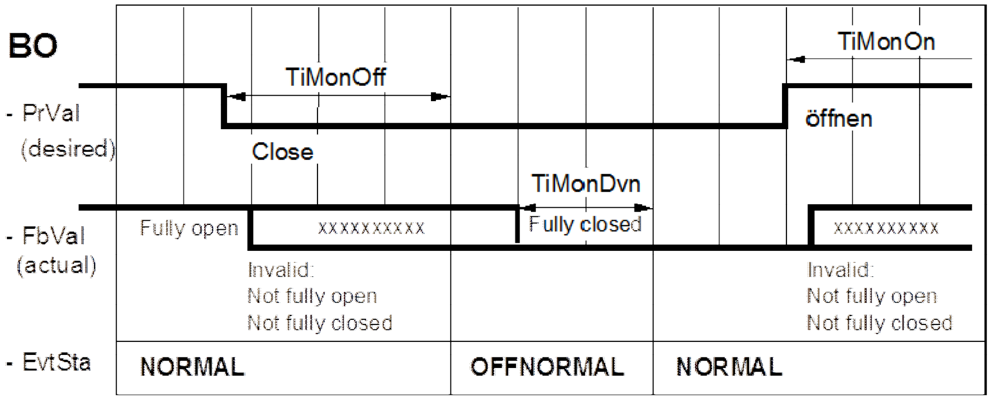


Figure 124: Fire protection damper timing with BO and two feedback addresses

Error condition: The damper does not close quickly enough.

Neutral zone [Nz]

[Nz] (data type Real) can be used to define a switching hysteresis for the state transition TO_NORMAL1. This is equivalent to the standard BACnet property Deadband.

Out of service [OoServ]

The following applies to alarm response:

[PrVal] can also change for [OoServ=TRUE].

[PrVal] is monitored for alarms irrespective of the source of any change in [PrVal]. In other words, the value of [OoServ] does not affect the monitoring of OFFNORMAL alarms. If [OoServ = TRUE], the [Rlb] property can be overwritten via BACnet. However, the alarm monitoring system responds to changes in Reliability in the same way as if [OoServ=FALSE]. This makes it possible to simulate FAULT alarms.

In the BACnet Device Info object, this Boolean variable is FALSE at the very time when the operating state is RUN, that is, when the D-MAP program is being run on the automation station. All the alarm-generating blocks (including the BACnet Device Info Object) are only monitored in the operational status RUN. Corresponds to the standard BACnet Property Out_of_Service.

Present value [PrVal]

OFFNORMAL alarms are monitored exclusively on the basis of the current value of [PrVal] the present value variable. The source of this present value (whether a process value, operator value, replacement value or commanded value) is irrelevant. This is equivalent to the standard BACnet property Present_Value.

Reliability [Rlb]

The value under [PrVal] is only plausible if [Rlb] = NO_FAULT_DETECTED.

When [Rlb] <> NO_FAULT_DETECTED, this is precisely the condition for a FAULT alarm.

The BACnet Device Info Object is an exception. The value of [Rlb] for the BACnet device object is NO_FAULT_DETECTED, except in the case of the fault FLASH_FULL (FAULT condition). This is equivalent to the standard BACnet property Reliability.

Reference value [RefVal]

[RefVal] is a set point, used to set the value which [PrVal] (the measured value) must assume in order to initiate an alarm after the time defined by [TiMonDvn] has expired. [RefVal] is equivalent to the standard BACnet property Alarm_Value.

Reference values [RefVals]

The variable [RefVals] comprises a list of multistate elements. The value range (number of states) of the items in the list is the same as for [PrVal]. All states to be treated as OFFNORMAL are entered under [RefVals]. [RefVals] is equivalent to the standard BACnet property Alarm_Values.

Example of [RefVals] : STEP 1, STEP 2, STEP 4

Name	Value
State 1	STEP 1
State 2	STEP 2
State 3	STEP 4

Table 35: Reference values

In this example, an incoming OFFNORMAL alarm will be detected if [PrVal] = STEP 1, STEP 2 or STEP 4 after expiry of the period defined by [TiMonDvn].

State flag [StaFlg]

The variable [StaFlg] includes the two bits 'In_Alarm' and 'Fault'.

By definition, In_Alarm is TRUE whenever [EvtSta] is not equal to NORMAL.

By definition, FAULT is TRUE whenever [EvtSta = FAULT].

The value of these two [StaFlg] variables is thus derived from another variable.

For each change of the variable [StaFlg] a Change of Value (COV) notification is sent to all COV subscribers of the alarm-generating object. In this way, the COV subscribers can be kept informed of an alarm state in their COV server. This is equivalent to the standard BACnet property Status_Flags.

Suppress event detection [SupEvtDet]

[SupEvtDet] (Boolean type) lets you turn the OFFNORMAL and FAULT alarm detection on/off. OFFNORMAL and FAULT alarms are only detected when [SupEvtDet] = FALSE. This is equivalent to the standard BACnet property Event_Algorithm_Inhibit.

Event time stamp [TiStmEvt]

This variable (ARRAY [3], type TimeStamp), contains time stamps for the last changes of state of the alarm-generating object TO_OFFNORMAL, TO_FAULT and TO_NORMAL. The value of the variables is updated immediately after the associated alarm state transition. This is equivalent to the standard BACnet property Event_Time_Stamps.

Notification function selector [NotifSel]

This variable specifies if the alarm function is executed as per default pattern (Simple-/Basic-/Extended alarm) or as per a customized alarm function.

8.4 Alarm Response of the Function Blocks

Alarm Collection

The default value of [EnEvt] for the Alarm Collection object is FALSE, that is, [EvtSta] transitions are not notified.

An OFFNORMAL alarm is generated when:

- The following applies to one or more alarm collection members:
  [EvtSta] <> NORMAL and applies simultaneously for all these members: [StaFlg].Fault = false.

A FAULT alarm is generated when:

- The following applies to one or more alarm collection members:
  [StaFlg].Fault = true and therefore is set [Rlb] = UNRELIABLE_MEMBERS.

Analog Input, Analog Value, Analog Output

The Analog Input, Analog Value and Analog Output function blocks all have an identical alarm handling procedure.

The analog output function block also has a feedback value [FbVal]; however, this is not used for alarm monitoring. High and low alarm limits (variables [HiLm] and [LoLm]) are set for the OFFNORMAL alarms of analog objects. An OFFNORMAL alarm occurs either when the high alarm limit is exceeded, or when the current value falls below the low alarm limit. OFFNORMAL alarms are thus subdivided into two subcategories: HIGH_LIMIT and LOW_LIMIT. In addition, the variable [Nz] can be used to define a switching hysteresis for [HiLm] and [LoLm] to prevent over-frequent switching of alarms around the alarm limit.

Alarm response

An OFFNORMAL alarm is generated:

- [PrVal] has either remained above the high alarm limit specified by the [HiLm] variable for a period of time longer than the period specified in [TiMonDvn]
- or [PrVal] has remained below the low alarm limit specified by the [LoLm] for a period of time longer than the period specified in [TiMonDvn]

An existing OFFNORMAL (HIGH_LIMIT) alarm will disappear when [PrVal] has remained below the value ([HiLm] + [Nz]) for longer than the time specified in the variable [TiMonDvn].

An existing OFFNORMAL (LOW_LIMIT) alarm will disappear when [PrVal] has remained below the value ([HiLm] + [Nz]) for longer than the time specified in the variable [TiMonDvn].

- A FAULT alarm is generated as soon as the [Rlb] property of the function block assumes any value other than NO_FAULT_DETECTED. In particular, this is the case when [Rlb] changes from a value not equal to NO_FAULT_DETECTED to another value not equal to NO_FAULT_DETECTED.
- A FAULT alarm will disappear as soon as the [Rlb] property of the function block changes from a value not equal to NO_FAULT_DETECTED back to the value NO_FAULT_DETECTED.

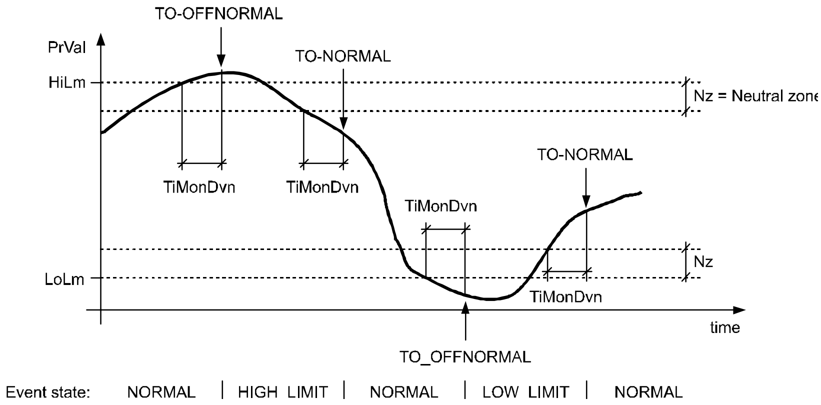


Figure 125: Alarm response

In Desigo S7 the monitoring described are not reported from the device object, but rather from an MV object.

BACnet Device Info Object

OFFNORMAL alarms

All the alarm-generating objects described so far model specific types of individual data points (physical or virtual). The BACnet device object by contrast, models the properties of an automation station as a complete entity. Alarm-relevant faults which cannot be allocated to a data point can be generated in an automation station (see the examples further below). This is why the BACnet device object includes an alarm mechanism. The alarm state machine and the alarm-related variables are essentially the same as for all the other alarm-generating block types. The difference lies in the possible causes of the alarm:

The alarm conditions described below cause the generation of an OFFNORMAL alarm in the BACnet Device Object:

Battery low

The battery in an automation station is checked periodically. An alarm is generated if the battery voltage is too low, or if the battery itself is missing. When the required voltage level is reached again, the alarm is reset with BATTERY_NOT_LOW.

RAM Pattern failed

This indicates that a memory-check error was found when the automation station was switched on. If no memory-check error is detected when the automation station is next switched on, the alarm will be reset.

Recipient not receivable

A recipient name (for example, the configured recipient of an alarm) could not be resolved, because, for example, the network connection to the recipient was interrupted. This causes an alarm to be generated. The alarm is cleared as soon as the subsequent name resolution process succeeds.

Notif. Class ref. missing

Each alarm-generating block includes a reference to a Notification Class block. If the referenced Notification Class block does not exist, the BACnet Device Object generates an alarm.

Life check error

While the life check is in progress, the primary server finds that it is unable to communicate with one or more of its backup servers (for example, owing to a network failure). This causes an alarm to be generated. The alarm is cleared when, during a subsequent life check, all the backup servers are found again.

Primary server not found

This bit is set when the backup server detects that the primary server is no longer connected to the network. At the same time a notification (data-type STRING) is sent, defining the source, target and reason. The bit is reset as soon as the backup server detects the primary server on the network again.

FAULT alarms

The condition described below causes a FAULT alarm to be generated in the BACnet Device Object:

Flash is full

The automation station checks periodically whether there is at least one free page (64 kB) in the flash memory. This bit is set if the flash memory falls below this value. The bit is reset when the flash memory contains at least one free page again.

Alarm response of the BACnet Device Object is also parameterized or depicted by the number of variables, but the display differs: The BACnet Device Object is not displayed by a D-MAP function block, but rather only visible via BACnet. The variables described are therefore only accessible as properties of the BACnet Device Object.

Binary Input and Binary Value

The alarm handling process is identical for the function blocks Binary Input and Binary Value.

- An OFFNORMAL alarm occurs when [PrVal] assumes the value specified by the variable [RefVal] for a time period at least equivalent to the delay time specified in the variable [TiMonDvn], [TiMonOff] or [TiMonOn].
- An existing OFFNORMAL alarm condition will disappear (a) when [PrVal] assumes the value complementary to [RefVal] for a period at least equivalent to the period specified in [TiMonDvn], [TiMonOff] or [TiMonOn] or (b) when [EnAlm] is changed from TRUE to FALSE (see further below).
- A FAULT alarm is generated when the [Rlb] property of the function block assumes any value other than NO_FAULT_DETECTED. In particular, this is the case when [Rlb] changes from a value not equal to NO_FAULT_DETECTED to another value not equal to NO_FAULT_DETECTED.
- A FAULT alarm will disappear as soon as the [Rlb] property of the function block changes from a value not equal to NO_FAULT_DETECTED back to the value NO_FAULT_DETECTED.

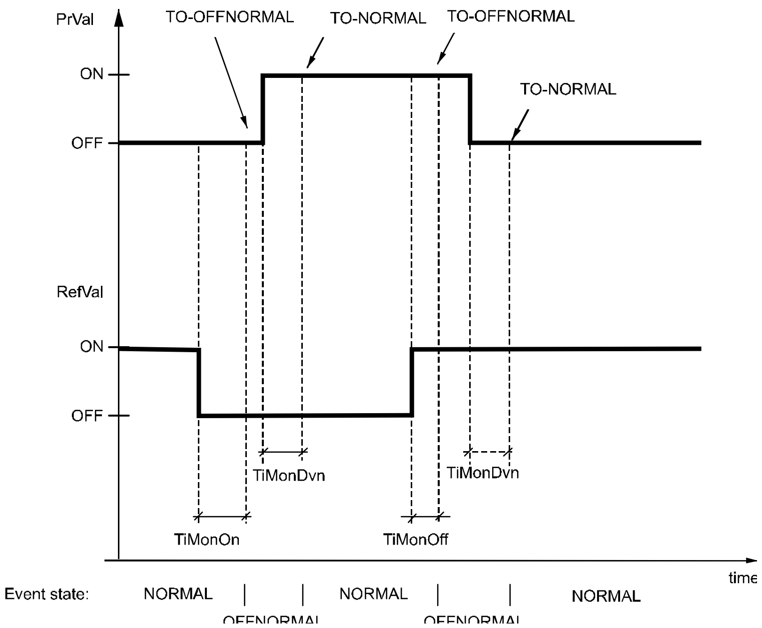


Figure 126: Binary Input and Binary Value

Binary Output

The alarm handling process in the binary output function block is essentially different from that of the binary input and binary value blocks.

- An OFFNORMAL alarm occurs when the current values of the variables [PrVal] and [FbVal] differ from each other for a time period at least equivalent to the delay time specified in [TiMonDvn], [TiMonOff] or [TiMonOn].
- An existing OFFNORMAL alarm will disappear when the current [PrVal] und [FbVal] are again identical and remain so for a period at least equivalent to the time specified in the variable [TiMonDvn].
- A FAULT alarm is generated when the [Rlb] property of the function block assumes any value other than NO_FAULT_DETECTED. In particular, this is the case when the [Rlb] property changes from a value not equal to NO_FAULT_DETECTED to another value not equal to NO_FAULT_DETECTED.

  In the case of the binary output, [Rlb] errors may originate both from the [PrVal] (or associated physical output) and from the [FbVal] (or associated physical input).
- A FAULT alarm will disappear as soon as the variable [Rlb] changes from a value not equal to NO_FAULT_DETECTED back to the value NO_FAULT_DETECTED.

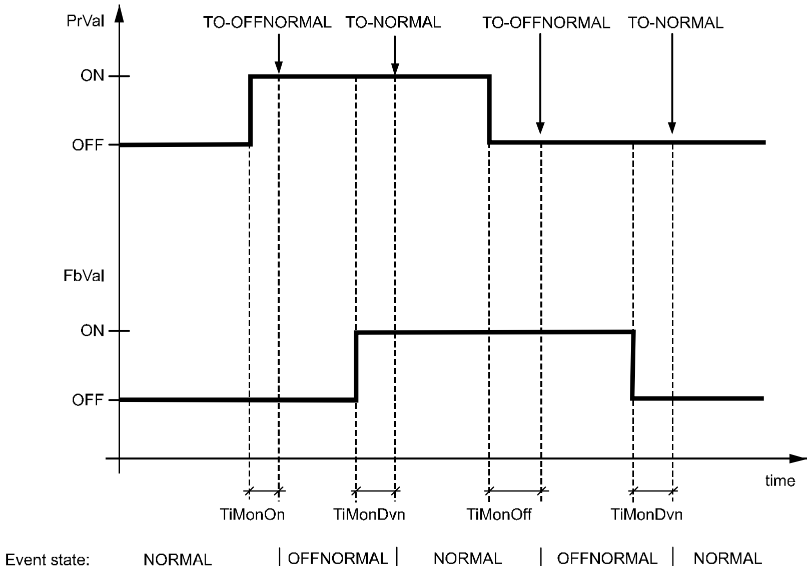


Figure 127: Binary Output

Command Control

An OFFNORMAL alarm is generated:

- A monitored, referenced object is not enabled
- A referenced object cannot be enabled

A FAULT alarm is generated when:

- A referenced object is not found
- A referenced object is not a commandable object (output object or value object)
- Invalid priorities are used for the referenced object (valid priorities are Priority 2, 5, 14 and 16)
- ProgramValue or ExceptionValue are outside the permissible range
- The referenced objects have a different number of operating modes
- The function table is empty

Discipline I/Os and Group

Alarm response

Alarm handling is identical for Discipline I/O and Group blocks. These function blocks only support FAULT alarms.

- A FAULT alarm is generated as soon as the [Rlb] property of the function block assumes any value other than NO_FAULT_DETECTED. In particular, this is the case when [Rlb] changes from a value not equal to

NO_FAULT_DETECTED to another value not equal to NO_FAULT_DETECTED.

- A FAULT alarm will disappear as soon as the [Rlb] property of the function block changes from a value not equal to NO_FAULT_DETECTED back to the value NO_FAULT_DETECTED.

The following conditions cause a FAULT alarm to be initiated:

- Address conflict:

  The subsystem fails to recognize the device defined in the [IOAddress] parameter. This alarm is issued by the associated function block.
- Communications error:

  The subsystem indicates a communications failure. This can be due to a bus open circuit or a faulty device, or, very rarely, to a communications overload on the bus. These alarms are indicated by the shared function block.

  The subsystem indicates an inadmissible response from a device for example in the case of faulty QAX… room unit. These alarms are indicated by the shared function block.

Multistate Input and Multistate Value

The alarm handling process is identical for the function blocks Multistate Input and Multistate Value.

- An OFFNORMAL alarm occurs when [PrVal] assumes one of the values specified under [RefVals] (list of multistate values) and remains at this value for a period at least equivalent to the time specified by the variable [TiMonDvn]. In particular, this applies when [PrVal] changes from one value in [RefVals] to another value in [RefVals].
- An existing OFFNORMAL alarm condition will disappear either if [PrVal] reverts to a value not contained in the [RefVals] list, and retains this value for a period at least equivalent to the period specified in [TiMonDvn], or if [EnAlm] is changed from TRUE to FALSE (see further below).
- A FAULT alarm is generated when the [Rlb] property of the function block assumes any value other than NO_FAULT_DETECTED. In particular, this is the case when [Rlb] changes from a value not equal to NO_FAULT_DETECTED to another value not equal to NO_FAULT_DETECTED.
- A FAULT alarm will disappear as soon as the [Rlb] property of the function block changes from a value not equal to NO_FAULT_DETECTED back to the value NO_FAULT_DETECTED.

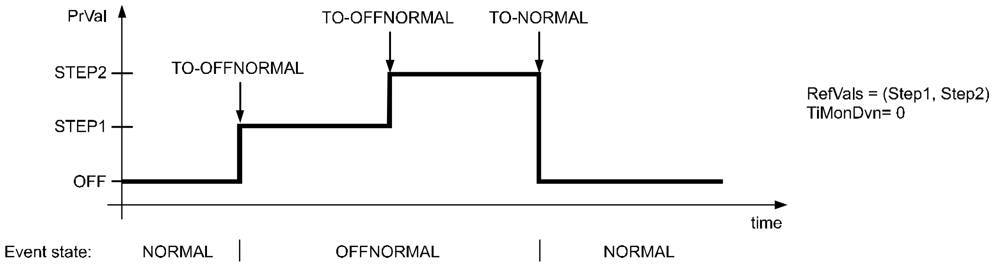


Figure 128: Multistate Input and Multistate Value

Multistate output

The alarm handling procedure for the Multistate Output function block is different from the alarm handling procedure for the Multistate Input and Multistate Value function blocks, but follows the same principles as for the Binary Output block:

- An OFFNORMAL alarm occurs when the current values of the variables [RwVal] and [FbVal] differ from each other for a time period at least equivalent to the delay time specified in [TiMonDvn].
- An existing OFFNORMAL alarm will disappear when the current [PrVal] und [FbVal] are again identical and remain so for a period at least equivalent to the time specified in the variable [TiMonDvn].
- A FAULT alarm is generated when the [Rlb] property of the function block assumes any value other than NO_FAULT_DETECTED. In particular, this is the case when the [Rlb] property changes from a value not equal to NO_FAULT_DETECTED to another value not equal to NO_FAULT_DETECTED. In the case of the multistate output block, [Rlb] errors may originate both from the [PrVal] (or associated physical output) and from [FbVal] (or associated physical input).
- A FAULT alarm will disappear as soon as [Rlb] changes from a value not equal to NO_FAULT_DETECTED back to the value NO_FAULT_DETECTED.

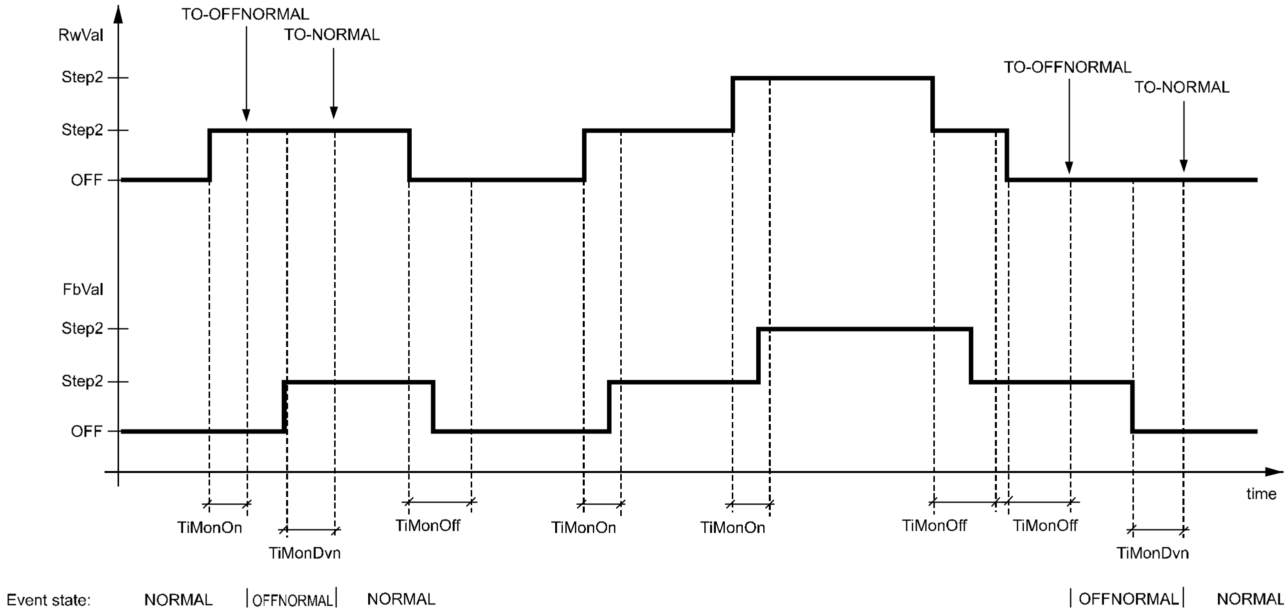


Figure 129: Multistate Output

Power Control

An OFFNORMAL alarm is generated:

- The UP command is issued but the maximum stage has already been reached
- The UP command causes MaxPower to be exceeded
- Table_No is set outside the admissible range

A FAULT alarm is generated when:

- A referenced object is not found
- A referenced object is not a multistate value object
- Object_No. is outside the admissible range
- StepLimit is outside the range of the referenced object
- The function table is empty

Pulse Converter

Alarm response

An OFFNORMAL alarm is generated, when [PrVal]:

- [PrVal] has remained above the high alarm limit specified by the [HiLm] variable for a period of time longer than the period specified in [TiMonDvn] (HIGH_LIMIT)
- or [PrVal] has remained below the low alarm limit specified by the [LoLm] variable for a period of time longer than the period specified in [TiMonDvn] (LOW_LIMIT)

An existing OFFNORMAL (HIGH_LIMIT) alarm will disappear when [PrVal] has remained below the value ([HiLm] + [Nz]) for longer than the time specified in the variable [TiMonDvn]

An existing OFFNORMAL (LOW_LIMIT) alarm will disappear when [PrVal] has remained below the value ([HiLm] + [Nz]) for longer than the time specified in the variable [TiMonDvn]

- A FAULT alarm is generated as soon as the [Rlb] property of the function block assumes any value other than NO_FAULT_DETECTED. In particular, this is the case when [Rlb] changes from a value not equal to NO_FAULT_DETECTED to another value not equal to NO_FAULT_DETECTED.
- A FAULT alarm will disappear as soon as the [Rlb] property of the function block changes from a value not equal to NO_FAULT_DETECTED back to the value NO_FAULT_DETECTED.

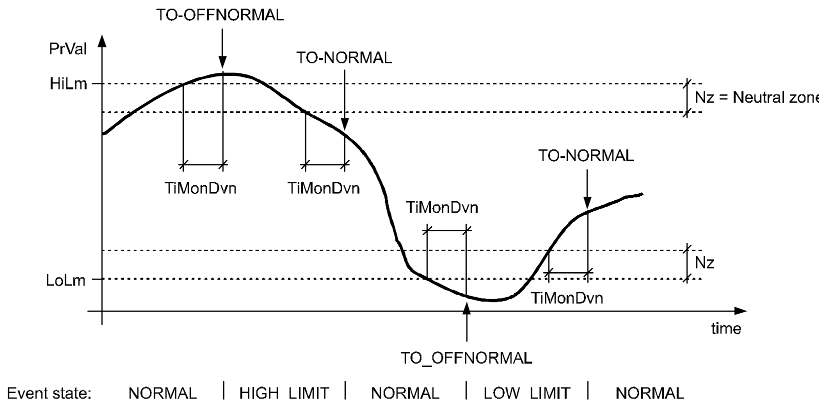


Figure 130: Pulse Converter

Trend Log

Alarm response

The Trend Log function has an Intrinsic Reporting mechanism, but does not issue OFFNORMAL alarms.

- A FAULT alarm is generated as soon as the [Rlb] property of the function block assumes any value other than NO_FAULT_DETECTED. In particular, this is the case when [Rlb] changes from a value not equal to NO_FAULT_DETECTED to another value not equal to NO_FAULT_DETECTED.
- A FAULT alarm will disappear as soon as the [Rlb] property of the function block changes from a value not equal to NO_FAULT_DETECTED back to the value NO_FAULT_DETECTED.

Event message

An event is generated when:

- The record count exceeds the record count value [RecCnt] set via the notification threshold [NotifThd], that is, the local non-volatile trend memory is overflowing.

Event Enrollment

The Event Enrollment object monitors referenced BACnet properties in other objects. The referenced property can be located in the local device or in another device.

Event algorithms

Monitoring details for a property value are defined by means of event algorithms. An event algorithm has a specific parameter. Event algorithms are the same as for Intrinsic Reporting. Intrinsic Reporting uses a subset of the possible event algorithms of Event Enrollment.

Event_Type	Event_State	Event_Parameters	Data Type
CHANGE_OF_BITSTRING	NORMAL OFFNORMAL	Time_Delay Bitmask List_Of_Bitstring_Values	Unsigned BIT STRING list of BIT STRING
CHANGE_OF_STATE	NORMAL OFFNORMAL	Time_Delay List_Of_Values	Unsigned list of BACnetPropertyStates
CHANGE_OF_VALUE	NORMAL	Time_Delay Bitmask Referenced_Property_Increment	Unsigned BIT STRING choice {BIT STRING, REAL}
COMMAND_FAILURE	NORMAL OFFNORMAL	Time_Delay Feedback_Property_Reference	Unsigned BACnetDeviceObjectPropertyReference
FLOATING_LIMIT	NORMAL HIGH_LIMIT LOW_LIMIT	Time_Delay Setpoint_Reference Low_Diff_Limit High_Diff_Limit Deadband	Unsigned BACnetDeviceObjectPropertyReference REAL REAL REAL
OUT_OF_RANGE	NORMAL HIGH_LIMIT LOW_LIMIT	Time_Delay Low_Limit High_Limit Deadband	Unsigned REAL REAL REAL
BUFFER_READY	NORMAL	Notification_Threshold Previous_Notification_Count	Unsigned Unsigned
CHANGE_OF_LIFE_SAFETY	NORMAL OFFNORMAL LIFE_SAFETY_ALARM	Time_Delay List_Of_Alarm_Values List_Of_Life_Safety_Alarm_Values Mode_Property_Reference	Unsigned list of BACnetLifeSafetyState list of BACnetLifeSafetyState BACnetDeviceObjectPropertyReference
EXTENDED	Any BACnetEventState	Vendor_Id Extended_Event_Type Parameters	Unsigned Unsigned Extended_Event_Type
UNSIGNED_RANGE	NORMAL HIGH_LIMIT LOW_LIMIT	Time_Delay Low_Limit High_Limit	Unsigned Unsigned Unsigned

Table 36: Event types and states and their parameters and data types

Event notification

An Event Enrollment object also monitors the status flag property of an object with referenced property. If the FAULT flag of the referenced object is set, the Event Enrollment object generates a Fault alarm.

Loop object

Alarm response

The Loop object contains intrinsic reporting.

An OFFNORMAL alarm occurs when:

- [XCtr] exceeds the limit (SetPoint + ErrorLimit) longer than the specified time (HIGH_LIMIT) defined in variable [TiMonDvn]
- [XCtr] drops below the limit (SetPoint – ErrorLimit) longer than the specified time (LOW_LIMIT) defined in variable [TiMonDvn]

An existing OFFNORMAL alarm (HIGH_LIMIT) disappears again when [XCtr] drops below the value (SetPoint + ErrorLimit – Deadband) longer than the specified time defined in variable [TiMonDvn].

An existing OFFNORMAL alarm (LOW_LIMIT) disappears again when [XCtr] exceeds the value (SetPoint – ErrorLimit + Deadband) longer than the specified time defined in variable [TiMonDvn].

FAULT alarm:

- A FAULT alarm occurs immediately as soon as [Rlb] of the function block has a value other than NO_FAULT_DETECTED. This is true in particular when [Rlb] changes from a value that is not equal to NO_FAULT_DETECTED to another value that is not equal to NO_FAULT_DETECTED.
- A FAULT alarm disappears immediately as soon as [Rlb] of the function block changes again from a value that is unequal to NO_FAULT_DETECTED to the value NO_FAULT_DETECTED.

8.5 Alarm Functions

Depending on the type and degree of urgency of the alarm, the system user may be required to acknowledge a change in the alarm state with an explicit operator action.

Acknowledgement

There are two types of acknowledgement:

- Acknowledgement: Confirmation of an incoming alarm
- Reset: Confirmation that an alarm is no longer present

This type of interaction can be carried out locally or with clients, via the network.

Standard pattern

There are three standard categories of alarm, or alarm functions, reflecting the type of acknowledgement required:

- Simple alarm
- Basic alarm
- Extended alarm

Each alarm source is assigned (via a Notification Class, see further below) to one alarm function only. No further distinction is made at this stage between OFFNORMAL and FAULT alarms.

Simple alarm

Neither incoming alarms (disturbance appears) nor disappearing alarms (disturbance disappears) require acknowledgement.

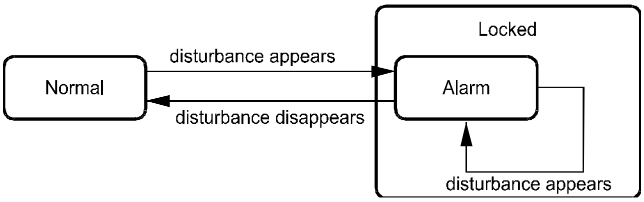


Figure 131: Simple alarm

Basic alarm

Acknowledgment is required for incoming alarms only, but not for alarms that have been cleared (that is, acknowledgement required but not reset).

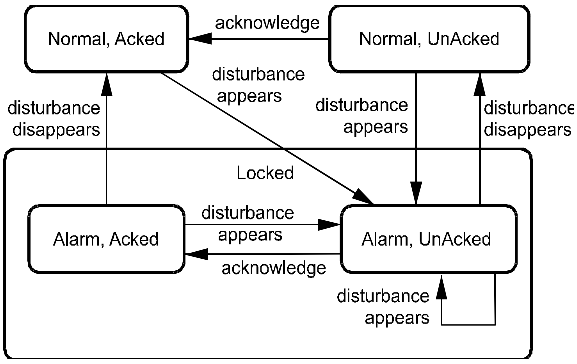


Figure 132: Basic alarm

Extended alarm

Locking alarm with acknowledgement of incoming alarms (disturbance appears) and cleared alarms (disturbance disappears). Alarms in this category require both acknowledgement and reset.

While testing the system, it may not be possible to reset an alarm. The reason is that an Extended Alarm is not reset until it has been acknowledged, and the time delay has expired.

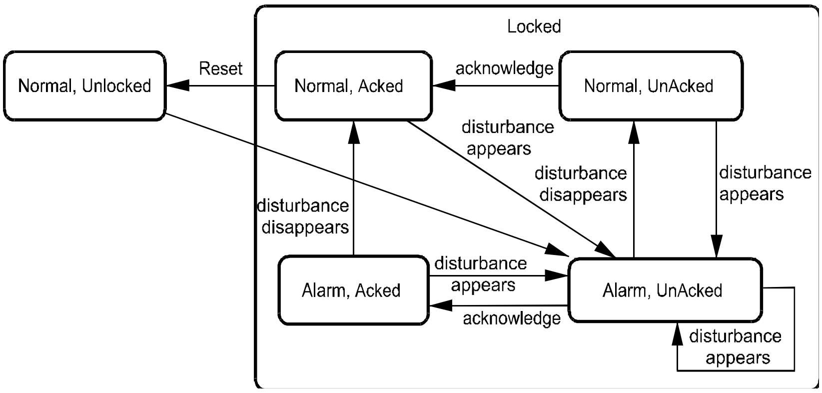


Figure 133: Extended alarm

Key:

The alarm remains locked until the fault has disappeared and has been acknowledged and a reset has been carried out. For example:

The burner system is restarted when the service engineer has acknowledged the alarm, cleared the fault and reset the alarm. The alarm state of every alarm-generating object is managed within the object itself. The state machines above illustrate this for each of the alarm functions.

Simple message

The alarm function simple message is the same function as the simple alarm. State transitions, however, are not indicated as events, but alarms.

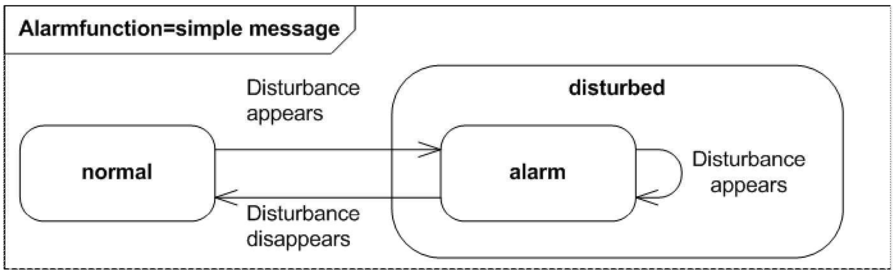


Figure 134: Alarm source with Simple message alarm function

For HVAC applications and response in the system, the functionality is identical to simple alarm: Simple alarm without acknowledgement of incoming and outgoing faults. The only difference is EventNotification as alarm or event.

Customized alarm

Any alarm function under BACnet can be used. The following behavior can be defined for customized alarms:

- EventNotification can occur as either event or alarm
- Acknowledgement: For each change of state (TO-OFFNORMAL, TO-NORMAL, and TO-FAULT) can be defined whether or not an acknowledgement is required.

[AckTra] Acknowledged transitions

This feature is used to represent the acknowledgement status, or to handle information about which state transitions currently still require acknowledgement. The value of [AckTra] is based on the alarm function, the current [EvtSta] and the monitoring of acknowledgements already received.

[AckTra] consists of three flags, one each for TO-OFFNORMAL, TO-NORMAL and TO-FAULT. The flags have the following meanings:

- The flag is always FALSE when there has been a relevant state transition and an acknowledgement is required, because this is a requirement of the alarm function and no acknowledgement has yet taken place.
- The flag is TRUE when no acknowledgement of the state transition is required. This may be the case because the alarm function does not require acknowledgement, or because no state transition has occurred, or because a state transition that has occurred has already been acknowledged.

[TiAck] Time of acknowledgement

Time of the last acknowledgement (time stamp).

8.6 Alarm Management by Notification Class

Intrinsic reporting

With intrinsic reporting, the alarmable object itself assumes alarm identification and state machine for alarm handling. However, the subsequent distribution of alarm messages to alarm clients (for example, the PXM20 operator unit) and the alarm management is no longer the responsibility of the alarm source itself, but of a Notification Class object assigned to the alarm source. The Notification Class object is both a D-MAP function block and a standard BACnet object, which contains all the information required for the distribution of alarms and system events within the system.

Algorithmic reporting

With algorithmic reporting, alarm detection and the state machine for alarm handling normally are taken over by the Event Enrollment object. In this case, alarm management also is set up in an alarm source via assigned Notification Class object.

Notification Class

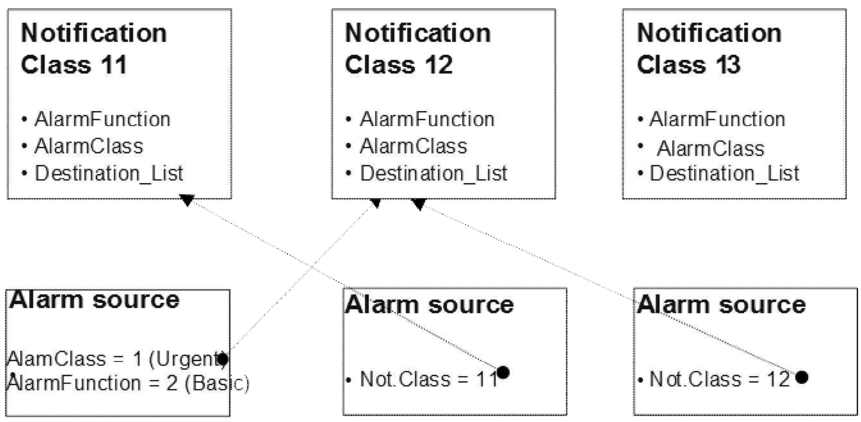


Figure 135: Alarm management by notification class

Each alarm-generating object is assigned one notification class [NotifCl] only, but one notification class can be used by more than one alarm-generating object. This makes it possible to create a Notification Class object for each group of alarms (for example, HVAC alarms, fire alarms etc.). Each alarm source in a given alarm group is assigned to the [NotifCl] for that group.

There are global and local notification class objects:

- Global notification class: One set of max. 18 global notification class objects per site. Global notification classes are replicated and thus exist on all Desigo PX of a site in identical form.
- Local notification class: On Desigo PX, local notification classes can be engineered, but are NOT replicated.
- Desigo Room Automation supports exclusively local notification classes.

Interface definition

The notification class function block [NotifCl] is the means by which functionality is transferred from the BACnet standard into the CFC environment.

Figure 136: Function block

This function block contains the instance number of the Notification Class (an integer). which must be identical to the value entered in the subordinate alarm sources. This makes it possible to create a unique reference.

The number must not be modified online.

In Desigo S7 all Notification Classes are compiled in a function block.

Notification class number

There are 18 predefined global notification classes. The notification class is identified with the two independent variables AlarmFunction and AlarmClass, and referenced in the alarm source:

- AlarmFunction [Simple(1), Basic(2), Extended Alarm(3)]
- AlarmClass [UrgentAlarm (1), HighPrioAlarm (2), NormalAlarm (3), LowPrioAlarm (4), UserDefinedAlarm (5) and OffLineTrend (6)]

Formula

The notification class number is calculated as follows:

NotificationClass# := 10 * AlarmClass + AlarmFunction

This gives the following notification classes:

AlarmClass	AlarmFunction	Priority (default values) To-Offnormal To-Fault To-Normal	Uses	NotificationClass# (derived)
			Highly critical alarms, system messages, device info object	
UrgentAlarm	Simple	1, 1, 5		11
UrgentAlarm	Basic	1, 1, 5		12
UrgentAlarm	Extended	1, 1, 5		13
			Critical alarms	
HighPrioAlarm	Simple	2, 2, 6		21
HighPrioAlarm	Basic	2, 2, 6		22
HighPrioAlarm	Extended	2, 2, 6		23
			Normal alarms	
NormalAlarm	Simple	3, 3, 7		31
NormalAlarm	Basic	3, 3, 7		32
NormalAlarm	Extended	3, 3, 7		33
			Non-critical alarms	

AlarmClass	AlarmFunction	Priority (default values) To-Offnormal To-Fault To-Normal	Uses	NotificationClass# (derived)
LowPrioAlarm	Simple	4, 4, 8		41
LowPrioAlarm	Basic	4, 4, 8		42
LowPrioAlarm	Extended	4, 4, 8		43
			As project-specific alarms for special applications	
UserDefinedAlarm	Simple	5, 5, 9		51
UserDefinedAlarm	Basic	5, 5, 9		52
UserDefinedAlarm	Extended	5, 5, 9		53
			Offline trends The To-Normal priority must be such that it is less than or equal to the Alarm Priority Limit of the device object (for Remote Mgmt)	
OffLineTrend	Simple	2, 2, 2		61
OffLineTrend	Basic	2, 2, 2		62
OffLineTrend	Extended	2, 2, 2		63

Table 37: Notification classes

Project-specific notification classes can be defined in addition to predefined ones. Alarm classes 7...16 are intended for this purpose. The associated calculation of a notification class number is identical to calculation of predefined notification class numbers.

Customized alarms can be engineered in Desigo PX. In this case, the value for a notification class number can be defined without restrictions.

Priority [Prio]

This defines the alarm priority on the basis of which alarm and system events are to be transmitted to the receivers. Every transition can be described individually with this BACnet property, data type ARRAY of INTEGERS [TO_OFFNORMAL; TO_FAULT; TO_NORMAL]. Priority levels can range in value from 0 to 255. The lower the value, the higher the priority. In Desigo only priorities 1 to 9 are used.

Alarmfunction [AlmFnct]

Alarm function types: Simple, Basic or Extended. [AlmFnct] is only supported by Desigo PX.

Destination list [RecpList]

The configured (permanent) alarm recipients, the week days, and the time window in which the alarm recipient is operated, are entered here. [RecpList] is equivalent to the standard BACnet property Recipient_List.

Destination list [DestLi]

This is where the configured (permanent) alarm receivers are entered, together with the days of the week and the time-window in which the alarm receiver is operated. [DestLi] is only supported by Desigo PX.

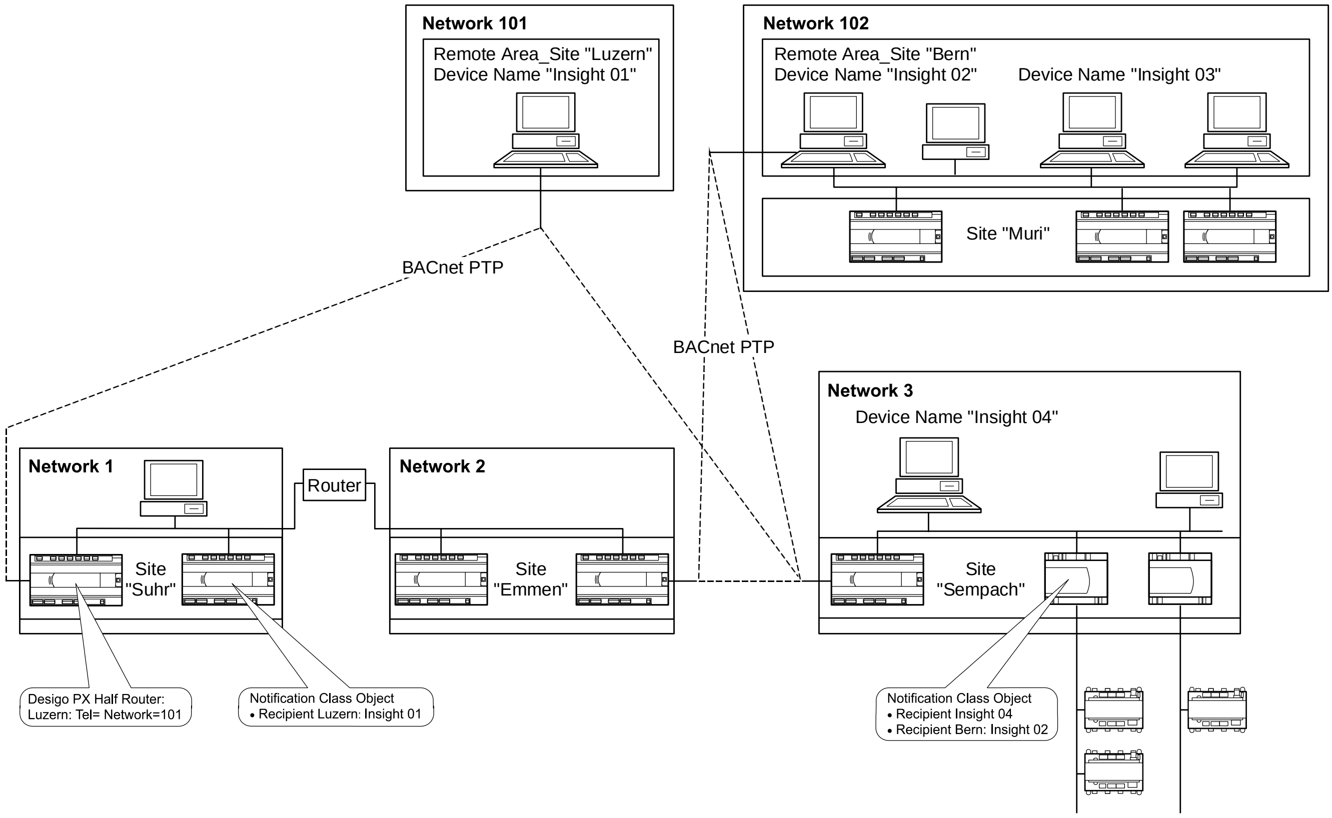


Figure 137: Allocation of operator units to a remote area site

Operator units:

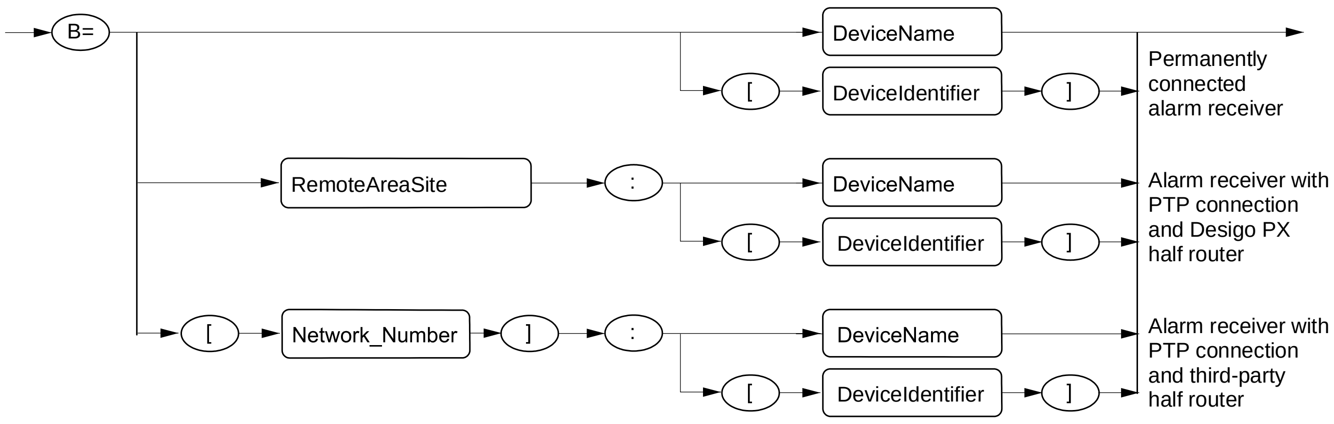
- Permanently connected operator units (and hence, alarm receivers) are addressed by their Device Name.
- Operator units (and hence alarm receivers) with a point-to-point connection (PTP connection) are addressed with a Remote Area Site identifier and their Device Name. For example:

  B=fff for permanent connection

  B=kkk:aa for point-to-point connection (PTP connection)
- Adjustments are required during the addressing process so that there is no conflict between the names of operator units and the plant or room management designations.

Permanent and point-to-point connections:

- For alarm receivers, the address syntax (see further below) indicates the type of connection: permanent or PTP connections.
- Desigo PX automation stations with half-routers must know the Remote Area Site designators of their remote alarm receivers to enable an PX automation station to resolve the remote alarm receiver designator.



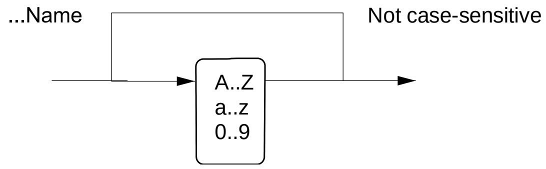


Figure 138: Alarm receiver syntax

Element	Description
DeviceName	Device name. In plain text so that the user can understand it. Example: Insight1
DeviceIdentifier	Device Identifier. Alternative syntax for the alarm receiver of a third-party manufacturer. If the alarm receiver has a special address range or if DeviceName does not work. Example: [13456]
RemoteAreaSiteName	Remote area site name. In plain text so that the user can understand it. Example: Chur
NetworkNumber	Network number. Required with a third-party half router. Example: [3]

Table 38: Alarm receiver syntax

8.7 Alarm Routing over the Network

Alarm server and alarm clients

Alarm servers are entities capable of producing an alarm. Alarm clients are entities capable of receiving an alarm.

There are two types of alarm client: temporary alarm receivers and pre-configured alarm receivers. The following concept for temporary alarm recipients is only valid for Desigo PX.

Temporary alarm receivers

Temporary alarm receivers are not defined at the engineering stage. They can be connected to or removed from the network at any time during operation. If a temporary alarm receiver is connected to the network, it will perform the following activities for every alarm server:

- The alarm recipient enters its address in the BACnet property recipient list [RecpList] of the BACnet device object of the automation station, using the BACnet service AddListElement.
- Read information about all currently existing alarms, and all currently outstanding acknowledgements, from the automation station (BACnet service

GetEventInformation). This ensures that the alarm receiver – irrespective of when it was connected – displays the current alarm status of the system.

After making these entries, the temporary alarm receiver, while connected, will receive all alarm messages from the automation station in accordance with the routing mechanisms described below.

If an automation station cannot transfer an alarm message to a temporary alarm receiver (for example, because it is no longer connected to the network), the address of the receiver concerned will be removed from the [RecpList]. All alarm messages destined for that receiver will then be deleted.

Preconfigured alarm receivers

The preconfigured alarm receivers are entered in the notification class object:

- In the [DestList] for Desigo PX
- In the [RecpList] for Desigo Room Automation

Time response in the network

The routing of all alarm and acknowledgement ,messages between the alarm server and the alarm clients takes place over the BACnet network using special BACnet services. These are:

- Confirmed Event Notification for all changes in the alarm state of an alarm-generating object (TO_OFFNORMAL, TO_NORMAL, TO_FAULT), and for messages via local acknowledgements. Direction: Direction: From alarm server to alarm client.
- AcknowledgeAlarm for the routing of acknowledgements (including reset) performed by the user on an alarm client. Direction: From alarm client to alarm server.

The two services are referred to as Confirmed Services, that is, the receiving device always confirms the receipt of a service by immediately returning a SimpleAck message. This tells the transmitting device that its message has been received by the receiving device. If no SimpleAck message is received, the transmitting devices tries to send the message again (up to three times).

An alarm is always issued by one (and only one) alarm server. Generally, however, there will be several alarm clients on the network. To maintain consistency, all alarm clients must always display the same alarm state. For this reason, all alarm-related functions must always be routed to all the alarm clients. The procedure is the same for both temporary and pre-configured alarm receivers.

The following time-diagrams describe the communications via the network for the various alarm-related events.

Change of alarm state

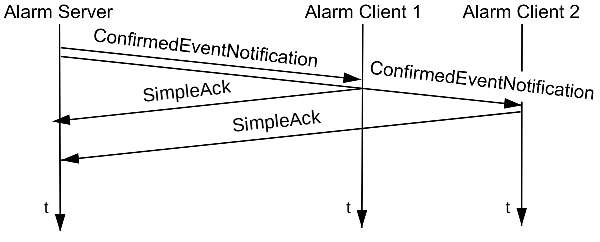


Figure 139: Change of alarm state

This procedure is carried out for every change in alarm state on an alarm server: TO_OFFNORMAL, TO_FAULT und TO_NORMAL. The data record Confirmed Event Notification contains the following information:

- BACnet address of the alarm server
- Object ID of the alarm-generating object
- Time stamp
- Alarm priority
- Initial and final state of the transmitted state transition (this is used to determine whether the state transition is TO_OFFNORMAL, TO_FAULT or TO_NORMAL)

- Acknowledgement required [AckReq]: Does the notified state transition require acknowledgement or not?
- Alarm text
- Other technical details

Based on this information, the alarm client can present the alarm in a comprehensible way; it may also read additional information automatically from the alarm server, and if required, return any acknowledgement to the correct address.

If a temporary alarm receiver does not confirm receipt with a SimpleAck message (via the Confirmed Event Notification input), the alarm server will try three times more to transmit the alarm to the relevant alarm receiver. The message for this alarm client will then be lost and its reference will be deleted from the [RecpList] of the BACnet device object.

Alarm acknowledgement over the network

This process is performed for all acknowledgements made on an alarm client.

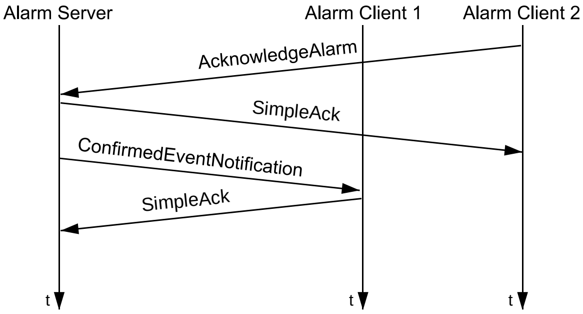


Figure 140: Alarm acknowledgement over the network

Acknowledge and reset

The alarm can be acknowledged by any alarm client. The AcknowledgeAlarm data record contains information as to which alarm is being acknowledged and other details related to this alarm and the acknowledging alarm client. The alarm acknowledgement is confirmed with a SimpleAck message by the alarm server which generated the alarm. All other alarm clients in the network will be sent a Confirmed Event Notification to notify them of the alarm acknowledgement. They, in turn, will send a SimpleAck message to acknowledge the receipt of this notification, the objective being to ensure that all clients have up-to-date and consistent information.

Local alarm acknowledgement

Alarms can also be acknowledged and reset locally on the alarm server. The alarm is acknowledged internally in the alarm server that generated the alarm. Confirmed Event Notifications are now transmitted to all alarm clients, to notify them that the alarm has been acknowledged. The alarm clients, in turn, send a SimpleAck message to acknowledge their receipt of the Confirmed Event Notification.

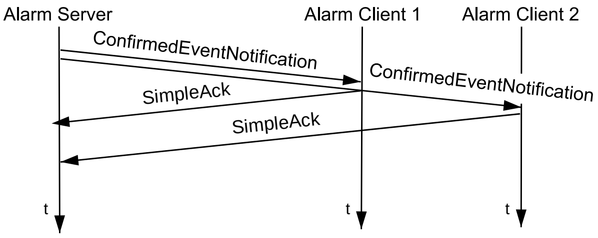


Figure 141: Local alarm acknowledgement

Disabling the routing of alarms

Each alarm-generating object has an [EnEvt] parameter (data type: Boolean). Alarm messages (and system events) are only transmitted over the network if [EnEvt=TRUE]. This does not affect the alarm monitoring of the object, that is, the alarm state machine is always kept up to date.

8.8 Alarm Queuing

Until they have been forwarded to all the pre-configured alarm recipients, all alarm messages are normally stored in the automation station.

Each automation station has its own alarm queue for this purpose. Each incoming alarm and each system event is entered in the queue. An entry remains in the queue until the alarm or system event has been sent with a confirmed event notification to all recipients listed in the notification class object, and until the relevant acknowledgements have been received.

If the queue is full to overflowing, the oldest entries are deleted automatically, and a system event message is generated. Entries are deleted irrespective of alarm priority.

Alarm queuing has no effect on the alarm state of the alarm source.

Alarms destined for a temporary alarm recipient are not saved in the automation station. If a temporary alarm recipient can no longer be reached, the address of the recipient concerned is removed from the [RecpList] of the device object.

BACnet device object properties

The queuing of alarms is controlled by the following BACnet properties in the device object of the Desigo PX automation stations. These properties are not mapped to a function block, and can therefore only be viewed and modified online.

Buffer size [BufSize]

This BACnet property defines the maximum number of entries which can be saved in the queue.

A new value will only be accepted if it is greater than the record count [RecCnt].

Buffer size [BufSize] of the alarm queue.

- Default = 100 (PXC) or 150 (PXR)
- Range = 10…500 depending on the available memory space

Record count [RecCnt]

This BACnet property represents the number of entries currently stored in the queue.

The alarm queue can be deleted by writing the value 0 to this property. A write of a value not equal to 0 results in an error message.

If the queue is deleted, this information is entered as a system event in the queue and transmitted to the receivers. This causes the value to change to 1 as soon as [RecCnt] is set to zero.

Notification threshold [NotifThd]

This BACnet property defines the dial-out threshold, and the number of alarms to be deleted in the event of a queue overflow.

If [RecCnt] is greater than or equal to [NotifThd], a connection is established with any alarm recipients connected by cable (modem) which are destined to receive alarms and events from the queue. The connection is established provided that the remote alarm recipient concerned is listed in the notification class object.

The message threshold also defines how many alarms are to be deleted in the event of a queue overflow. As many alarm entries are deleted as necessary until [RecCnt] is equal to [NotifThd]. This function does not distinguish between local and remote alarm recipients in the notification class object.

To avoid deleting too many alarms, it is recommended that [NotifThd] be set to approximately 80% of the [BufSize].

Alarm queue message threshold [NotifThd]:

- Default = 80 (PXC) or 130 (PXR)
- Range = 5…495

Alarm priority limit [PrlmAlm]

This BACnet property defines another independent threshold for dial-out.

An alarm priority which is less than or equal to [PrlmAlm] results in a connection with any alarm recipients connected by cable (modem) which are destined to receive alarms and events from the queue. The connection is established provided that the remote alarm recipient concerned is entered in the list of Notification Class objects.

Alarm priority limit [PrlmAlm]:

- Default = 2 (HighPrioAlarm or UrgentAlarm)
- Range 0…255

If the notification class object contains only local alarm recipients, then the optimum results are achieved by use of the default values for control of alarm queuing. The default values should therefore not be changed.

If the notification class object contains remote alarm recipients, then it may be appropriate to modify the default values for control of alarm queuing.

The values for [NotifThd] and [PrlmAlm] determine when a remote cable connection (modem) is to be established, in order to inform the user of the occurrence of alarms.

If low-priority alarms are to be forwarded immediately, the [PrlmAlm] value must be increased (the higher the number, the lower the alarm priority). The value for [NotifThd] must not be modified.

The value for [NotifThd] can be reduced, however, in cases where a connection is to be established when there is a smaller number of alarms in the alarm queue. It is important to ensure, however, that the difference between [BufSize] and [NotifThd] does not become too great, as this is the value that controls the deletion of alarms in the event of a queue overflow.

Note that modifying these values also affects connection costs.

It takes time to establish a connection by cable (modem). If it is likely that further alarms will occur during this time, thereby causing the queue to overflow, the difference between [BufSize] and [NotifThd] should be increased.

The following settings are recommended:

- Buffer size [BufSize] = 120
- Notification threshold [NotifThd] = 80

In cases of doubt, the default values should be left unchanged.

The parameters are hardcoded in Desigo S7 and not mapped in BACnet. A project-specific modification is not required since only Ethernet-IP networks are supported.

8.9 Common Alarms

The BACnet object alarm states InAlarm, Unacked and Unreset are grouped in the following blocks:

- The CommonAlarm block for Desigo PX
- The CommonEvent block for Desigo Room Automation

The difference between CommonAlarm and CommonEvent is, that the CommonAlarm block supports Intrinsic Reporting. The alarm detection and notification of the CommonEvent block is handled by a special Event Enrollment object called CommonEventEnrollment. The CommonEventEnrollment block also handles the common alarm reset / ack and common manual intervention functions.

All alarms generated by alarm-generating BACnet objects on the same chart level or subordinate charts are automatically grouped into a common alarm. There is therefore no need for the user to create a common alarm by establishing links or interconnections. The engineering process simply involves placing the block at the required chart level. No other configuration steps are necessary.

Common alarm reset / ack

Similarly, all the alarms covered by this block can be the subject of a common alarm reset and acknowledge.

Acknowledging the common alarm object is equivalent to acknowledging all objects on the same and lower levels in the hierarchy.

Resetting the common alarm object is the equivalent to resetting all objects on the same and lower levels in the hierarchy.

Common manual intervention

The same common alarm object also uses the status flag Overridden to indicate the manual operation of one or more of the BACnet objects (with [StatFlag] override facilities) on the same or a lower chart level. Manual intervention are determined on the properties: Out of service [OoServ], overridden, commanding to Prio 7 (manual switch) and Prio 8 (operator).

This diagram shows the practical application of the common alarm object within the technical hierarchy. The common alarm object in the partial-plant compound encompasses all the alarms of this partial plant. The higher-level common alarm encompasses the alarms of both partial plants.

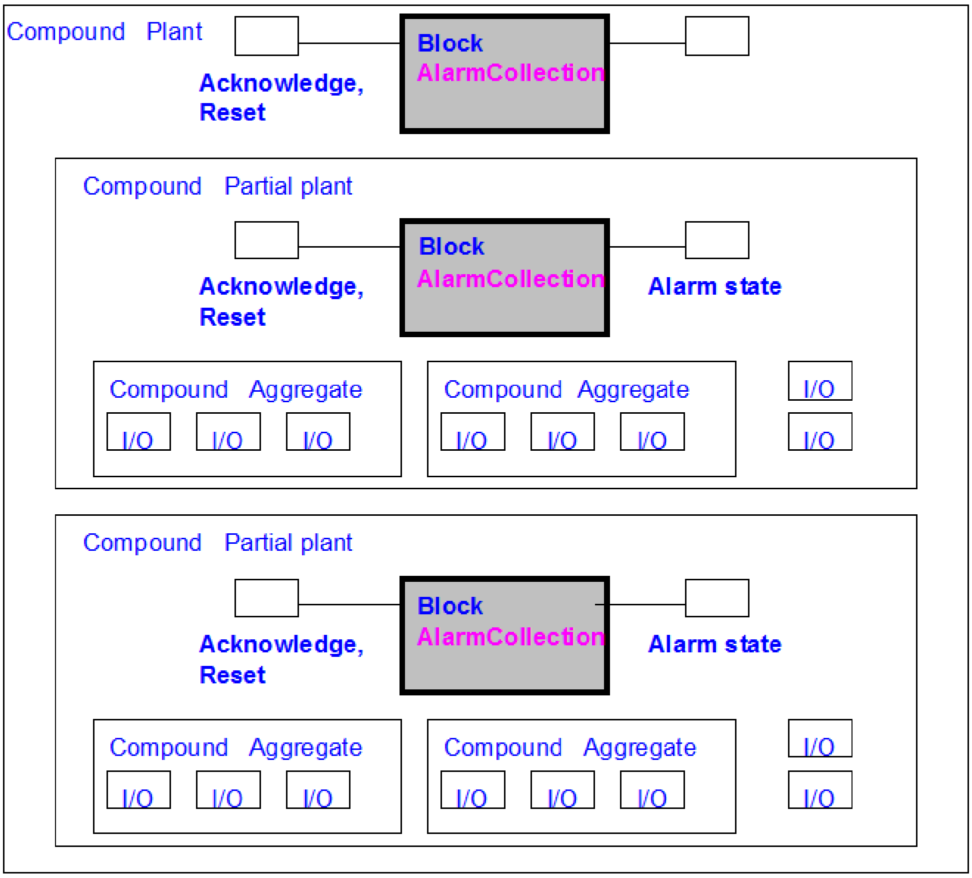


Figure 142: Common alarm object

In Desigo S7 the Common Alarm block in the CFC is nested with the block generating the alarm.

8.10 Alarm Suppression

Alarm suppression refers to suppression of alarm and event notifications in the Desigo system. Thus, sending BACnet event notifications is suppressed. Alarm suppression does NOT prevent detection of alarm states.

Alarm suppression types

The following types of alarm suppression exist in Desigo:

- Alarm suppression by automation station using function block AS_STA allows for implementing alarm suppression at the automation station level.
- Hierarchical alarm suppression is made possible via the common alarm object based on the structure of the technical view.
- Specific alarm suppression: All alarmable objects offer alarm suppression by object.
- Exceptions for alarm suppression: Each alarmable object has a pin SupEcpt. This pin allows for defining exceptions to hierarchical alarm suppression.

Validity for alarm suppression

All types of alarm suppression apply to Desigo PX. Desigo Room Automation devices can generate and suppress alarms. Alarming for Desigo Room Automation devices without their own alarming is ensured in Desigo PX via Event Enrollment objects. General types of alarm suppression of Desigo PX apply to the Event Enrollment objects.

Alarm suppression by automation station

AS_STA (Device Access) is a Desigo PX function block that allows to suppress all alarms of an automation station. The function block allows for suppressing BACnet event notifications by means of an application. Thus, sending of alarms and events during, for example, maintenance, can be suppressed, for example, via a key switch.

Alarm suppression is controlled via pin SupEvt. The following values are defined for SupEvt:

- true: The automation station sends NO BACnet event notifications.
- false: The automation station sends BACnet event notifications.

For more information on function block AS_STA, see *Desigo Firmware blocks, automation level, Overview* (CM110749) and *Desigo Vxx Firmware blocks* (CM110729).

Desigo Room Automation supports the suppression of all alarms of an automation station. To do this, it uses the device infrastructure objects CommonEvent and CommonEventEnrollment.

Hierarchical alarm suppression

Hierarchical alarm suppression allows for suppressing alarms of a plant, partial plant, aggregate, component, or subcomponent. Hierarchical suppression is based on suppressing alarms of any part of a partial tree in the technical structure.

For Desigo PX hierarchical alarm suppression is carried out via the Alarm Collection (CMN_ALM) object. CMN_ALM comprises all alarmable BACnet objects as a group on the same or lower hierarchies in the technical view. Thus, CMN_ALM allows for controlling alarm suppression for all alarmable BACnet objects of a group.

Alarm suppression is controlled via pin SupEvt. The following values are defined for SupEvt:

- true: Alarmable BACnet objects of a group do NOT send BACnet event notifications.
- false: Alarmable BACnet objects of a group send BACnet event notifications.

Desigo Room Automation supports the hierarchical suppression of alarms. It uses the CommonEvent and CommonEventEnrollment objects.

The CommonEvent object aggregates the alarm state of all BACnet objects on the same or the lower hierarchy levels of the technical view.

The CommonEventEnrollment object monitors the CommonEvent object. The hierarchical alarm suppression can be turned on or off in the CommonEventEnrollment object.

Specific alarm suppression

All alarmable BACnet objects allow for specific suppression. Each alarmable BACnet objects offers pin EnEvt for this type of alarm suppression.

The following values make sense for EnEvt:

- (False, False, False): The object sends NO BACnet event notification.
- (True, True, True): The object sends BACnet event notification.

Value combinations with True and False for EnEvt should be avoided.

Alarm suppression exceptions

A possible application is to activate alarm suppression during plant maintenance. Vital alarms must be excepted from alarm suppression.

For Desigo PX exceptions can be defined for hierarchical alarm suppression with CMN_ALM.

Function block CMN_ALM has pin EnSupEcp. This exception specifies if exceptions are possible within the alarmable BACnet objects of the group. The following values are defined for EnSupEcp:

- true: Exceptions for alarm suppression within the group of alarmable BACnet objects are considered.
- false: Exceptions for alarm suppression within the group of alarmable BACnet objects are NOT considered.

Each alarmable BACnet object can be exempted from hierarchical alarm suppression with CMN_ALM. To do this, each alarmable BACnet object has pin SupEcpt. The following values are defined for SupEcpt:

- true: The object is considered as an exception for alarm suppression.
- false: The object is NOT considered as an exception for alarm suppression.

Combination of multiple alarm suppressions

The above options to suppress alarms can overlap. For an object impacted already by multiple types of suppression, the following rule applies: One type of alarm suppression cannot be overridden by another type of alarm suppression.

The following table shows combinations of different alarm suppression types:

AS_STA. SupEvt	CMN_ALM. SupEvt	CMN_ALM. EnSupEcp	FB.SupEcpt	FB.EnEvt	Resulting alarm suppression for function block
True	•	•	•	•	suppressed
•	•	•	•	(F, F, F)	suppressed
False	False	•	•	(T,T,T)	not suppressed
False	True	False	•	(T,T,T)	suppressed
False	True	True	True	(T,T,T)	not suppressed
False	True	True	False	(T,T,T)	suppressed

Table 39: Alarm suppression

8.11 Alarm Message Texts

Desigo contains all the alarm texts necessary to help the user maintain an overview and an understanding of the alarms. These alarm texts can be freely defined in the engineering tool for each alarm source individually. If this is not done, text will be generated automatically on the basis of the Technical Designation of the individual function blocks. In a third category are the predefined alarm texts used in conjunction with device faults.

Configured alarm message texts

The Desigo system supports alarm message texts.

For Desigo PX the message texts for TO_OFFNORMAL, TO_FAULT and TO_NORMAL alarms are entered as an Array [3] in the BACnet property [Message_Text]. For Desigo Room Automation the BACnet Property Event_Message_Texts_Config is used.

For Desigo PX if no alarm message text has been entered for an alarm source, or if the alarm message text for a given state (for example, TO_FAULT) has been left blank, an alarm message text will be generated from the existing descriptions.

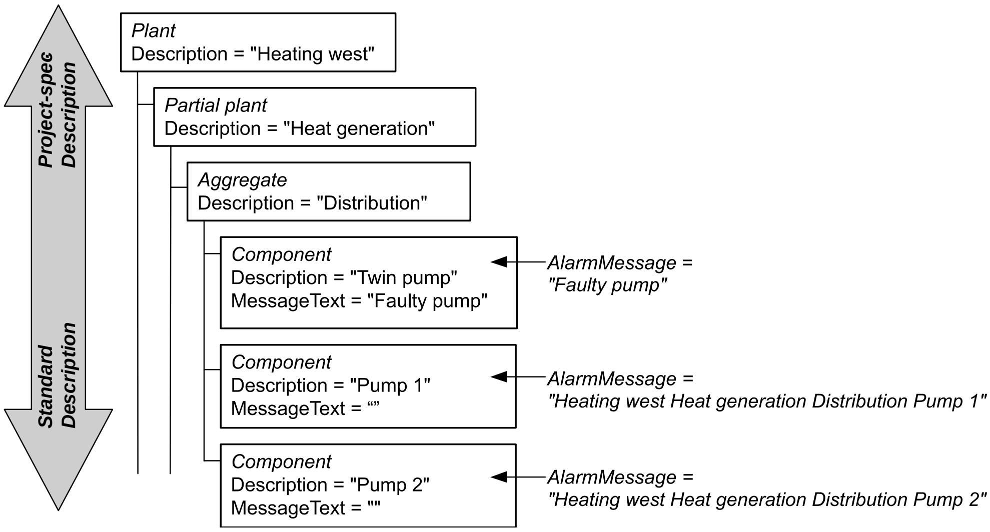


Figure 143: Alarm message texts

Longer messages are divided into segments with forward slashes // so that the client can display the message over several lines. Each segment may contain a maximum of 70 characters, with a maximum of three segments separated by // for any one message.

Non-configured message texts

System alarms and events of the BACnet Device Info Object use text messages which cannot be configured, for example, Battery low.

Predefined, language-dependent text

System alarms and events of the BACnet Device Info Object use non-configured text messages whose contents are language-dependent. These language-dependent texts are organized into text groups with a predefined server system text scope, and can be translated. The translated text groups are loaded into the automation station via BACnet description information. The BACnet generator has to insert the text group into the BACnet description information.

9 Calendars and Schedulers

Standard BACnet objects

The standard BACnet objects Schedule and Calendar are used for time scheduling functions in the Desigo system. These objects can be used to configure and operate time scheduling functions at different operating levels within the system (Desigo Insight, Desigo CC, PX Web, PXM20/40/50) and via BACnet-compatible operator units from other manufacturers.

The local PXM10 operator unit can also be used to operate the standard BACnet objects for the connected automation stations and PXC.

Function blocks

The time scheduling functions are implemented as function blocks in CFC charts of PX automation stations. Each automation station and each switching operation requires one schedule block. The pins of the function blocks are mapped to standard BACnet properties.

There are four versions of the schedule block, with an analog, binary or multistate output or with a variable data type (Boolean, Unsigned, Real or Enumerated). A schedule block can only contain schedule values of the same data type.

[WeekSchd] [EcptSchd]

The scheduler program consists of a weekly schedule [WeekSchd] and an exception schedule [EcptSchd]. The weekly schedule contains a 24-hour profile for each day. The exception schedule contains up to 20 profiles, which can be activated for a date or date range. The date or date range can be defined both in the schedule itself and in the calendar object.

[Prio]

A priority must be assigned to each of the profiles in the schedule. Based on the priority level assigned, the scheduler program determines from the priority [Prio] which profile is to be processed. The weekly schedule has the lowest priority.

[EfPrd]

The effective period [EfPrd] property defines the time period for which the schedule is active.

[PrVal] [NxVal] [NxTi]

The present value [PrVal], next value [NxVal] and next time [NxTi] are available at the output of the time schedule. [NxVal] and [NxTi] are used for optimization purposes.

Commanded objects

The time schedule also incorporates a list of references to BACnet objects and (optionally) a property which is to be controlled by the scheduler program via BACnet.

[DefVal]

The BACnet property Relinquish_Default is the default value [DefVal] for the present value output [PrVal].

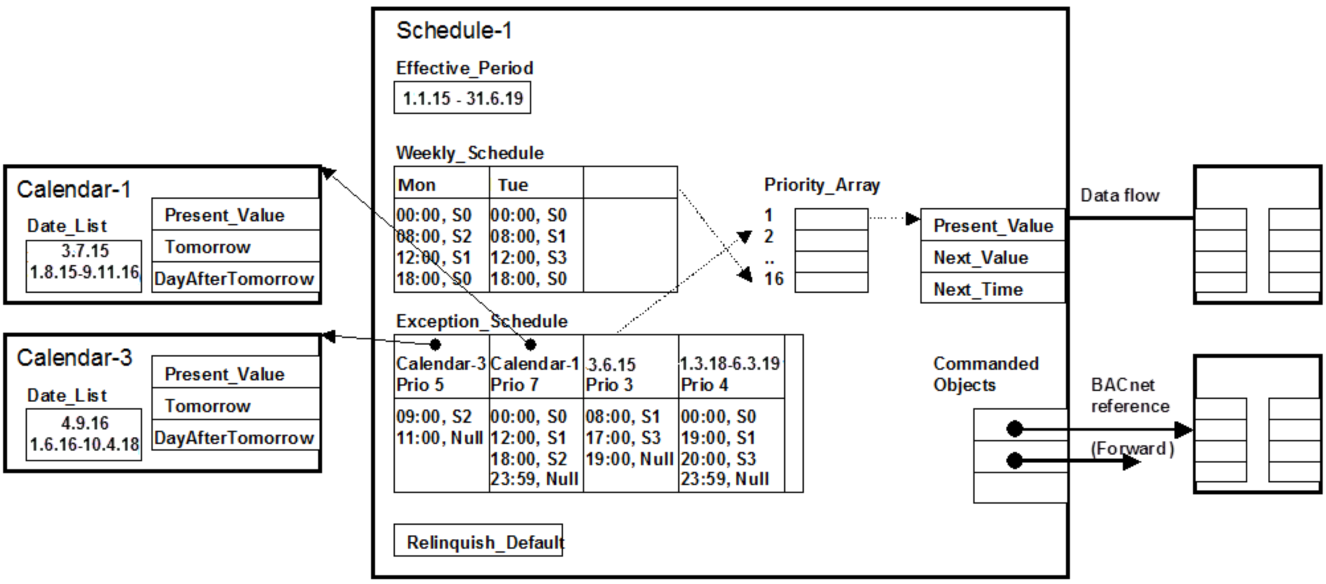


Figure 144: Scheduler with referenced calendar

9.1 Schedule

Weekly schedule [WeekSchd]

The weekly schedule [WeekSchd] consists of seven 24-hour profiles, one for each day of the week. By default, the priority level assigned to the weekly schedule is 16 (the lowest priority). The weekly schedule is active unless there is an exception schedule.

For system limits, see chapter *System Configuration*.

24-hour profiles

A 24-hour profile is a list of time-and-value pairs. The present value remains at the [PrVal] output until the processing of the next time-and-value pair causes a new value to be written to the output.

If there is no schedule entry with a switch time of 00:00 in the daily profile, the default value determines the resulting Present_Value (=Rule schedule default value).

If the daily profile encompasses an empty list of schedule entries, the default value [DefVal] determines the resulting Present_Value (=Rule schedule default value).

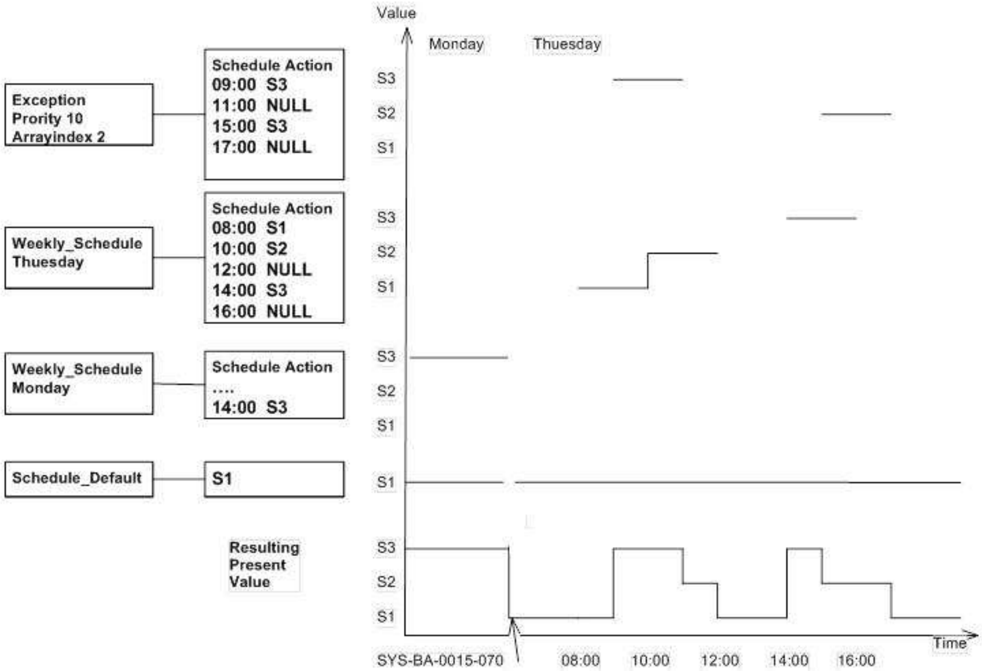


Figure 145: Evaluate exception day program, weekly program and Schedule_Default

The evaluation of the exception schedule, weekly schedule, and [DefVal] is as follows:

Start of the day:

- Exception schedule with switch value at 00:00:

  The exception schedule determines the resulting Present_Value if an active switch value exists at 00:00. The day begins with this exception value (=Rule switch value exception schedule).
- Empty daily profile:

  If the daily profile encompasses an empty list, the default value [DefVal] determines the resulting Present_Value (=Rule schedule default value).
- Daily profile with switch value at 0:00.

  If a schedule entry with switch time 00:00 and active switch value is available in the daily profile, the switch value determines the resulting Present_Value. The day begins with the daily profile value (=Rule Switch value daily profile).

Course of the day:

- Switch value exception schedule:
  If an active switch value exists for a specific time, the exception schedule determines the resulting Present_Value.
- Daily profile switch value:
  If an active switch value from a daily profile exists for a specific time, the daily profile determines the resulting Present_Value.
- Default value switch value:
  If no active switch value from the exception schedule and the daily profile exists at a specific time of day, the default value determines the resulting Present_Value.

Exception schedule [EcptSchd]

Exception profiles

The exception schedule [EcptSchd] overwrites some or all of the daily switching operations in a weekly schedule [WeekSchd]. It consists of one or more profiles (max. 20).

Each profile has a:
- Date
- Specified time
- Priority
- Value for the output signal

The exception schedule may be a time range, including multiple days.

Activating exception profiles

Depending on the customer's requirement, the date on which an exception profile is to be activated can be defined either in the time schedule itself, or in the standard BACnet object Calendar. In the latter case, the calendar object is linked to the time schedule via BACnet references.

An exception begins with the first time entry and ends with the last. Each profile may contain up to 20 switch times.

Setting priorities

The switch value of all current profiles is continuously monitored for present priorities. The priorities determine which switch value is transferred to the [PrVal] output. The system evaluates every minute if a day or an exception profile should be active. Each profile of the exception schedule is assigned a priority level from 1 (highest) to 16 (lowest). If several exceptions are valid at the same time, the profile with the highest priority is processed.

If multiple switch values from different exceptions with the same priority exist at a specific time, the active switch value of the exception with the lowest array index (from the exception schedule) determines the exception switch value. The procedure is the same as the procedure for various priorities. The array index is used as a sub-priority. Exceptions with different priority levels however, are independent of each other. That's why it is preferable to assign different priorities to exceptions defined in the schedule.

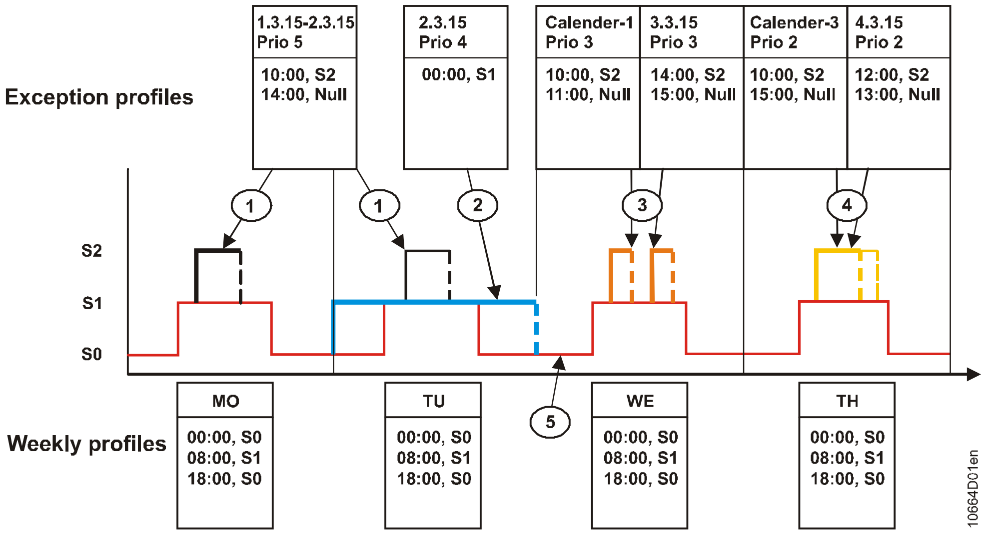


Figure 146: Exception schedule

Key:

1 An exception profile applies to more than one day. On the second day, the exception profile is inactive, because another profile with a higher priority is active for the whole day.

2 An exception program without the entry NULL. This exception profile is active for the whole day and ends automatically in the automation station at 24:00 hours by the NULL entry.

3 Several exceptions with the same priority on the same day, but without overlapping times. The exception profiles do not interfere with each other as an exception begins with the first time entry and ends with NULL.

4 Several exception profiles with the same priority on the same day with overlapping times. These exception profiles affect each other, as several exceptions with the same priority level are active simultaneously. In such cases, the rule is that if the switch commands are the same, the first time-entry applies (in this example 13:00 to NULL). With non-identical switch commands, the latest time-entry applies.

5 Operation in accordance with the weekly schedule.

Output signals

[PrVal] [NxVal] [NxTi]

The scheduler sends the following output signals:

- [PrVal]
- [NxVal]
- [NxTi]

The [NxVal] und [NxTi] output signals support the optimum start/stop control of the plant. When determining [NxVal] and [NxTi] in the time schedule, the current day and the next two days are taken into account. This results in a time window of 48 to 72 hours, depending on the current time and the next switch entry. If there is no change in [PrVal] within the time window, then [NxVal] is the same as [PrVal] and [NxTi] is equivalent to the current date plus 3 days (00:00h).

[DefVal]

This default value [DefVal] appears at the [PrVal] output when there is no active entry in the time schedule, or when the entries are all NIL, or when the time period is outside the active period.

[EnDef]

The [EnDef] variable enables or disables the [DefVal] variable.

The function block variables [DefVal] and [EnDef] are mapped to the Schedule_Default property. The property Schedule_Default can have the value [DefVal] or NIL.

Variable DefVal	Variable EnDef	Property Schedule_Default
Value	True	Value
Don't care	False	NIL (= Release)

Table 40: DefVal and EnDef function block variables

The NIL value in the Schedule_Default property is the release value for the active priority of the object controlled by the scheduler. Do not confuse it with the NIL value in the exception schedule used to prioritize the time entries.

Function blocks for various data types

There are four versions of the schedule block, with an analog, binary or multistate output or with a variable data type (boolean, unsigned, real or enumerated).

Function block	Output	Example
BSchd	Binary	True/False
ASchd	Analog	20°C
MSchd	Multistate	Off, Stage 1, Stage 2, Stage 3
Schd	Boolean / Unsigned / Real / Enumerated	

Table 41: Function blocks for data types

The switching value is output to [PrVal] and to the objects to be switched (commanded objects list). A schedule block can only contain switching values of the same data type (binary or analog or multistate or boolean or unsigned or real or enumerated). It is therefore not possible to switch two different data types in sequence.

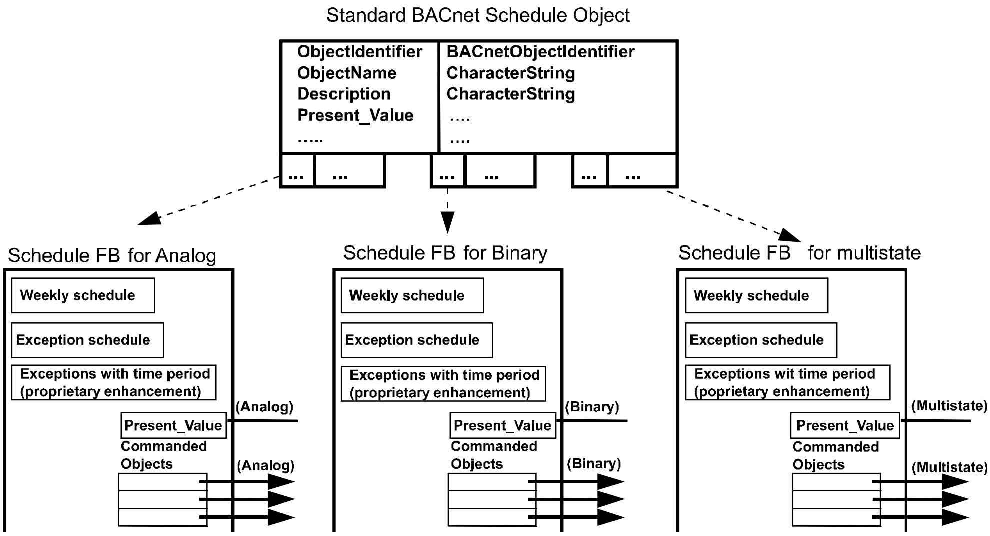


Figure 147: Schedule function blocks for analog, binary, and multistate

The CAL (calender) and SCHED (schedule) function blocks can be created online. The ASCHED, BSCHED and MSCHED function blocks cannot be created online.

Commanded objects

The schedule can influence other commandable objects, irrespective of whether or not they are in the same automation station.

The schedule is thus a grouping object and contains a list of group members, in the form of a list of name references [NamrList]. These group members are the commanded objects, that is, the objects to be switched. The list can contain up to five entries.

Referencing

The referencing of group members is based on the technical designation (TD) and is resolved at runtime.

Information flow

The grouping and the information flow only go in one direction (forward referencing).

The information flows inside one automation station or across several automation stations. The scheduler object recognizes the flow of information and knows where to send information and what data type is required by the group members. The information transmitted covers only the present value [PrVal] or the values for the Optimum Start/Stop functions [PrVal], [NxVal] and [NxTi].

Heartbeat [Hrtbt]

The function block variable Heartbeat [Hrtbt] determines the period measured in seconds at which the current value (Present_Value) is written.

Enable_Repeat_ Command [EnRptCmd]

The function block variable Enable_Repeat_Command [EnRptCmd] defines if the switching action is executed if the Present_Value does not change:

- EnRptCmd = TRUE: Switching action is executed if Present_Value does not change.
- EnRptCmd = FALSE: Switching action is NOT executed if Present_Value does not change.

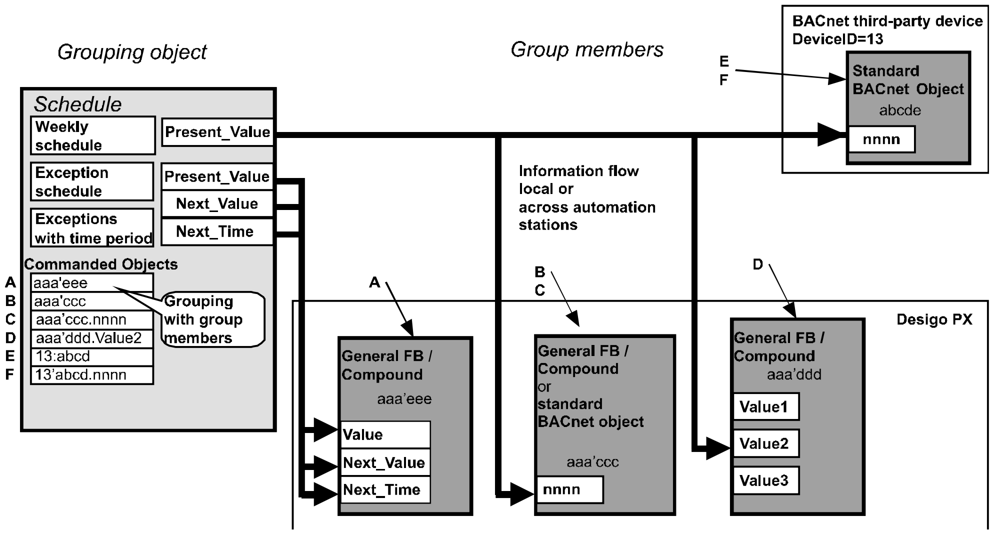


Figure 148: Commanded objects

In Desigo S7 commandable objects are not supported. Control of the objects to be switched occurs via interconnecting the output signals in the CFC.

Effective period [EfPrd]

You can define the period for which the schedule is to be active, for example, you can configure separate schedules for summer and winter operation. If the current day is outside the active period, the [PrVal] output is equal to the default value [DefVal].

Time resolution

The smallest unit in the scheduler program is one minute and in the calendar one day. The schedule may be dependent on the calendar. In the PX automation stations, the calendar function block is automatically processed before the scheduler function block. The superposed cycle for processing the calendar and scheduler begins at the start of the new minute of the system time.

A PX automation station incorporates an automatic load shedding mechanism. The result is that a switch command at time x is executed within a time-period defined by time x + 1 minute.

System time

Schedules and calendars are based on the same global time. This ensures that all automation stations on a site have the same time base.

For a description of the functions associated with the global time, such as the time synchronization between the automation stations, UTC (Universal Time Coordinated), local time and the daylight saving time-change, see *Desigo Insight Engineering of user functions* (CM110592).

Interdependency and order of processing

Interdependency of function blocks

The calendar and schedule function blocks are standalone objects which are processed individually. The Schedule function blocks depend on the Calendar function blocks. The objects to be switched (commanded objects or data flow output) depend on the Schedule function blocks.

Processing order

At start-up, when delta loading and when adjusting the date and time, the order of processing is a key factor in ensuring that from the first processing cycle on, the correct output values of a schedule function block are determined and transmitted to the output. The temporary transmission of incorrect switch values can be avoided in this way. The order of processing of the individual function blocks is determined in the CFC Editor (manual/automatic).

The order of processing is:

1. Calendar function blocks
2. Schedule function blocks
3. Any other function blocks, which could be switched by a schedule function block

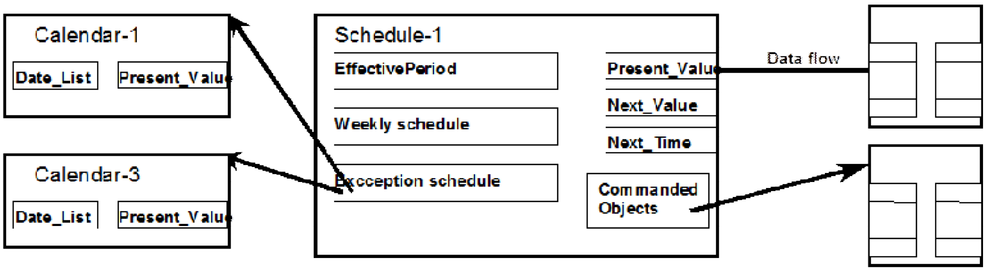


Figure 149: Order of processing and interdependency of function blocks

9.2 Calendar

Function block Calendar

The calendar object is a function block from the firmware library. It contains a list of dates [DateList] with, for example, a date or a date range.

The date list [DateList] uses Boolean logic to control the calendar outputs. [PrVal] activates an exception profile if the calendar object is referenced by a schedule object. The outputs tomorrow [Tmw] and day after tomorrow [DayAfTmw] support the optimum start/stop control of the plant.

Standard BACnet object Calendar

The SCHED (schedule) and CAL (calender) function blocks in the firmware library correspond to the SCHED and CAL standard BACnet objects. Standard BACnet object can be operated via the BACnet clients.

The calendar and schedule can be linked at the BACnet level by references. There is no data flow link between the calendar and schedule function blocks in the CFC chart.

9.3 Wildcards

A wildcard character (*) generates a repetition and is an abbreviated way of listing individual entries. For example, writing 3.* is a short way of representing 3.1., 3.2., 3.3., 3.4., 3.5., etc.

All data structures of the scheduler or calendar objects support dates with wildcards. Date ranges and time specifications do not support wildcards. Invalid weekdays are ignored.

Date entries with wildcards

The following table shows examples of date entries containing wildcards:

Date	Meaning
23.April.2001 /Monday	23.April.2001, Monday
23.April.2001 /Tuesday	Never, since 23.April 2001 is a Monday
23.April.2001 /*	23.April.2001
23.April.* /Monday	Each April 23rd, each year if the weekday is a Monday
.April.2001 /	Every day in April 2001
.April. /Tuesday	Each day in April of each year if the weekday is a Tuesday
31.*.* /*	Each January 31, March 31, May 31, … of each year or each February 28/ 29, April 30,... of each year

Table 42: Date with wildcards

If a date contains a wildcard in the month or year, the last day of the month is used for the day, if the value of the day is greater than the maximum number of days in the month.

Week and day with wildcards

The following table shows an example of entering a week and day (WeekNDay) using wildcards. During the evaluation, a wildcard is replaced by the corresponding value of the current date. If the WeekNDay generated in this way is equivalent to the current date, this is an exception day.

Day of the week	Meaning
January/2/Monday	Monday in the second week of January
*/1/Tuesday	Every first Tuesday of a month
February/*/Wednesday	Every Wednesday in February

Table 43: Week and day with wildcards

9.4 Alarm Messages

The scheduler object cannot directly generate alarms when, for example, a commanded object cannot be found.

The alarm function (extended, basic or simple) which defines the alarm behavior of the object in the system, and the alarm class do not exist because of standard compliance.

The fault alarming of the schedule object must therefore be implemented as an additional binary value function block. That's why the function block is linked with the Dstb (Disturbed) pin of the scheduler and parameterized accordingly. The additional binary value function block is optional and only required, when a fault alarming of the scheduler is wanted, for example, for scheduling external objects.

The scheduler object in Desigo S7 is not alarm capable.

10 Trending

Trend data provide important information about the processes in a building automation and control system. For example:

- Monitoring of the control system for optimization purposes
- Logging the room temperature in association with the set temperature
- Logging of temperature and humidity trends for the pharmaceutical industry

Offline/Online trend

There are two types of trend data:

- Offline trend:

  The recorded trend data are saved in the automation station and uploaded to the management station periodically or as needed. The data can be analyzed in the management station.

  A connection is needed only during the data upload. Trend objects are needed in the automation station.

  Offline trend is mostly used for long term data logging.
- Online trend:

  Arbitrary data points that are, for example, visible in the Desigo Insight Plant Viewer or Object Viewer, can be saved as online trends.

  A permanent connection is needed. No trend objects are needed in the automation station.

  Online trend is mostly used for temporary data logging.

Trend Log Objects

The trend data is saved in the buffer of the Trend Log and Trend Log Multiple objects in the automation station.

The Trend Log object can only record one value of a data point. The Trend Log Multiple object can record up to six different values of a data point.

The Trend Log object cannot be set up online, but must be set up in advance, offline in the application. A Technical Designation (TD) determines (BACnet reference) which object is to be logged. This presupposes that the referenced object is visible via BACnet (not No Element). The reference and the parameters can be defined and modified online or offline.

When the number of trend log entries reaches a definable threshold (Notification Threshold [NotifThd]), the Trend Log object generates an event. The Trend Log object sends out an alarm which is defined in a notification class specified for Trend Log.

The trend log data acquired can only be read, and if necessary, archived, with a BACnet Client configured for this purpose (for example, the management station). The status of a Trend Log object is not affected by reading out trend log data. It is not possible to reload sampled data into Xworks Plus (XWP).

A BACnet client cannot reserve a Trend Log object. Every BACnet client can access the Trend Log object. In the case of access or modifications undertaken by several clients, the rule is that the most recent one always takes priority.

PX Web

In PX Web you can view trends graphically and in list form. You can export the trend data in a CSV file.

See *Web operation PX Web User's Guide* (CM110757).

PXM20

In the PXM20 operator unit you can view trends graphically and in list form. You cannot export the trend data.

See *Operator Unit PXM20 / PXM20-E* (CM110754).

10.1 Trend Functions

The trend log object supports the following functions.

Continuous Run

The trend data is saved continuously (ring buffer). When the available memory area is full, the oldest data is overwritten by new data. You can define the Continuous Run function with the parameter Stop when full.

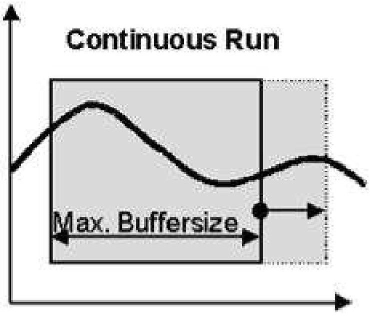


Figure 150: Continuous run

Single Run

The trend data is saved until the available memory area is full. You can define the buffer size [BufSize] within the range 2 to 5,000 entries. You can define the Single Run function with the parameter Stop when full.

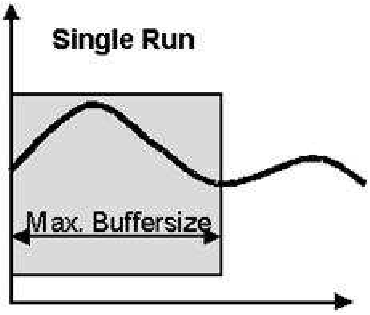


Figure 151: Single run

Logging Type

The parameter Logging Type [LogTyp] defines the logging type. The values are:

- POLLED: Periodic Sampling
- COV: COV Sampling
- TRIGGERED: Triggered Sampling

By setting the parameters accordingly, you can define combinations of Continuous Run / Single Run and Periodic Sampling / COV Sampling / Triggered Sampling.

Periodic Sampling

In Periodic Sampling data is acquired by sampling and storing values in a regular cycle. Periodic Sampling is supported by the trend log object and the trend log multiple object.

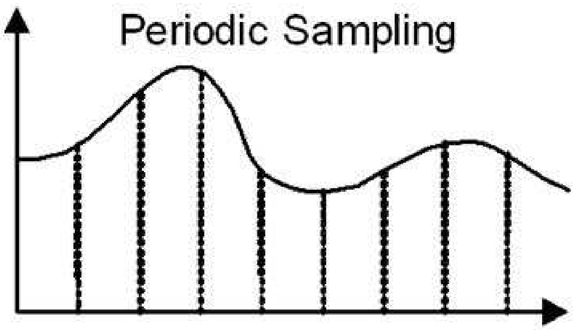


Figure 152: Periodic sampling

COV Sampling

In COV Sampling data is stored based on a change of value (COV) of the referenced parameter. A COV subscription can be applied to all supported data types (analog, Boolean and multistate). The amount of change required to initiate a COV is set as a parameter in the object to be referenced. COV Sampling is supported only by the Trendlog object.

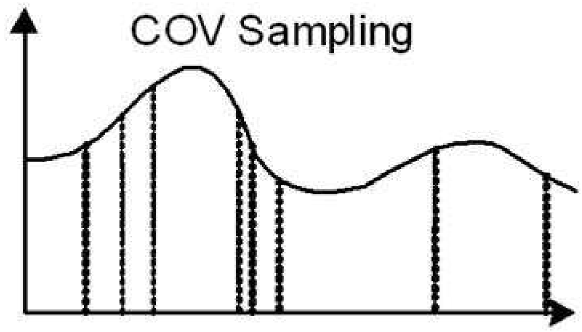


Figure 153: COV sampling

Triggered Sampling

In Triggered Sampling an application (for example, via data flow interconnection) determines when values are acquired/logged and saved. Triggered Sampling is supported by the Trendlog object and the Trendlog Multiple object.

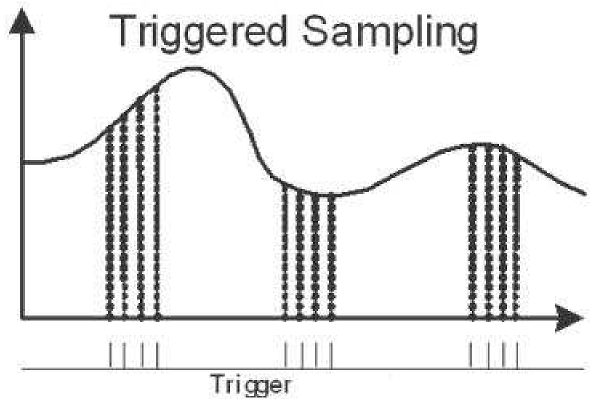


Figure 154: Triggered sampling

10.2 Editing Parameters

Many of the parameters in the trend log object are definable only if:

- Enable for logging (Enable logging) [EnLog] is *inactive*
- The log buffer is *empty* (Record count = 1)

  In this state, the following variables can be modified:
  - Start time [TiStt] and stop time [TiStp]
  - Interval [Ivl]
  - Buffer size [BufSize]
  - Record count [RecCnt] (can only be overwritten with 0: delete log buffer)
  - Notification threshold [NotifThd]
  - Input/Output address [IOAddr] (if an unavailable BACnet address is entered, an alarm is initiated)
- [EnLog] is *inactive* or *active*
- The log buffer is *not empty* (log count > 1)

  In this state, only the following parameters can be configured:
  - Start time [TiStt] and stop time [TiStp]
  - Record count [RecCnt] (can only be overwritten with 0: delete log buffer)
  - Notification threshold [NotifThd]

The record count [RecCnt] can only be overwritten with 0. This deletes all the log data. After a write operation of 0, there is one entry showing the log status (record count = 1).

It is not possible to reload sampled data into the CFC Editor.

With a full loading procedure, any previously sampled data will be lost. With differential or delta loading the data will not be lost.

The PXM20 stores modified parameters in its internal memory cache. To display the data actually written, you must exit from the trend log object and re-select it.

10.3 Processing Trend Data in the Management Station

Trend data in Desigo CC

The Trends application in Desigo CC lets you create and display online trends and offline trends. You can save, query, delete, edit and save trend data in Trend Views.

You can display the trend data in the Trend Viewer any time, even if the management station is not connected to the site (no real-time data is available).

For more information, see *Desigo CC User Guide* (A6V10415471).

Trend data in Desigo Insight

After the trend data has been stored in the Desigo Insight trend database, you can use the data to display curves in the Trend Viewer. These curves are used, for example, to monitor a plant's behavior.

The trend database continuously receives data until a specific limit is reached. You can define the limit in the System Configurator. You can then archive or delete the data.

For more information, see *Desigo Insight Operating the Management Station* (CM110588).

Complex analyses

In addition to the life cycle of trend data in Desigo Insight, you can also archive trend data over a longer period and conduct additional, more complex analyses, for example, for energy management purposes. To do this the data must be transferred to Advanced Data Processing (ADP) or Consumption Control (CC). The ADP/CC program then runs together with the PDM database on the same or on a different Desigo Insight management station in the same network.

In mid to large-sized projects, we recommend that you separate Desigo Insight from ADP/CC and PDM to ensure performance and stability. In such projects Desigo Insight and ADP/CC are usually operated by different people anyway.

In critical environments such as the pharma industry, InfoCenter is the preferred and supported solution for long-term data archiving.

11 Reports

You can create reports for information and analysis.

11.1 Desigo Insight Report Viewer

The Desigo Insight Report Viewer lets you query defined samples and displays them as reports. The reports are used for analysis of plant data and behavior, and for evaluation and documentation purposes.

Desigo Insight Report Viewer functions:

- Alarm reports (query from alarm database)
- Log reports (query from log database)
- Audit trail reports (query from audit trail database)
- Data point reports (query from automation station and system database)
- Emergency lighting reports (query from automation station and system database)
- TRA group reports (query from system database)
- System reports (query from system database)
- Archive reports (query from log and audit trail database)
- Manual or automatic reporting
- Operation/Report display for desktop and web users

You can select existing report definitions to manually start sample logging of data. A report is then created containing the values of the plant data defined in the report definition at the time of the data logging (snapshot function).

Together with the Desigo Insight event program (reaction processor resp. global schedule with calendar), you can automatically run preselected reports at a predefined time.

You can save reports in PDF format for printing or CSV format for analysis in MS Excel or MS Access.

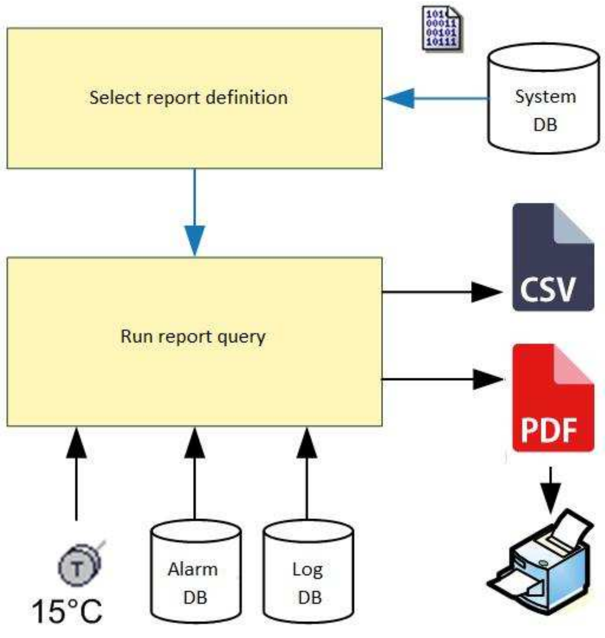


Figure 155: Report function

Standard report definitions The following standard report definitions are provided with Desigo Insight:

- Reports to show alarm and fault states (active, unacknowledged, acknowledged, etc.)
- Reports to show logbook entries (alarm, system and user events)
- Reports to show plant states (manual interventions, maintenance request, room measured value, actual values, set point settings, etc.)

Customized report definitions

With the Report Builder tool you can create customized report definitions based on your individual needs. The basic Desigo Insight license includes the report function using standard report definitions. The Report Builder is subject to a separate licensing agreement.

Filters

To display only specific data in the reports, you can define filter criteria in the search queries (for example, address mask wildcards, plant, data point type, time, date, etc.). You can save the search queries.

Report-based batch processes

The dialog box for the data point report allows for adapting individual values or groups of values and write back the data as part of one single batch process to the automation stations.

Query reports via the web

When using a Desigo Web Client PC with the appropriate access rights, you may select report definitions in Desigo Insight using the Web Report Viewer function and start sampling. The report is then displayed in Desigo Web and can be downloaded in PDF format from the web server to the client computer.

ADP/CC

Advanced **D**ata **P**rocessing and **C**onsumption **C**ontrol (ADP/CC) lets you create expanded and enhanced reports through the use of archived data, long-term operational data evaluation, energy management, consumptions checks, etc.

11.2 Desigo CC Reports

The Reports application in Desigo CC lets you create reports about the functioning of the building automation and control system.

You can configure:

- The elements in the report (such as tables, plots, logos, form controls, text and so on), and their layout.
- Filters (such as name, condition, time, and/or row) to populate the elements of the report with information. For example, if you want a report on a room's activity data over the past month, you could define a name filter and a time filter in an activities table.
- The formatting of the report elements and the page layout.
- The output type (PDF or XLS) and the output destination (file, email, or printer).

You can save your report definition for later use, run it, or schedule the report to be run at a specified time.

You can use reports as a reference or as a troubleshooting mechanism. Reports are helpful during system operation.

For example, you can:

- View a mixed report containing:
  - A table displaying details of all active events for a floor of a building
  - A table displaying a history report of events
  - A trends plot displaying the temperature variations gathered from temperature sensors
- Export trend data for statistical analysis to:
  - An XLS file
  - A CSV file (according to the EMC requirement)
- Schedule production of a report using macros and reactions
- Send a report by email, print it or save it as a PDF

You can export and import report definitions and logos.

You can also create and configure reports for operating procedures. These reports are used during assisted treatment to enter information about how the alarm or event is being handled.

12 Data Storage

Large volumes of data are created in the Desigo system during engineering, commissioning and plant operation. The data is processed, saved, and archived as needed in accordance with type, generation, and meaning in the various system components.

12.1 Data Categories

The application logic (control functions) and the required setting and configuration data are processed during engineering and loaded in the corresponding system products, such as the management station or automation station during commissioning.

This data is arranged according to two criteria:

- Data category
- Data ownership

Data categories

The following table shows a common method of classifying data in building automation and control systems.

Data category	Description	Related terms
Program elements	Software components which perform a predefined task and have a known interface.	Function blocks, functions, program blocks, compounds, solutions
Setting parameters	Values that affect the program elements.	Setpoints, default values, limit values, address settings
Configuration parameters	Data in the form of defined constants, or data that influences the appearance or operability of the plant.	Description data, templates, profile, metadata
Process data	Physical process variables of the plant during operation. History or saved process data are plant data.	Measured values, state variables, calculated values

Table 44: Data categories

Data ownership

Data ownership is based on the practical allocation of data to its owner. The owner, usually an organizational entity, a person, or a group of people, checks the data and is responsible for its scope and content. Data ownership shows in which Desigo system product the data is located and which tools are available for its management. Data ownership is divided in four groups.

The following table shows the four data ownership groups.

Data ownership	Description	Owner	User
Program data	Software of a Desigo system product with basic data blocks.	Research & Development (R&D) (HQ)	Project/Library engineer
Libraries	Collection of predefined, specific, and tested program elements. Libraries can be copied and customized.	Library manager (HQ/RC)	Project/Library engineer
Project data	All data for the customer project or customer plant.	Contractor Project engineer	Plant operator
Plant data	Data from the customer plant saved permanently following commissioning.	Plant operator	Customer

Table 45: Data ownership

12.2 Program Data

The executable software of a Desigo component is composed of programs. There are system and product components.

System components

System components are:

- System blocks for controlling the plant
- System interfaces which are implemented in every component and which control the data traffic between the components

Product components

Product components are the local subroutines responsible for the internal consistency of setup, startup, shutdown, navigation and display, etc. among the individual components.

Parameterization

There are two parameter types:

- Setting parameters: System and product components have predefined default settings. These values are application-independent, but always lie within the system limits.
- Configuration parameters: The system and product components have a basic configuration. The basic configuration of certain blocks is not complete and must be supplemented during engineering with, for example, addresses of the I/O blocks.

The library or project engineers can adapt the setting and configuration parameters to the plant or project conditions.

12.3 Libraries

Libraries are needed during engineering. You can create loadable applications using libraries. Library elements are compiled from system basic components. For example, the graphic library of the management station contains default graphics for visualizing plants during engineering.

You can copy and customize or extend libraries. Every engineering level has a library. Libraries can cover many combinations.

DXR2 automation stations are delivered with preloaded applications and only need to be configured.

There are three library types:

- HQ libraries are tested, well documented and delivered with the system version. Every new Desigo version contains new libraries.
- RC libraries are tested, well documented and contain country-specific characteristics. They are optional, independent or an addendum to the HQ library. Not all RCs offer comprehensive libraries.
- Project-specific libraries are not tested and documented.

Application libraries

Application libraries contain plant-specific functions (heating, cooling, control of electrical equipment, etc.) or templates for subsystem bindings. You can set up and manage libraries with the Xworks Plus (XWP) and Automation Building Tool (ABT) engineering tools.

PX libraries

The functional units of the PX application libraries are defined by compounds. You can copy, change and extend the compounds of the PX library.

Application libraries for PX and Desigo S7 are designed using the same application principles and are provided via Xworks Plus during project engineering.

PXC3/DXR2 libraries

The functional units of the PXC3/DXR2 application libraries are defined by application functions. You can copy, change and extend the application functions of the PXC3/DXR2 library.

Parameterization

The library elements have plant-specific or function-specific setting and configuration parameters:

- Setting parameters: The default values are defined by the application and usually do not require adjustment.
- Configuration parameters: The default values can be adapted as needed.

Graphics libraries contain graphics that represent the operating elements of the firmware and application libraries. The graphics are used in the management

Graphics libraries

station to visualize and operate plants. The elements of the graphics libraries depend on the elements of the application libraries. Any changes to the application libraries must therefore also be made to the graphics libraries.

The graphics libraries for Desigo PX, PXC3/DXR2, and Desigo S7 are identical. Desigo Insight and Desigo CC have one library each.

12.4 Project Data

There are three types of project data:

- Project data that is saved locally and then loaded into the system.
- Data on the Branch Office Server (BOS).
- Data that is loaded into the system with ABT Site and is not saved locally.

Project data is created during project engineering, when you create a project program using library components. Project programs define the sequence in which function blocks (programming elements) are processed, and what interconnections are used between blocks.

The library components are selected:

- In Xworks Plus (XWP) in the Solution Generator (recommended workflow for Desigo PX)
- In the CFC Editor from the compound and firmware libraries for Desigo PX and Desigo S7
- In Xworks Plus and Automation Building Tool (ABT) from the Desigo Room Automation automation stations

Desigo Room Automation room applications

Desigo Room Automation room applications are configured in ABT by selecting the required functions or model rooms.

RXC/RXB room applications

RXC/RXB room applications are configured in XWP by selecting the required functions or sample rooms. Data import in XWP to address the room devices is carried out in different tools, depending on the RX device.

For device...	From tool...
RXC	RXT10
RXB, RXL and KNX/EIB third-party devices	PX KNX tool
RXB and KNX/EIB third-party devices	ETS
LonWorks third-party devices	Standard LON tools

Table 46: Tools and devices for importing data

PXC3 room applications

PXC3 room applications are programmed and configured in XWP/ABT by selecting and configuring the applications required for the rooms and room segments (application functions).

TX-I/O modules

The configuration of TX-I/O modules depends on the PX automation station:

- PX automation station with island bus connection: The XWP/ABT tools transfer the configuration data (IOC) to the target automation station PX/PXC3.
- PX automation station with P-bus connection: The configuration data (IOMD) from XWP is loaded into the I/O modules via the TX-I/O tool.

The IOC/IOMD configuration data is saved as project data.

Back up and restore

Project data is stored offline in XWP/ABT and Desigo S7 engineering tools. The backup and restore function creates a backup of the data and, in case of data loss, restores the data to the PX automation station.

Back up your data regularly to protect yourself against data loss.

The backup copy contains all necessary data of a PX automation station to ensure the automation station is fully functional after data restoration. You can back up and restore data on third-party automation stations. You can save engineering data on PX compact automation stations.

Backup

Data from the PX automation stations are saved as a backup copy on Desigo Insight. The data is exported and saved as BACnet data.

To back up the data:

- The PX automation station must be connected and available (online).
- The PX automation station must support backup and restore.
- The building automation and control system must work smoothly.

Restore

You can restore data backed up on Desigo Insight to the corresponding PX automation stations. The restored PX automation station automatically restarts after data restoration.

12.5 Plant Data

Plant data is process data from the operation of a customer plant, that is permanently saved from the time of commissioning. Process data represents process variables in a building. The data is continuously changed by the environment, automation station and, in the event of physical outputs, the operator. Most process data is volatile. Few process data, such as adaptive control parameters and runtime totalization counts, remains available following a restart or power failure of the automation station. Process data can be archived as plant data.

12.6 Data Transfer Processes

Project data is transferred from the tools to the devices or other consumers online and offline via the system interface. PX automation stations are configured offline and then the data is downloaded onto the automation station. Desigo Room Automation automation stations (PXC3 and DXR2) can be engineered. DXR2 automation stations also have preloaded applications and only need to be configured.

Transfer operations

There are four transfer operations for data synchronization:

- Offline generation
- Online loading
- Online readback
- Offline import

Data transfer to PX automation stations

You can load a new program on a PX automation station while the old program is still running. The operation of the automation station is not interrupted. Process values remain intact. If you load a firmware on the automation station, you must restart the automation station.

Data transfer to Desigo Room Automation automation stations

If you load a new program on a Desigo Room Automation automation station, you must restart the automation station. The operation of the automation station is interrupted. Process values do not remain intact. If you load a firmware on the automation station, you must restart the automation station.

There are four loading units for Desigo Room Automation automation stations:

- Load program
- Load parameters (full download for DXR automation stations)
- Load configuration (settings on the automation station)
- Load firmware (programs, parameters and configuration are not lost)

Offline generation

Full code generation

Full code generation:
- Checks the overall application consistency (limits, identifiers)
- Converts the application into loadable units
- Generates the appropriate description data for configuration

You must compile the code to get the required performance. You cannot engineer a compiled program.

Delta generation

Delta generation (converts only the modifications):
- Improves performance
- Is faster than full code generation

Online loading

Full download

The full download transfers all loadable units into the automation station.

Delta download

The delta download:
- Copies additional blocks into the automation station
- Deletes blocks which are no longer valid
- Updates parameter settings

The delta download is faster than a full download. You do not need to interrupt the operation of the automation station.

The delta download helps prevent unintentional parameter changes. Online changed process data and settings parameters are protected against unintentional overwriting, provided the process data was not changed in the tool.

Download options

You can define what happens in the automation station before and after the download. You can define if:
- Parameters are read back before the download
- The program starts and/or the I/O bus is turned on after the download

Online readback

During readback of non-volatile process values and parameter settings the data in the automation station is aligned with the project data in the tool.

Readback comprises two steps:
1. Current parameter settings and non-volatile process values in the PX/PXC3 automation station are read from the automation station and copied to the data storage.
2. The values are updated in the CFC data storage or PXC3 program and configuration data storage.

The following data can be read back from PX/PXC3 to the project data storage in the XWP/ABT tools:
- Setting parameters changed in the PX/PXC3 automation station
- Changed, non-volatile process values or configuration data

Advantages

Reading back data has the following advantages:
- Outdated data in XWP/ABT is overwritten by current data and thus is available again for reloading programs in the PX/PXC3 automation station.
- During online changes of background variables (for example, calendar), data between CFC and XWP/ABT and the automation station is retained.

- Current setting parameters and non-volatile process values (for example, operating hours) are saved.
- The newest configuration is saved offline and can be used for, for example, reports.

Runtime data cannot be read back. Only offline data can be read back. Only objects (not individual properties) can be read back. If a property is changed, the entire object (for example, data point), that is, the last change on the object is read back. The last change per object is always valid.

Workflows for changes

There are two workflows for changes:

Workflow 1 (ideal workflow):

1. Perform readback before the changes
2. Perform changes offline
3. Download

Workflow 2:

1. Perform changes offline
2. Perform readback
3. Compile
4. Download

Offline import

You can import configuration and description data for the plant into the management station. This is the same as the data downloaded to the automation station.

12.7 Texts

If you work with HQ or RC libraries, the texts are from a text database. These texts can be automatically translated, because they have a unique ID. Project-specific texts that are not from the text database cannot be automatically translated.

13 Network Architecture

The Desigo system is divided into three network levels:

- Management Level Network (MLN)
- Automation Level Network (ALN)
- Field Level Network (FLN)

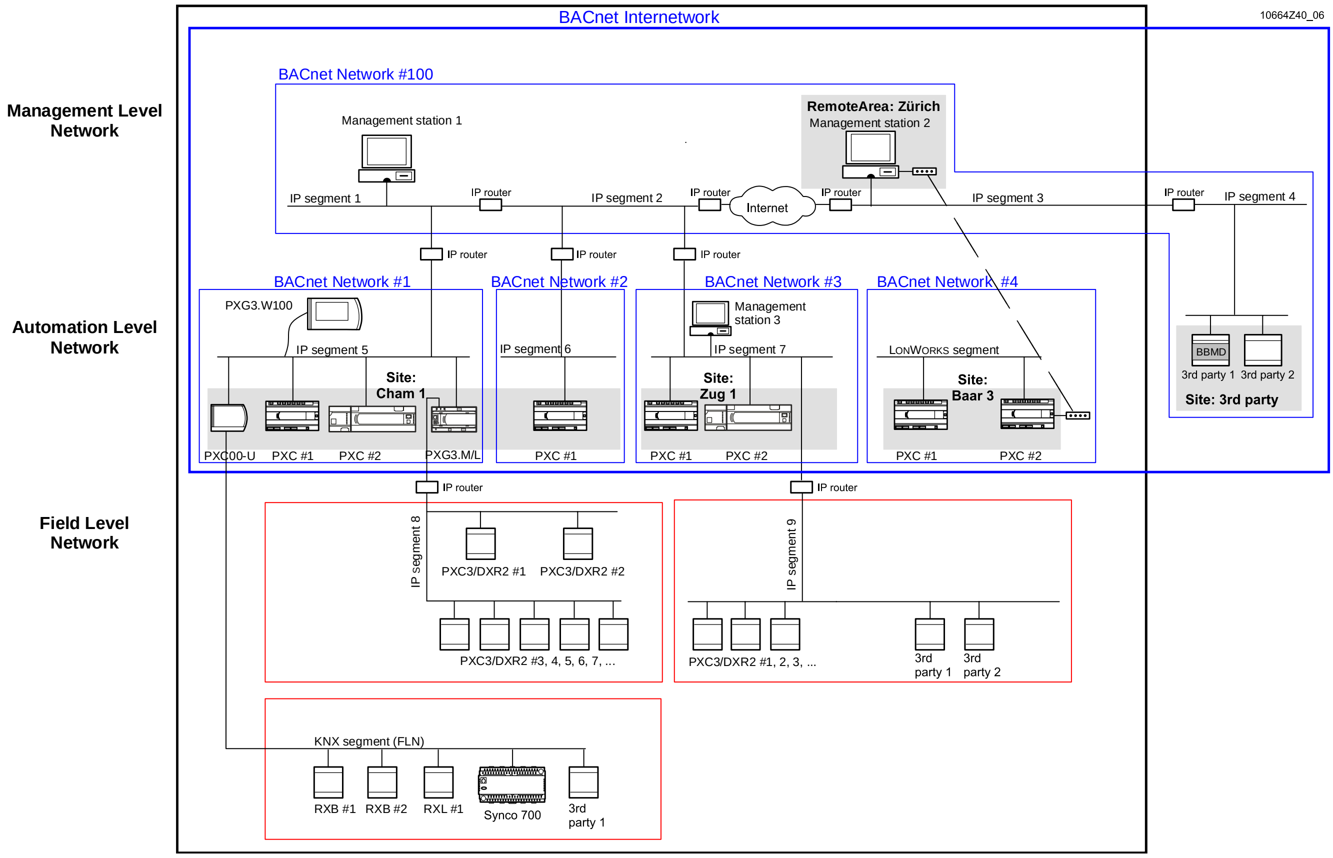


Figure 156: Desigo architecture

This classification is based on the functions performed at a given level, rather than on the communications protocol or medium. The MLN and ALN use the BACnet protocol. The transport protocol (Data Link Layer) is LonTalk or IP. The FLN uses LonWorks, KNX and MS/TP technology.

13.1 BACnet Architecture (MLN & ALN)

Structuring

BACnet defines the following structuring of the network topology:

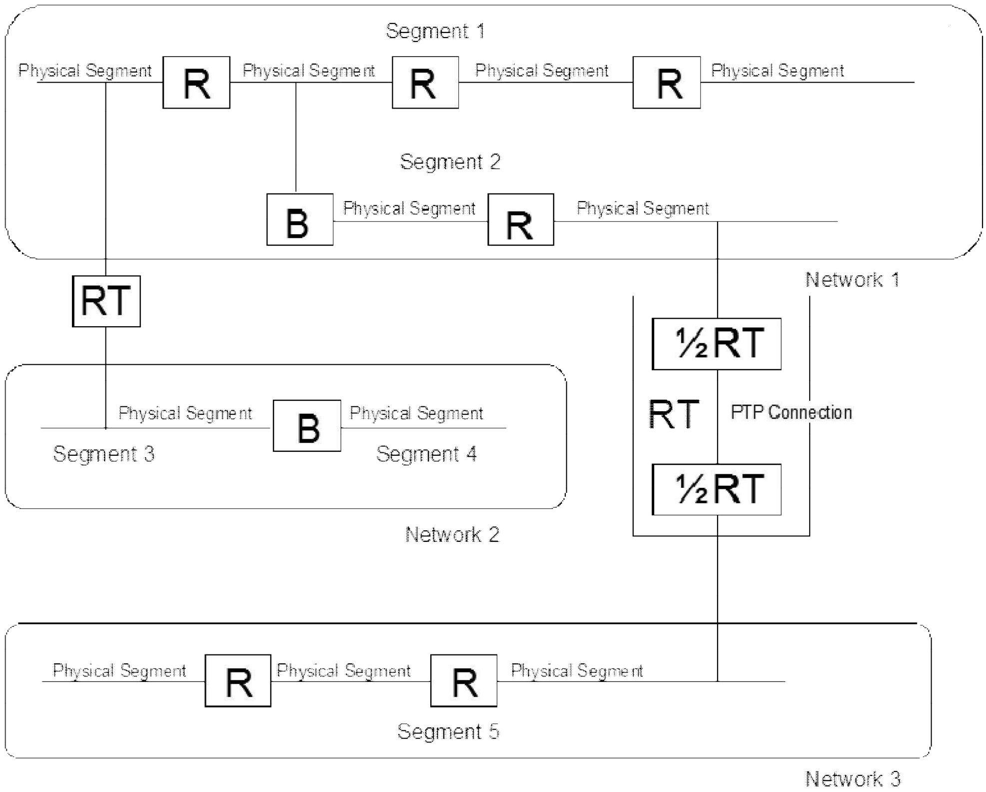


Figure 157: BACnet internetwork

Key:

B	Bridge, for example, IP router, LonWorks router
R	Repeater, for example, LonWorks physical repeater
RT	Router, for example, PXG3
½RT	Half router, for example, PX..-T

Internetwork

In BACnet, the BACnet internetwork is defined as the largest BACnet unit. It consists of one or more BACnet networks. Only one active connection can exist between any two BACnet devices in a BACnet internetwork.

A BACnet internetwork is a closed address range. Only BACnet devices within the same internetwork can communicate with each other.

All bus subscribers from the ALN and MLN, including BACnet third-party devices, are part of the BACnet internetwork. The devices in the FLN are part of the Desigo system but not part of the BACnet internetwork, because they do not communicate via BACnet.

Network

Desigo devices use LonTalk (BACnet/LonTalk), IP (BACnet/IP) or MS/TP (BACnet MS/TP) as their transport protocol. If different transport protocols are used, different physical networks are created, which must be connected to the PXG3 router. BACnet routers connect networks on the BACnet network layer and transmit messages via the network number.

If the transport protocol changes, the BACnet network also changes. For example, BACnet devices that use LonTalk as their transport protocol are always located in a different network than devices that use IP as their transport protocol. This also applies to PTP connections.

Desigo devices use LonTalk (BACnet/LonTalk) or IP (BACnet/IP) as their transport protocol and MS/TP (BACnet MS/TP) to integrate third-party devices. If different transport protocols are used, different BACnet networks are automatically created, which must be connected to the PXG3 BACnet router. Multiple BACnet internetworks can be created on an IP segment by using different UDP port numbers.

Desigo establishes PTP connections only between operator units (Desigo Insight, XWP/ABT) and a network. Operator units duplicate a virtual network since PTP connections demand a network at both ends.

Desigo CC does not use PTP.

Segment

Large networks are structured, that is, divided into several (logical) network segments for reasons of security, performance, size and (limited) address range of network devices. The segments must then be connected to routers of the corresponding transport protocol (for example, LonWorks router, IP router).

In most cases it is not necessary to divide a BACnet/LonTalk network into several LonWorks segments (ALN). However, if it does prove necessary, it is not possible to use a LonWorks router, because this limits the length of the data packets. An L-switch (Loytec) can be used as a router on the ALN.

BACnet MS/TP networks cannot be segmented, because there are no associated routers.

With BACnet/IP some IP segments may be connected by IP routers. Since the IP router prevents broadcasting, the connection must be activated with the BACnet Broadcast Management Device (BBMD).

Physical segment

Physically, (cable) networks cannot be expanded as desired. Depending on electrical transmission properties and the data link layer based on it, repeaters must be added at specific cable lengths to amplify the signal. This divides the network into multiple, physical segments. A repeater does not impact the transmission protocol; it merely electrically connects two physical networks.

Dividing up the network into several physical segments may be necessary in LonWorks technology.

See *RXC Installation Guide* (CA110334).

The physical segments are connected with physical or logical repeaters. Due to the limited buffer size of logical repeaters, only physical repeaters may be used on the ALN. Only one physical repeater may be located between any two nodes.

MS/TP is transmitted on a two-wire cable as per EIA-485/RS-485*. The length of the physical segment can be max. 1,200 m and can be extended with EIA-485 repeaters.

*TIA standard (Telecommunications Industry Association): TIA-485-A Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems (ANSI/TIA/EIA-485-A-98) (R2003)

Desigo site

A site is an independent and self-contained logical entity within the building automation and control system. This type of structuring is not defined by BACnet, and is therefore largely independent of the BACnet network topology. The BACnet devices bound to a site can therefore be placed anywhere within a BACnet internetwork. A site cannot extend across a PTP connection. Communication occurs only within the site, but data can be exchanged with any device on the BACnet internetwork.

Only automation stations (PXC/PXC3) and LonWorks system controllers (PXC...D+PXX-L11/12)) are assigned to the sites, by special structuring of the Device ID and Device Name. SX Open and Desigo S7 cannot be assigned to a site. These products are considered third-party devices for the purposes of a site.

Protocol layer model

Desigo supports:

- BACnet/IP
- BACnet/LonTalk (LonWorks technology)
- BACnet/PTP

- BACnet MS/TP
- BACnet/IPv6 (only via PXG3 BACnet router)

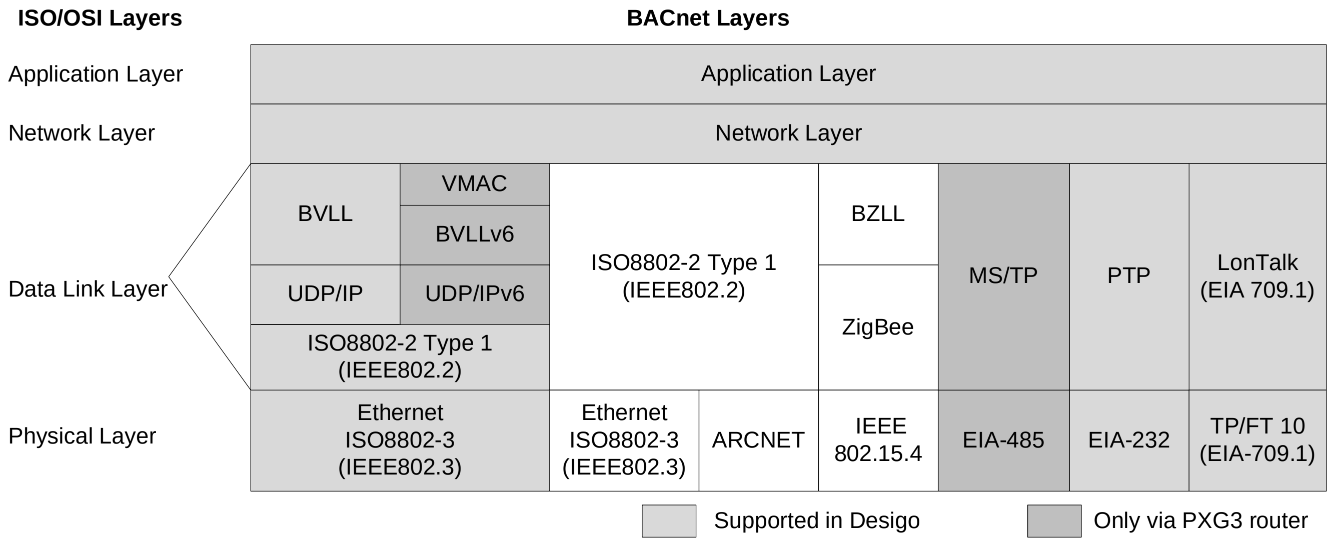


Figure 158: BACnet protocol layer model

BACnet directly over ethernet, ZigBee or ARCnet is not supported.

Application layer

The BACnet application layer defines services, objects and their characteristics. From the network viewpoint, the Device object is important. The object ID and the object name must be unique within the BACnet internetwork.

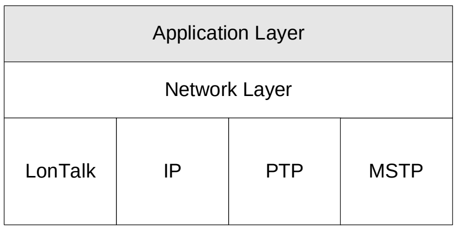


Figure 159: Application layer

Device ID

The Device ID is the object ID of the BACnet device object.

The device ID is divided into the following categories:

Category	Device ID				Description
	Object type	Object instance			
		2 bit	10 bit	10 bit	
Unconfigured	DEVICE	00	0000000000 0000000000		All unconfigured devices
Class A	DEVICE	00	xxxxxxxxxx xxxxxxxxxx (1...1048576)		Third-party devices
Class B1	DEVICE	01		Device number	Stationary operator units (Desigo Insight, Desigo CC)
			0000000000	xxxxxxxxxx (1...999)	
Class B2	DEVICE	01		Device number	Mobile operator units / tools (PXM20, PX Web)
			0000000001	xxxxxxxxxx (1...999)	
Class B3	DEVICE	01		Device number	System devices (BACnet router)
			0000000010	xxxxxxxxxx (1...999)	

Category	Device ID				Description
Class C	DEVICE	01	Site number	Device number	Automation stations (PXC…) System controllers (PXC…)
			xxxxxxxxxx (1...999)	xxxxxxxxxx (1...999)	
Class D	DEVICE	11	xxxxxxxxxx xxxxxxxxxx (1...1048576)		Reserved

Table 47: Desigo definitions

Device name

The device name is the object name of the BACnet device object.

Guidelines

Different rules for object names apply for configuring TD (Technical Designation), UD (User Designation), or FD (Free Designation):

- The TD is generated from predefined partial names, separated by an apostrophe ('), that show the technical hierarchy with plant, partial plant, and component. The TD is supplemented by site name and pin name.
- The names may consist of upper- and lowercase letters and numbers 0 to 9. The site name is separated by a colon (:) and the pin name by a period (.). The maximum total length is 30 characters.
- The UD is formed similar to the TD based on partial names. However, users determine the partial names, structure, and separators. The names consist of upper- and lowercase letters, numbers 0 to 9, and separators, such as _-;=’, etc. The maximum total length (including site name and pin name) is 80 characters.
- The FD is a freely assigned name consisting of letters, numbers and a few special characters, limited within the system only by uniqueness and length. The maximum total length is 80 characters, ten of which, plus one separator, are reserved for the site name.

Category	Device name	Description
Unconfigured	““	Empty string for unconfigured devices
Class A		No rules
Class B1		Meaningful text for the user (this text is used as a reference for the alarm recipient)
Class B2	Model name + device ID	Model name + “ “ + 8 character device ID (hexadecimal). The device name for temporary devices is generated automatically.
Class B3		Max. 25 characters
Class C	Site name + automation station name	Site name + “:“ + automation station name

Table 48: Desigo definitions

Category	Site number	Device number	Device ID	Site name	Device name	Device name
A	–	1	0x02000001	–	Third-party 1	Third-party 1
B1	–	1	0x02100001	–	Management station 1	Management station 1
B2	–	15	0x02100401	–	–	PXM20TMP0210040f
C	1	1	0x02200401	Cham	PXC #1	Cham:PXC #1
C	1	2	0x02200402	Cham	PXC #2	Cham:PXC #2
C	1	3	0x02200403	Cham	PXC... #1	Cham:PXC... #1
C	2	1	0x02200801	Zug	PXC #1	Zug:PXC #1
C	2	2	0x02200802	Zug	PXC... #1	Zug:PXC... #1
C	3	1	0x02200C02	Baar	PXC #1	Baar:PXC #1

Table 49: Examples from the topology at the beginning of the chapter

BACnet device parameters

The BACnet device parameters are written to the devices during commissioning. These parameters include the following values:

Designation	Description	
Max APDU Length Accepted	Maximum length of application message (Application Protocol Data Unit) supported for this device. The length depends on the transport medium used, and the capacity of the device buffer. The length of the APDU must always be less than the length of the smallest NPDU (Network Protocol Data Unit) between the different bus subscribers.	
Beispiel	There are two IP networks linked by a PTP connection. The two IP bus subscribers could have a maximum APDU length of 1476 octets. However, since the maximum NPDU length of the PTP connection is 500 octets, the maximum APDU length of both devices must be set to 480 octets.	
Values for LonTalk	Range:	50/128/206 Octets
	Default value:	206 Octets
Values for MS/TP	Range:	50/128/206/480 Octets
	Default value:	480 Octets
Values for IP (equal for IPv6)	Range:	50/128/206/480/1024/1476 Octets
	Default value:	1476 Octets
APDU Segment Timeout	Timeout of an APDU segment (= part of an APDU). This value must be identical throughout the internetwork.	
	Range:	1000...5000 ms
	Default value:	2000 ms
APDU Timeout	Timeout for an acknowledged message. This value must be identical throughout the internetwork.	
	Range:	1000...5000 ms
	Default value:	3000 ms
Number of APDU Retries	Number of retries in the event of an APDU or APDU segment timeout. This value must be identical throughout the internetwork.	
	Range:	1...5
	Default value:	3

Table 50: Desigo definitions

Window size

To transfer large data packs, BACnet uses the windowing algorithm. Windowing means that instead of acknowledging individual segments separately, the acknowledgement applies to a specific number of segments, referred to as a window.

Definitions for Desigo

The window size is permanently set to four for all Desigo devices, so that for segmented messages, only every fourth segment is acknowledged.

Network layer

The most important information in the network layer is the network number of the BACnet network.

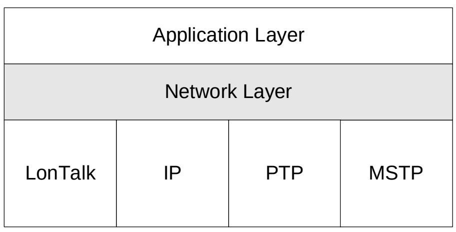


Figure 160: Network layer

Network number

The network number is the unique identification of the BACnet network. There are stationary and temporary networks:

- Stationary networks are defined during commissioning and then remain unchanged.
- Temporary networks are created when a tool (for example, XWP/ABT) dials into a network via PTP.

Range/Value	Description	
0	Reserved for applications with only one BACnet network in a BACnet internetwork, that is, where there are no BACnet routers.	
1...65280	Network number for stationary BACnet networks. You can select any network number in this range. We recommend that you form categories, for example:	
	BACnet/LonTalk networks via (half)router:	1...99
	BACnet/IP network (common network):	100
	Management station or XWP/ABT connected via BACnet/PTP:	1000...1099
65281...65534	Reserved for temporary BACnet networks. Not yet used in Desigo.	

Table 51: Desigo definitions

Router parameters

The router parameters are written to the BACnet router during commissioning. The following information is required for each port (logical connection to network):

Designation	Description	
Network Number	Network number of the directly connected network.	
Max NPDU Length	Max. message length supported in this network. This value depends on the transport medium used.	
Values for LonTalk:	Range:	50/228
	Default:	228
Values for MS/TP:	Range:	50/228/501
	Default:	501
Value for IP (equal for IPv6):	Range:	50/228/501/1497
	Default:	1497
Values for PTP:	Range:	50/228/501
	Default:	228 for LonTalk / 501 for Ethernet/IP

Table 52: Desigo definitions

Hop counter

Every BACnet that is routed to another BACnet network has a hop counter. The counter reading is reduced by one with each pass of the BACnet router. When the counter reads 0, the message will not be routed further. This prevents continuously circulating messages.

Definitions for Desigo

For Desigo the hop counter is initialized with a fixed value of 5. This means that a message can pass through a maximum of four BACnet routers.

LonTalk data link layer

The LonTalk data link layer is supported by the PX automation station and by the operator units and tools.

LonTalk ist he communications protocol for LonWorks technology.

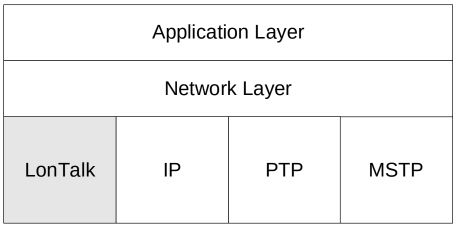


Figure 161: LonTalk data link layer

Addressing under LonWorks technology

Physical address, neuron ID: The Neuron ID is the physical address for a LonWorks device. It is a unique 48-bit (6 byte) identifier which is assigned to each neuron chip during manufacturing.

Logical address: The logical LonTalk address is written to the LonWorks node during commissioning on the network side.

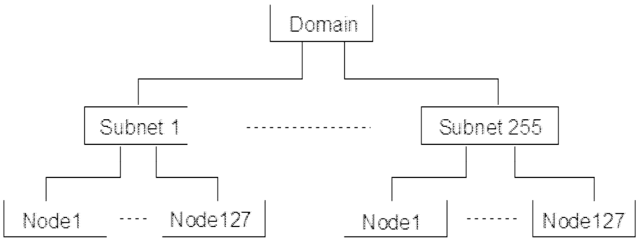


Figure 162: Logical address structure

Domain ID: The domain ID is the highest unit in the LonWorks addressing system. Data can only be exchanged within a domain. A gateway is required for inter-domain communication. The domain ID can be 0, 1, 3 or 6 octets in length. A domain can consist of up to 255 subnets.

Subnet ID: The subnet is a logical collection of up to 127 nodes within a domain. The bus traffic within a subnet can be kept local by using BACnet routers. Subnets must never be defined across a router.

Node ID: Unique identifier within the subnet. Each node can be addressed uniquely within a domain by the subnet ID and the node ID.

Group ID: The group address is a type of addressing. The group address is not used in BACnet.

On the ALN, the following rules apply to Desigo:

Designation	Values/Range	Description
Domain ID	0x49h (73)	The default length of the domain ID is one octet and the default value is 0x49h (73).
Subnet ID	1…255	The subnet ID is a consecutive number that starts with one. The subnet ID is incremented by one when a subnet is full (no free node IDs).
Node ID	1…100	This range is for automation stations (PXC), system controllers (PXC...) and system devices (BACnet routers).
	101…120	Operator units and management stations are assigned to this range.
	121…127	Temporary operator units (PXM20) and tools (XWP/ABT) look for a free node ID in this range.

Table 53: Desigo definitions

IP data link layer

An additional layer, the BACnet Virtual Link Layer (BVLL), is used for BACnet over IP. This layer transmits broadcast messages across IP routers.

Application Layer			
Network Layer			
LonTalk	IP	PTP	MSTP

Figure 163: IP data link layer

Below the BVLL, BACnet relies on UDP (User Datagram Protocol). Unlike TCP (Transmission Control Protocol), UDP supports broadcast messages. The connection monitoring (carried out by TCP) is resolved in the Application Layer.

All media, such as ethernet, are available if supported by IP as physical layers.

For detailed information on the IPv6 data link layer, see *Ethernet, TCP/IP, MS/TP and BACnet basics* (CM110666).

IP addresses

The IP address of stationary and temporary operator units can be set automatically via DHCP (Dynamic Host Configuration Protocol) provided that there is a DHCP server in the network. The use of DHCP is not recommended with automation stations and BACnet routers. DHCPv6 is currently not supported for IPv6.

DHCP is not allowed for devices using integrated BBMD functionality.

The IP addresses must be agreed upon with the IT department.

RFC1918 defines three specific address areas for private networks. IP addresses within these ranges are not routed:

10.0.0.0 - 10.255.255.255 Subnet mask: 255.0.0.0

172.16.0.0 - 172.31.255.255 Subnet mask: 255.240.0.0

192.168.0.0 - 192.168.255.255 Subnet mask: 255.255.0.0

For IPv6, IP addresses and private address ranges are defined differently. See *Ethernet, TCP/IP, MS/TP and BACnet basics* (CM110666).

IP address: Host address of the network subscriber.

Subnet mask: Subnet mask of the IP segment in which the device is located. This value must be aligned with the other IP devices.

The subnet mask is required for the identification of broadcast messages and for communication across IP segments. The subnet mask and target IP address enable the transmitting IP device to decide whether the data packet can be delivered directly to the target device or if it must be forwarded via the default gateway.

For IPv6, the subnet mask corresponds to the network prefix. See *Ethernet, TCP/IP, MS/TP and BACnet basics* (CM110666).

Default gateway: IP address of the IP router. This value is relevant for communication across IP segments.

UDP port number

For BACnet/IP to use UDP, a UDP port number must be defined. Only devices with the same UDP port number can communicate with each other.

Port numbers are divided into the following classes by the IANA (Internet Assigned Numbers Authority):

- Well Known Port Numbers: Fixed port numbers assigned by IANA (0… 1023)
- Registered Port Numbers: Numbers registered with IANA (1024…48151)
- Dynamic and/or Private Ports Dynamically assigned or privately used port numbers (49152…65535)

For BACnet, port number *47808* (0xBAC0) is registered with IANA.

If there are several BACnet internetworks on an IP network, they can be separated by different port numbers. Using several internetworks can be helpful in very large projects, for migration, and to encapsulate sections of a plant with different reliability criteria. Since the management station communicates simultaneously with multiple internetworks, the operation is not restricted.

However, only one port number is registered for BACnet with the IANA. If additional UDP port numbers are required, we recommend the use of port numbers 47809 to 47823 (0xBAC1...0xBACF). This does not comply with IANA regulations. This range is reserved for future applications and should not be used. There is only a very small chance that these ports might be used elsewhere. To avoid clashes, do not use any port numbers from the range of dynamic or private ports. See www.iana.org/assignments/port-numbers.

BACnet Broadcast Management Device (BBMD)

The BBMD is required as soon as IP routers are used in a BACnet network. IP routers limit broadcast messages to the local IP segment, that is, they do not allow any broadcast messages to pass through. In order to distribute BACnet broadcast messages across IP segments irrespective of this limitation, a BBMD is required in the relevant IP segments. If a BBMD receives a broadcast message, for example, within the local IP segment, it transmits this as a unicast message to all other BBMDs. The BBMDs then transmit the received message to their own local IP segments. BACnet refers to this as two-hop distribution:

1. Hop: BBMD sends a unicast message to all other BBMDs.
2. Hop: They then distribute the message to all BACnet devices in the local IP segment.

One-hop distribution can be implemented with Direct Broadcasts. In this case the BBMD sends a direct broadcast to all remote IP segments. This broadcast is received by all IP bus subscribers in the relevant segment. Not all IP routers support Direct Broadcasts.

IPv6 (BVLLv6) only supports two-hop BBMD. Broadcasts are implemented via IPv6 mutlicasts. See *Ethernet, TCP/IP, MS/TP and BACnet basics* (CM110666).

BBMDs ensure that broadcast messages are distributed in a BACnet network. They are grouped by BACnet network. A maximum of one BBMD is allowed in any one IP segment.

BACnet network #100 is separated by IP routers. The Internet also contains IP routers. This is why different segments are shown before and after the Internet cloud. BBMDs are required so that BACnet broadcast messages are available in all IP segments.

BBMD parameters

The BBMD parameters are written to the BBMD or (for Desigo) to the BACnet router during commissioning. The following information is required for each BBMD in the BACnet network:

Designation	Description
IP address	IP address of the BBMD.
UDP port	UDP port number of the BBMD.
Broadcast mask	If the BBMD is to be addressed via direct broadcast (one-hop distribution) the subnet mask of the BBMD must be specified. Since not all IP routers support this mechanism, direct broadcasts are not supported by default. Two-hop-distribution is always possible. The broadcast mask is then 255.255.255.255. Not required for IPv6.

Table 54: Structure

Foreign device

A foreign device is a (remote) BACnet device in a remote IP segment. It registers with a BBMD in order to send or receive broadcast messages. Registration with a BBMD involves making an entry in its Foreign Device Table (FDT). The registration must be renewed at regular intervals.

The foreign device does not send broadcast messages, but passes them as unicast messages to the BBMD for distribution. The BBMD in turn passes incoming broadcast messages as unicast messages to the foreign devices in its FDT.

In the Desigo system, the management station, XWP/ABT, PX Web and PXM20-E can be operated as foreign devices. IPv6 does not support foreign devices

Examples from the Desigo topology

- IP Segment 1: Management station 1 does not have to be configured as a foreign device, because this IP segment contains a BBMD.
- IP Segment 2: PXM20-E does not have to be configured as a foreign device, because this IP segment contains a BBMD.
- IP Segment 2: Management station 3 does not have to be configured as foreign device, because this IP segment contains a BBMD.
- IP Segment 3: This segment only contains Management station 2. To enable Management station 2 to receive and send broadcast messages, it must register with a BBMD as a foreign device. It does not matter with which BBMD it registers.

Foreign device parameters

If a BACnet device operates as a foreign device, the IP address and UDP port number of the BBMD must be specified.

Designation	Description
IP Address of BBMD	IP address of the BBMD with which the foreign device registers.
UDP Port of BBMD	UDP port number of the BBMD with which the foreign device is registered. The default is 0xBAC0.

Table 55: Structure

The recording interval (Time-To-Live) for Desigo products is set at 300 seconds (= 5 minutes).

PTP data link layer

The PTP Data Link Layer is used for remote management over the telephone line. Unlike LonTalk and IP, PTP does not allow the creation of a network. The PTP connection is always between two half routers, and between two different BACnet networks. Several BACnet networks may be located at each end of the PTP connection. Only one active communication line can exist between any two BACnet networks or between any BACnet devices.

The half-router function is implemented in the management station, XWP/ABT and PX.

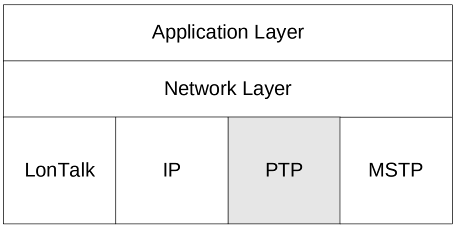


Figure 164: PTP data link layer

PTP connections are only possible between the management station, XWP/ABT und PX. PTP connections between PXs are not permitted.

PX devices which can be reached via PTP always belong to a separate site. With reference to the topology at the beginning of the chapter, the site named Baar must not be combined with the sites named Zug or Cham. Several PXs per site can be used as half routers. When establishing a communication, the best-performing connection is always selected. Redundancy is not allowed, that is, several simultaneously active connections in a given BACnet network are not allowed.

With the management station, a separate, independent, internal BACnet internetwork is created for each Data Link Layer type. Routing between LonTalk, IP or PTP is therefore not possible.

The following parameters are required for each half router:

Designation	Description
Local network number	The BACnet network number to which the half router belongs. With PX, the local network number is the same as the device's own network number. The management station supports all three different Data Link Layers (IP, LonTalk and PTP). They are handled internally as independent BACnet internetworks. This means that routing between the different Data Link Layers is not possible. Therefore, the local network number can be allocated to IP and/or LonTalk independently of the networks. However the local network number must be unique among all networks which could possibly be reached from the management station via a PTP connection. Recommendation: If the management station has an additional Data Link Layer (IP and/or LonTalk), the local network number of this network should be used (example in the beginning of the chapter: For management station 2, the local network number of BACnet network #4 should be adopted). In a management station system with only one PTP connection, the local network number must be in the range 1000 to 1099. (Example: Management station 3 -> #1000).
COM parameter	For the PX half router, the COM port to which a modem or null modem is connected must be specified.
Modem parameters	The modem parameters contain individual settings for the relevant modem types. Predefined parameter sets are available for the PX half router.

Table 56: Parameters for half routers

The following parameters are required for each PTP connection starting from a PX half router:

Designation	Description	
Remote network number	This network number determines the BACnet network in which the remote partner device is located. In the Desigo system this is the local network number of the management station.	
Remote area name	The remote area name stands for a peer-to-peer remote network number of the network containing the management station. During configuration, the remote area number lets you assign a clear name to the (remote) alarm recipient rather than a network number.	
Telephone number	The telephone number for access to the remote device.	
Performance index	The performance index refers to the quality of the router data connection. If multiple PX half-routers are available in a PX site, and if a connection to a remote network is to be established, the router with the best performance index is selected. If no connection is established, the router with the next best performance index automatically tries to connect.	
	Range: 0...255	(0= best / 255 = worst connection)

Table 57: Parameters for PTP connections

For each PTP connection in the management station, only the telephone number needs to be defined.

Data link layer MS/TP

Data Link Layer Master/Slave Token Passing MS/TP is another protocol variant for BACnet. Desigo supports this variant via a specific router that connects BACnet MS/TP to BACnet/IP.

MS/TP is based on the physical layer EIA-485/RS-485 and supports baud rates up to 76.8 kbps. Up to 256 devices can be connected to one MS/TP segment (in theory, dependent on their unit load).

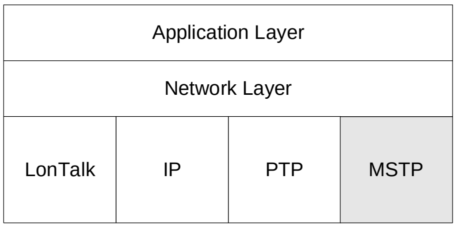


Figure 165: Data link layer MS/TP

Addressing MS/TP devices

Each device has its own unique MAC address. The MAC address is one octet long and defined as follows:

- 0-127 reserved for master devices
- 0-254 reserved for slave devices
- 255 reserved for broadcasts

The MAC address can be set via DIP switch (hardware) or related configuration tools (software) for each device.

Structuring

MS/TP is transmitted via two-core cables as per EIA-485/RS-485. The maximum length of a segment is 1200 meters. The specification allows for up to 32 full unit load devices on the segment (unit load is the assumed load derived from electrical resistance of the transceiver block in the device). Modern devices only need load units of 1/2, 1/4 or even 1/8. This allows for up to 256 devices per segment.

Different segments can be interconnected via repeaters to form a larger EIA-485-network. The specific electrical properties, such as polarity, common signal ground, terminating resistances, etc. must be taken into account. The actual, possible network size and maximum transmission rate primarily depend on the network structure. Establishing a network in daisy chain form is best.

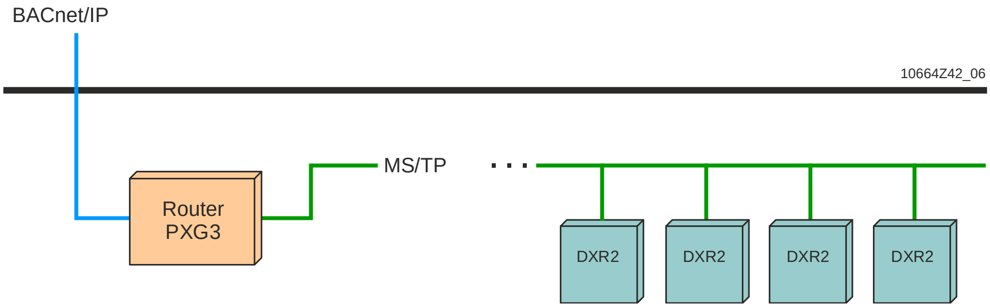


Figure 166: MS/TP nodes in a line architecture

Due to relatively difficult, electrical conditions imposed by EIA-485 wiring and limited data transmission capacity, we recommend using BACnet MS/TP only for devices with low data volumes that are geographically far apart.

For devices with larger data volumes and shorter distances to the Desigo automation station, integration in Desigo primarily should be carried out via TX Open or PX Open.

System devices

PXG3 is a BACnet router that routes BACnet telegrams between BACnet networks and different data link layers. It is available in two versions:

- PXG3.L: (triangle router) Simultaneous routing between Ethernet/IP, LonTalk, and MS/TP
- PXG3.M: Routing between Ethernet/IP and MS/TP

See *BACnet router for BACnet/Ethernet/IP, BACnet/LonTalk, BACnet MS/TP PXG3.L, PXG3.M* (CM1N9270).

An individual BACnet IPv6 data link can be used as an option for the router. As a result, the PXG3.M is turned into a triangle router and the PXG3.L to a square router. The router can be configured either via XWP or the integrated web server.

BACnet address

Every BACnet device in the BACnet internetwork can be accessed via its BACnet address.

The BACnet address is defined by the BACnet standard and comprises the following elements:

<table>
<tr><th>Designation</th><th colspan="2">Description</th></tr>
<tr><td>Network number</td><td colspan="2">Network number of the BACnet network in which the device is located. The network number is only parameterized on devices with BACnet router functionality (including half router) and is implicitly valid for all BACnet devices in the BACnet network.</td></tr>
<tr><td rowspan="5">BACnet MAC address</td><td colspan="2">Address specific to the transport protocol. This address is written to the device in the commissioning phase.
BACnet MAC address for:</td></tr>
<tr><td>LonTalk:</td><td>2 octets, subnet ID und node ID</td></tr>
<tr><td>IP:</td><td>6 octets, IP address and UDP port</td></tr>
<tr><td>IPv6:</td><td>3 octets as virtual MAC address (VMAC)</td></tr>
<tr><td>MS/TP:</td><td>1 octet, MAC address (master 0-127, slave 0-254, broadcast 255)</td></tr>
</table>

Table 58: Structure

BACnet device address

Each BACnet device has a device address. This address is written to the device during the network commissioning process. The BACnet device address is unique within the BACnet internetwork. The term BACnet device address is an in-house term rather than an official BACnet term.

Designation	Description
Device ID	Object identifier of the BACnet device object. The device ID is unique within the BACnet internetwork.
Device name	The object name of the BACnet device object. The device name is unique within the BACnet internetwork.

Table 59: Structure

13.2 LonWorks Architecture (ALN)

With the LonWorks-based communication protocol complete networks made up of interoperable products can be created. The protocol conforms to ISO/IEC 14908 (worldwide), EN 14908 (Europe), ANSI/CEA-709/852 (U.S.) and is also standardized in China. See www.lonmark.org.

LonWorks is suited for use with different types of transmission media, such as twisted pair cables, power line, RF, fiber optics or IP (TCP/IP and UDP/IP) It supports straightforward installation with different cabling topologies (for example, star or line). The connection of objects via bindings (for example, standard network variables (SNVTs), standard configuration properties (SCPTs)) can be defined at the project engineering stage or can be adapted in the field.

Structure

The following figure shows the structure of a Lon network in the FLN

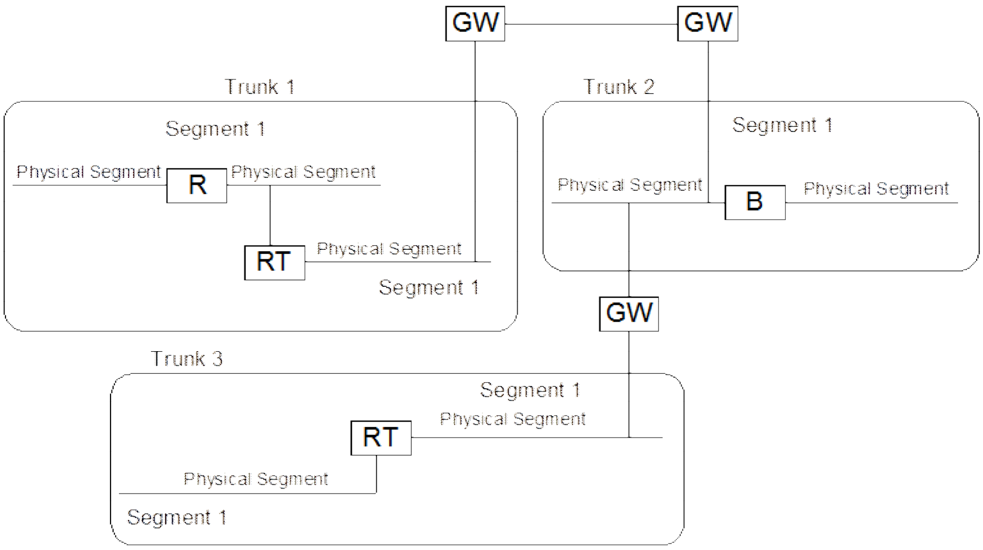


Figure 167: LonWorks network

Key:

R	Repeater, for example, LonWorks physical repeater
B	Bridge, for example, L-Switch (Loytec)
RT	Router, for example, LonWoks router
GW	Gateway, for example, PXC..., RXZ03.1

See *LonWorks networks Checklist* (CA110335).

Trunk

A trunk holds all devices that can communicate with each other directly or via repeater, bridge or router. The term trunk is specific to the Desigo system. One trunk corresponds to one LonWorks or Desigo RXC project. Trunks can be connected via gateways.

Segment

A trunk can be divided into segments. The segments are connected by a router. If there are no routers, the trunk comprises only one segment.

Physical segment

The physical segment is the communication medium. LonWorks devices are connected to the physical segment. One segment can be divided by bridges or repeaters into several segments. The number of devices per physical segment is limited. See *RXC Installation Guide* (CA110334).

System devices

Gateway

The gateway links trunks. It operates on the application layer of the ISO/OSI layer model. The following LonWorks gateways are available:

The RXZ03.1 point coupler provides a fixed number and type of LonTalk network variables (NV). Each side of the point coupler belongs to a trunk or LonWorks project. The point coupler can be used to implement time-critical connections between two trunks. The point coupler integrates third-party devices that have been engineered with a different tool.

Loytec L-Proxy and Sysmic XFM-LL are freely programmable point couplers. The XFM-LL device may be used, when depicted like a standard third-party device (configuration via its own tool).

The PXX-L.. extension modules let you connect LonWorks devices to the PXC..D modular series. This adds the grouping, schedule, trend, and alarm management functions to the RXC room automation and allows the mapping of data points to BACnet/IP or BACnet/LonTalk.

The LonWorks router operates on the network layer of the LonWorks protocol. It filters data packets based on their subnet ID or group ID. Subnets or groups must

Router

never be defined across a router, that is, the subnet IDs and group IDs at each end of the router must never be the same. Routers are used where there is heavy local network traffic. They allow the unloading of unaffected devices from the network traffic. In Desigo there are no large LonWorks networks, as the FLN is divided into trunks. Routers are only required in exception cases.

L-Switch (Loytec)

The L-Switch filters the package on the basis of the subnet/node ID or group ID. It automatically learns the topology and forwards the data packets accordingly. The L-switch does not have to be configured. Unlike the router, there is no need to take account of any addressing limits (allocation of Subnet ID or Group ID).

Physical repeater

LonWorks has physical and logical repeaters. The physical LonWorks repeater does not filter the data packets. It regenerates the electrical signal. One physical LonWorks repeater can be used in the path between any two devices within a segment.

In logical repeaters, the data packet is processed by the neuron chip. This enables several logical repeaters to be connected in series. The disadvantage is that the logical repeater must be configured, and that owing to the limited size of the buffer, it cannot be used for large data packets, that is, for BACnet/LonTalk.

13.3 KNX Architecture (ALN)

KNX is an open standard that conforms to EN 50090 and ISO/IEC 14543. See www.knx.org. KNX corresponds to the former European Installation Bus (EIB) and is backward-compatible.

With KNX technology, advanced multiple disciplines and simple solutions can be implemented to satisfy individual requirements in room and building automation in a flexible way. The ETS, a vendor-independent tool is available for commissioning.

KNX can use twisted pair cables, radio frequency (RF) or data transmission networks in connection with the Internet Protocol for communication between the devices. KNX has links and interfaces for connection to Ethernet/IP, RF, lighting control with DALI and building automation and control systems.

Structure

The following figure shows the structure of the KNX network:

- KNX: KNX devices, for example, third-party KNX
- PX KNX: Automation station PXC001.D or PXC001-E.D and PX KNX firmware

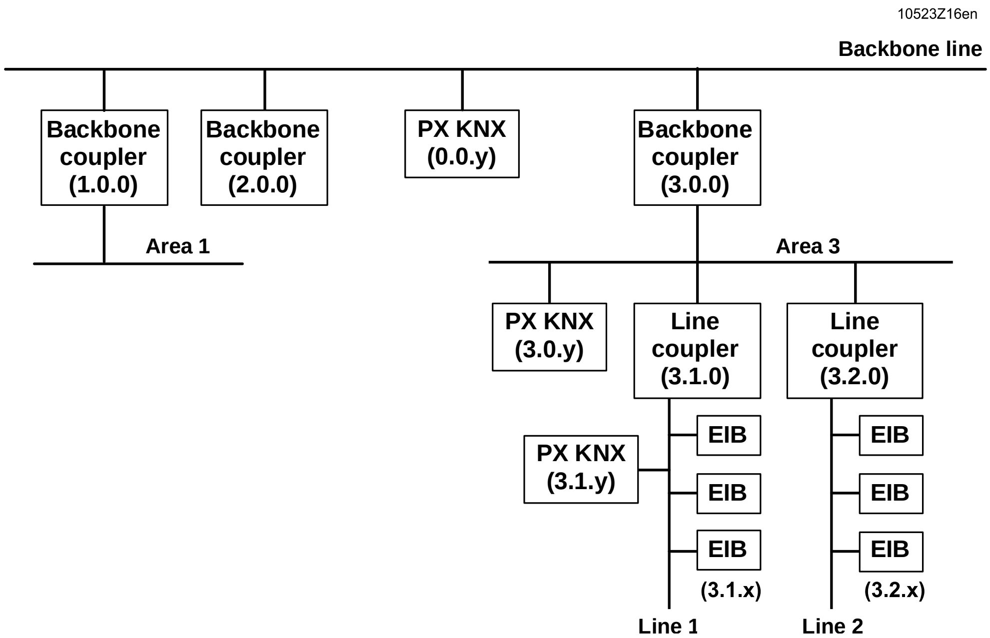


Figure 168: KNX network topology

Line

A KNX network consists of lines. Up to 64 devices can be connected to each line.

Area

Up to 15 lines can be connected to a main line via line couplers (LC). This is called an area.

Backbone line

The topology can be expanded by means of a backbone line. Up to 15 areas can be connected to the backbone line via backbone couplers (BC). Technically, these are the same devices as line couplers.

Line/Backbone couplers

Couplers separate the areas and lines. Couplers keep the bus traffic within bounds. Datagrams that are only needed on one line should not create a load on the entire network and hence have to be confined to that line. Respective filter tables are created (ETS) when setting up the project/network.

Engineering Tool Software (ETS)

The KNX Engineering Tool Software (ETS) is used to create KNX projects. A bus interface is required to commission the devices with ETS.

For a detailed description of the KNX topology, see http://www.knx.org/fileadmin/template/documents/downloads_support_menu/KNX_tutor_seminar_page/basic_documentation/Topology_E1212c.pdf.

System Devices

PX KNX

The PX KNX system controller maps KNX devices to BACnet objects. PX KNX also supports different system functions, such as grouping, scheduling, alarming, trending, etc.

The system controller must be positioned correctly in relation to the topology and the load on the bus caused by the devices and connections (group addresses).

Bus power supply

Each line and each area must include a bus power supply.

13.4 KNX PL-Link Architecture (FLN)

KNX PL-Link (PeripheraL-Link) connects communicating room and field devices (room devices, sensors, actors) with the PXC3 room automation station and the DXR2 compact room automation station. KNX PL-Link fully complies with the KNX standard.

Siemens field devices can be connected to the KNX PL-Link using the KNX PL-Link plug & play capability. KNX PL-Link devices are configured using the Desigo tools. The KNX commissioning software (ETS) is not needed.

One or more KNX PL-Link devices are connected to the trunk of the corresponding room automation station in a line topology.

A comprehensive library with preconfigured devices supports simple engineering.

The PXC3 room automation station allows for simultaneous integration of devices with KNX PL-Link and KNX S-Mode on a single bus line. Devices with KNX S-Mode are additionally commissioned using ETS.

Structure

The following figure shows an example of a logical network topology with KNX PL-Link devices, a room automation station and several rooms.

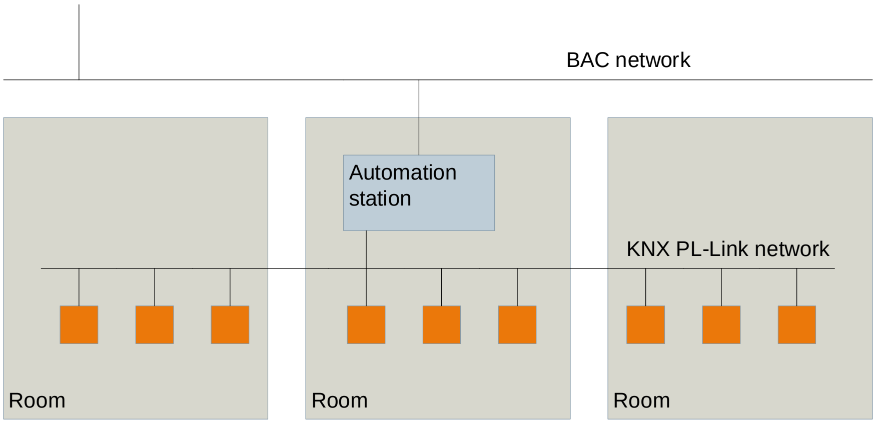


Figure 169: KNX PL-Link logical network topology

Power supply concept

The PXC3 and DXR2 room automation stations have an integrated KNX power supply to supply their trunks with the corresponding KNX PL-Link devices. This allows simple installations, for example, an automation station with one or a few room units, without an extra device for power supply to the KNX PL-Link network. If many KNX PL-Link devices are connected, the power supply at the room automation stations is shut off and an external KNX power supply must be used.

The following figure shows the concept of a built-in power supply unit (PSU):

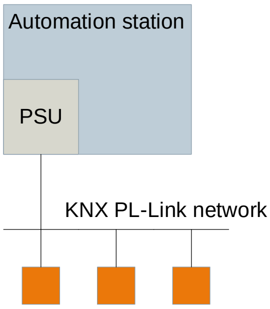


Figure 170: Built-In KNX PL-Link power supply unit

System devices

Third-party KNX devices can be integrated in KNX PL-Link networks via KNX S-mode. The KNX Engineering Tool Software (ETS) is necessary to engineer and commission these devices.

DXR2.M.. automation stations cannot integrate KNX S-Mode devices.

13.5 DALI Architecture (FLN)

DALI (Digital Addressable Lighting Interface) is a dedicated protocol for lighting control. See www.dali-ag.org.

DALI is tailor made for modern lighting solutions. A DALI system can be as small as a single luminaire, or can encompass multiple systems across one or more buildings. DALI systems can be connected using lighting hubs/routers.

DALI features:

- Max. 64 devices per subnet (hub/routers)
- Max. 300m cabling
- Max. 250mA device consumption
- Standard two-core cable (1,5mm²)
- Polarity free & free wiring topology
- DALI power and data on the same pair of wires
- Bidirectional communication with feedback of operating state (dim level, lamp failure, etc.)

Structure

A DALI system can be made up of control gear, control devices and bus power supplies.

Control gear

Control gear usually contains the power control circuit to drive lamps, or some other type of output, such as on/off switching or 1 to 10 V analog signals.

Control devices

Control devices can provide information to other control devices, such as light intensity information, and can send commands to control gear. Input devices are a type or a part of a control device that provides some information to the system, such as a button press or movement detection. DALI application controllers are also control devices, for example, they can send commands to control gear to modify the lighting.

Bus power supplies

At least one bus power supply must be present in a DALI system. This is necessary to allow both communications on the bus, and to power any bus-powered devices. The bus power supply does not need to be a separate unit – it could be part of another device such as a LED driver or a sensor.

Bus wires

A DALI system also includes the bus wires that are used to connect the DALI terminals of the various devices in the system.

Addressing

DALI allows the flexible addressing of devices.

At the simplest level, all devices are addressed simultaneously by broadcast commands. This allows the control of lighting in a similar manner to 1 to 10 V analog control, without requiring any configuration of the individual devices. If a level (Direct Arc Power Command) is broadcast, then all control gear will act upon that command, changing their output to the same new level.

With simple configuration, DALI devices can be given one of 64 short-addresses. This allows individual control, configuration and querying of any single device in the system.

DALI devices can also be group addressed. For example, a DALI LED driver could be programmed to be in any combination of the 16 available groups. When a command is sent to a group, only devices that are in that group are addressed.

System devices

PXC3...A

The PXC3…A automation stations have a DALI bus for connecting up to 64 DALI ballasts/drivers.

PXC3.E16A

The PXC3.E16A room automation station is optimized for lighting applications. It has an onboard DALI interface for connecting up to 64 electronic ballasts or LED drivers

14 Remote Access

The remote access is an access to resources via the internet or a point-to-point connection.

The remote access is used to:

- Connect a remote location to a management station, for example, for on-call service, managing different locations or support by a specialist
- Remotely access a management station
- Make a change, create an extension or search for errors using an engineering tool
- Forward alarms as text messages or emails from PX Web, TP Web or a management station

14.1 Remote Access Methods

There are two remote access methods:

- Methods that establish a direct point-to-point connection
- Methods that use public networks (for example, telephone networks for accessing the internet) as a transport medium

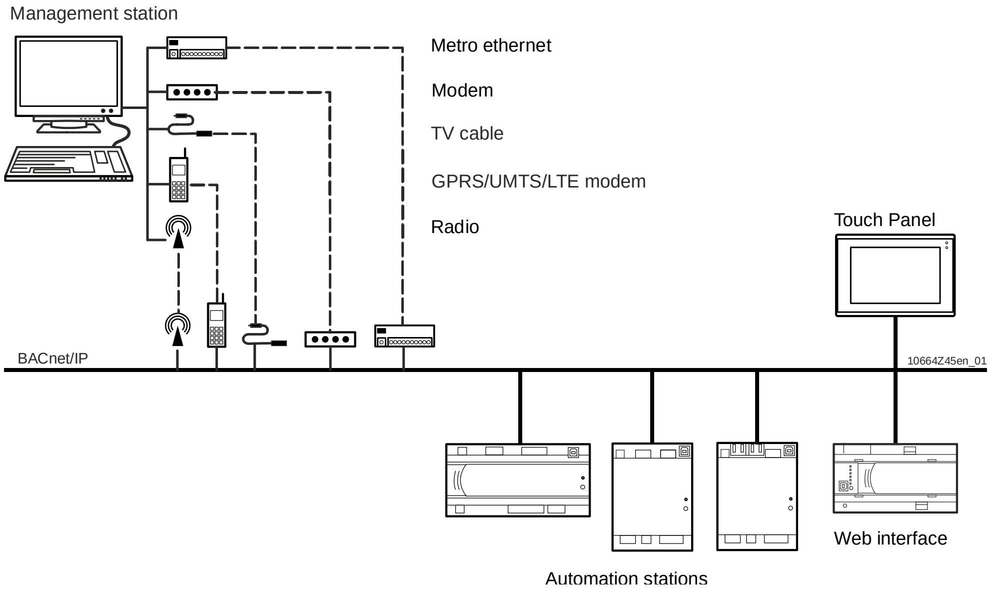


Figure 171: Remote access methods

The following access networks can be used for the remote access:

- Telephone network
- TV cable network
- Other cable-based networks, such as metro ethernet
- Mobile networks
- Other RF-based access networks

Telephone network-based technologies

DSL variants

Characteristics of DSL variants:

- There are different ADSL and VDSL variants. The DSL variants are country-specific.
- The uplink (that is, the data flows from your private home or project to the internet) and downlink (that is, the opposite direction) bandwidth are different. Take this into account when you select a suitable internet access.

- The DSL line in parallel can be used for telephone calls.
- If you want to use telephony on the same line, you need a splitter in addition to the DSL modem.

TV cable-based access

- This access is similar to DSL. You can access the system remotely via a cable modem provided by the cable network operator.

Other cable-based networks, such as metro ethernet

Characteristics of other cable-based networks, such as metro ethernet:

- Connections with very high bandwidth are available.
- A metro ethernet connection is usually not implemented as part of a BACS project.

Use of mobile telephone networks

The available bandwidth is shared by an unknown number of users with an unknown usage profile. The maximum data transfer rates that are advertised by the mobile network operators deviate substantially from the actual data transfer rates.

The access via a mobile network is less stable than via a cable-based network in terms of availability and data throughput.

If you have to establish a remote access in a remote area, check the service availability and stability. You can use the distance from the base station of the network operator as a criterion. You can also check if there are any large obstacles (mountains, etc.) between the base station and the building.

LTE & UMTS

Characteristics of LTE & UMTS:

- Can be fast

GPRS

Characteristics of GPRS:

- The speed suffices merely for tasks requiring a low bandwidth, for example, for the system to send an email with a small attachment.

Other RF-based access networks

Characteristics of such RF-based technologies:

- Suited for remote locations, when no DSL is available.
- There are various technologies used by the different providers. Find out what is available at your location.
- Depending on the used frequency, transmission problems can occur during rain or snowfall, even over short distances.

14.2 Choosing a suitable Access Technology

The technology depends on your intended use and the required bandwidth.

For details about the required bandwidth of the management stations, see chapter *System Configuration*.

I want to use the remote access for...	DSL	LTE & UMTS	GPRS	TV cable	Metro ethernet	RF-based
Remote access to the management station	o/+	o/+	-	+	+	o/+
Remote access to another BACnet client	+	o	o/-	+	+	+
Connecting a Desigo system to a management station	o/+	-/o	-	+	+	o/+
Alarm forwarding	+	+	+	+	+	+

Table 60: Which remote access technology is suitable for which task?

Key:

+ Good
o Slow but still possible
- Not possible or too slow

The different access technologies are available with different bandwidth, for example, DSL (o/+) can be fast or relatively slow.

Costs

The costs are divided into monthly basic costs and usage costs. To optimize costs, analyze your usage profile, that is, how many times per month do you use it and how much data do you exchange per use.

A data flat rate ensures that the costs are capped. Choosing an inappropriate rate plan for a mobile subscription could result in high costs.

Availability

RF-based links and all mobile network-based transmission standards can suffer from transmission problems due to bad weather especially at the cell border. The bandwidth that can effectively be used in the project can vary over the day, because the bandwidth is shared by all users. The bandwidth variations for cable-based technologies are lower.

Recommendations

To ensure a reliable remote access, use cable-based technologies even if the cost is slightly higher. Use mobile networks or RF-based systems only if no alternative is available. If you require a high availability remote access, you can additionally establish a mobile network-based link as a fallback solution. To do this, use a router that offers both a DSL and a GPRS/UMTS/LTE modem.

i

Every remote access can be attacked. Note the safety measures in the document *IT Security in Desigo Installations* (CM110663).

i

Access to the PXC..D/-U automation stations via Desigo Insight remote management or Xworks Plus (XWP) can be protected with a password (password property for remote access [RemAcpwd]). You can enter the password in the Device Property dialog in XWP.
If the automation station establishes the connection, the connection is not protected by a password.

Migrating from an analog modem-based method

Analog modems should not be used in new installations and are not future-proof due to the migration of the networks to Voice over Internet Protocol (VoIP).

ISDN also is not a future-proof technology and should therefore not be used.

If DSL is available, use DSL. Otherwise, use other cable-based internet access networks. If you cannot use such a network, use a mobile network or an RF-based access.

If a project is based on LON, use the PXG3.L router, to connect the remote access on the IP side of the router.

14.3 Technical Details

DSL

The DSL modem must match the used xDSL technology and should be purchased in the country of use. DSL connections can use different coding methods, which differ from country to country.

A modem either has one RJ45 connector for connecting the router or has a built-in router. The router must be configured. The modem needs an access code from the Internet Service Provider (ISP).

If the telephone line is to be used for DSL and telephony, a DSL splitter that splits the phone and data signals is necessary.

TV cable-based method

The operator provides the modem. Sometimes, you have to configure the modem. Usually, the cable operator provides a preconfigured modem or the modem configures itself automatically when you connect it for the first time. The modem has an RJ45 connector to connect it to the IP network (the router) or a built-in router. The router must be configured. Sometimes you need to enter an access code received from the operator.

A separate DSL splitter for splitting TV and data signals is not necessary.

Metro Ethernet

Metro ethernet is usually not implemented in a BACS project and is therefore not described in this document.

Use of mobile telephone networks (GPRS/UMTS/LTE)

Several suppliers offer GPRS/UMTS/LTE modems, for example, modems for private use and modems for industrial applications (also top-hat rail).

Because of the attenuation of the walls and ceilings, the signal inside a building can be weak, that is, an antenna must be placed on the exterior of the building, preferably on the roof.

You can get the best signal strength when the nearest base station of the mobile network you want to use is not too far away and there are no large obstacles between the base station and the modem's antenna (line of sight). Directional antennas improve the transmission quality, but must be optimally directed towards the base station.

The antenna cable between the modem and the antenna must be short, otherwise the signal is too weak. Observe the manufacturer's information on the cable type and maximum length. Antenna cables may not be bent or pinched too severely. The mobile modem must be placed near the optimum antenna location. The length of the cable to the IP network is not that critical.

The mobile network operator provides the SIM card. SIM cards come in various sizes, depending on the modem. Choose the correct SIM card.

The modem is connected to the IP network. The safety measures depend on the modem.

GPRS modems with an RS-232 connection can be connected to some PX controllers using a USB-RS-232 converter.

RF-based access networks

Since there are different technologies, an RF-based access is only implemented in tight cooperation with the network operator. We recommend that you strictly follow his guidelines.

15 Management Stations

A building automation and control system encompasses all control functions of one or more buildings.

In addition to typical HVAC systems, there is a need to integrate other areas of the building, such as lighting and blind control systems, fire alarm systems and access systems.

At completion the system comprises one or more superordinate management stations that let you centrally operate and monitor the individual plants, while each plant's technical building equipment still continues to work autonomously.

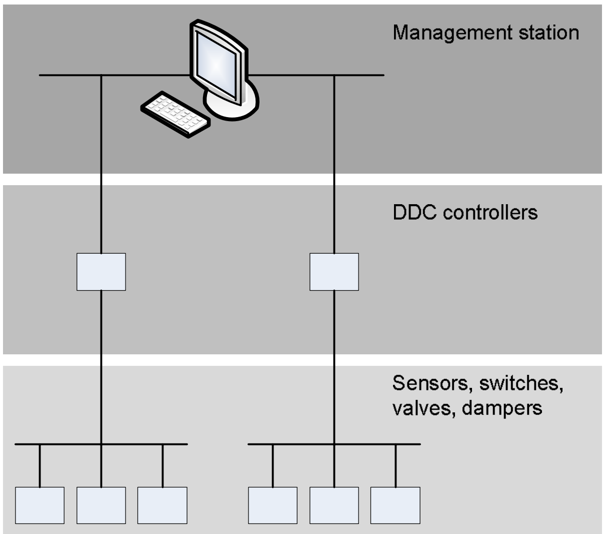


Figure 172: The management station lets you operate and monitor the plants

Functions

The management level has the following functions:

- *Central operation* of HVAC processes and related areas of a building
- *Visualization, storing and interpretation* of data from underlying levels
- *Control of superordinate functions* (time catalogs, external process reactions)
- *Interface* for external communication (alarm messages, etc.)
- *Data exchange* between DDC controllers (automation level)

Requirements

Modern building automation and control systems need to fulfill the following requirements:

- User friendliness
- Integration capability
- Expandability
- Remote operability
- Cost effectiveness

Advantages

Under the brand name Desigo™, Siemens offers a system family of complementary automation modules and management stations for buildings and infrastructures of all types and sizes.

The Desigo management stations have the following advantages:

- A uniform interface for all connected areas from heating, ventilation and air-conditioning through fire alarm systems, video solutions and intrusion alarms to access control systems.
- Cost-effective solutions in every expansion phase through the broad scalability of the number of data points, functions, and broad integration of subsystems.
- A state-of-the-art graphical user interface.
- PC- or server-based management station based on the current Microsoft operating system.

15.1 Desigo Insight

Client-server architecture

Desigo Insight is based on a client-server architecture, which improves system performance and reduces the costs of a large installation with multiple user stations. Desigo Insight can be installed as a desktop, server or web application.

Desktop application

The desktop application is suitable for small plants and does not have web and remote desktop access.

Server application

The client-server application with centralized data handling and enhanced access through web or remote desktop is suitable for larger or more complex installations.

Web application

The web application is suitable for operation as a service. The Desigo Insight server process can thus run continuously, like the web server (MS IIS), without a Windows user being logged in or without the need to start a desktop application. This lets you access the plants via the web at any time.

The Desigo web application provides the most important Desigo Insight user functions. It does not provide engineering and configuration tasks.

Terminal server application

Via the terminal server function, a remote desktop client has full access to all Desigo Insight functions, including engineering and configuration (remote service and engineering). To use the remote desktop and terminal server functionality, Desigo Insight must be installed for operation as a service.

15.1.1 User Functions

Desigo Insight shell

The Desigo Insight shell is a taskbar that shows the connected sites, time and date, pending alarms and events, and the logged in user.

The taskbar lets you do the following:

- Log in and log out
- Launch Desigo Insight user functions
- Connect and disconnect the site
- Start configured third-party applications
- Open the online help
- Close Desigo Insight or third-party applications

Plant Viewer

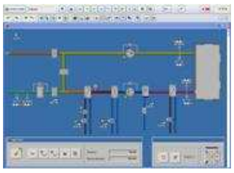


Figure 173: Plant Viewer

The Plant Viewer graphically displays the areas of a building and the associated plants. You can monitor and control data points in the building, change values and acknowledge alarms. You can view several windows at the same time (overlapping or tiled). You can even view large graphics, such as floor plans by freely adjusting their size.

Measured values, setpoints, operating states and alarms are continuously updated and displayed in real-time. You can define the way they are displayed during engineering, for example, status changes are indicated by the object symbol, such as animation, change in shape and color.

Time Scheduler

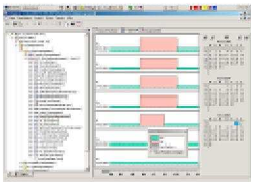


Figure 174: Time Scheduler

The Time Scheduler lets you centrally program all time-controlled functions in the building automation and control system, including the individual room control system. With the graphics-based operation of weekly schedules and exception programs, you can easily modify and optimize scheduler programs at any time.

Alarm Viewer

Figure 175: Alarm Viewer

The Alarm Viewer displays alarms by type, and helps you choose the appropriate action required by the system. Its extensive filter and search functions, help you quickly find the necessary information.

In larger systems with more than one management station, all management stations access the same alarm database. An alarm for any given management station is entered in this database and automatically displayed on all management stations.

Alarm Router

Figure 176: Alarm Router

The Alarm Router transfers messages or events in the building automation and control system to specific receivers without the need for user action at the management station. The Alarm Router launches when Desigo Insight is started, and runs in the background whether or not a user or site is connected.

Alarms and important system events can be transferred via the following media:

- Printers
- Faxes
- Pagers
- Mobile phones
- E-mail systems

Trend Viewer

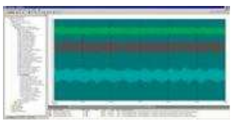


Figure 177: Trend Viewer

The Trend Viewer displays current process data in real time (online) and past process data (offline) in a historical view over a time period in an easy-to-use graphical or textual form. The Trend Viewer is used to optimize plant operation and reduce costs.

Trend data can be displayed in the following modes:

- *Online trend logging* displays real-time process data that are updated whenever a change of value (COV) occurs, or as the result of a time-based scan.
- *Offline trend logging* displays past process data that was recorded by an automation station and uploaded to a database at the management level.
- *Archive data* displays older data that was moved from the trend database into archive files.

The trend views can be saved. Online trend data can be continuously logged and stored in the trend database.

Eco Viewer

Figure 178: Eco Viewer

The Desigo System Eco Monitoring function offers decision-making basics on economic operation of primary plants. The Eco Viewer uses reference data (quality status indicators) to illustrate the efficiency of primary plants in real time (baseline comparison). If limit values are violated, the Green Leaf display in the Eco Viewer and Plant Viewer changes its color from green to red. To evaluate data, the calculated value for the associated time period is logged via Trendlog object.

Object Viewer

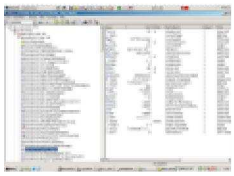


Figure 179: Object Viewer

The Object Viewer helps you navigate through the entire structure. You can select, view and change the hierarchically organized data objects.

The Object Viewer supports four hierarchical views:

- *Technical View* is the plant-based standard view associated with the technical designation (TD).
- *User View* is based on customer-specific user designations (UD) (user addresses). The address structure and contents are defined during the engineering process.
- *System View* is the standard hierarchical view that represents the topology of the BACnet network. A site contains devices and each device contains objects.
- *Online View* reads all BACnet objects on a network. Data can be imported to the database using the device wizard.

  See *Import BACnet project data* (CM110591).

Log Viewer

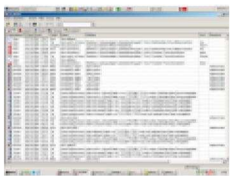


Figure 180: Log Viewer

The Log Viewer shows all tracked events that have occurred in the system. Events and user activities are archived in chronological order in the log database and can be viewed at any time.

The Log Viewer runs in the background (Event Handler) as a service and continuously logs the following events:

- *Alarm events* from the process level, for example, plant alarms and high priority warnings. The alarm is logged when it occurs, upon acknowledgment, reset and return to normal.
- *System events* from Desigo Insight management stations and automation stations, for example, communication failures, selection procedures, start-up, shutdown, hard-disk monitoring, battery checks, etc.
- *User events* for reporting user activities on the management station, for example, authorized and unauthorized user login procedures and the modification of values, parameters and setpoints, etc.
- *Status events* from the process level, for example, plant ON/OFF, etc.

The logged data are stored on a Microsoft SQL server or in an MSDE database, and are protected by password.

Archiving log and trend data

The archiving function (proprietary or in XML format) removes data from the runtime databases to create space for new data if storage capacity is limited, and to store the data in a suitable form for retrieval at a later date. Data are archived either manually by the user or automatically on the basis of time or data quantity.

Report Viewer

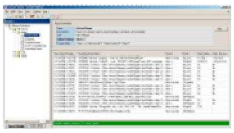


Figure 181: Report Viewer

See chapter *Reports*.

Reaction Processor

Figure 182: Reaction Processor

The Reaction Processor monitors plants and processes system-wide for the occurrence of specific criteria (events). If one (or a combination) of these monitored criteria is met, the Reaction Process triggers preconfigured (re)actions. The Reaction Processor is a server function that operates continuously.

Reactions are actions that – based on certain conditions – are automatically executed, either at the automation or at the management level. Process-critical reactions, such as reactions with high requirements regarding real-time response and reliability must operate on the automation level and must therefore be set up accordingly during the engineering phase.

Reactions can be configured by an operator online during the normal operating phase (not during the engineering phase). Reactions on the management level replace repetitive manual tasks by the user, that is, tasks that an operator runs per clearly defined circumstances (for example, on Monday morning print high-priority alarms that occurred over the weekend).

The Reaction Processor lets you automate repetitive operator actions that are usually run manually by the operator, for example:

- Automated control and switching of plants based on events that occur and are monitored during operation
- Automated start up and routing of reports

The Reaction Processor includes a global scheduler / calendar program at the management level for plants integrated at the automation level without a time switch.

User-oriented reactions should not represent an integral part of standard process programming, as the latter should operate autonomously and decentralized and be protected against unauthorized access.

Desigo Insight has a global time scheduler with calendar functions on the system management level to execute reactions at predefined times of the day (time

Global time scheduler with calendar function

schedule) or on specific days (calendar/date). Plants and devices can be controlled on the automation level accordingly without time and calendar functions.

15.1.2 Main Components

Generic configuration tools

The generic configuration tools are offline tools that let you configure the organization and behavior of the management station. The tools only use the data at the management station and do not communicate with the automation systems.

The tools are generic, as they are not specific to any particular automation system.

Generic editors

The generic editors let you operate the building. You can change or override parameters and edit management objects (for example, time schedules, trend log objects and destination lists).

Generic DB Import tool

The generic DB Import tool imports, updates or deletes the engineering data of the automation stations from the engineering tool into the Desigo management station database.

Change of State (COS) PDX and SDX

PDX (Process device Data eXchange) is an interface for reading data from and writing data to devices in the subsystem. PDX allows the integration of automation systems (Desigo PX, Unigyr, Visonik and Integral automation systems and BACnet third-party devices), which depend on connection-based or connection-free communication protocols.

See *BACnet Third Party Integration* (CM110795).

SDX (Storage Directory eXchange) provides two major services for the Desigo Insight applications:

- A directory service that enables an application to browse through the engineering data in the automation systems. This service supports different views (System View, Technical View and User View).
- A naming conversion utility for conversion between the various address formats.

License server

The license server provides services to client applications that are used to determine the exact range of functions and sizes for which the user has a valid license. The server also includes functions for sharing dongles over a LAN.

Database server

The database server relies on the Microsoft SQL Server and manages the databases for alarming, logging, trending and the system database. The server handles the manipulation of the database and is responsible for transactions, rollbacks and the locking mechanism. It also provides a uniform data management architecture that is reliable and open to a wide range of applications and data sources.

Alarm server

The alarm server handles alarms from various automation systems and adds information, such as alarm status, to the alarms. The server has an interface to the alarm database for permanent storage and provides clients with an interface for reading and manipulating alarms.

Protocol drivers

Protocol drivers, such as the BACnet driver, act as an interface between the automation system and Desigo Insight. The protocol drivers are used for the automation system-specific mapping of information and services to the standard PDX interface.

Trend server

The trend server stores offline trend data uploaded from the automation systems and online trend data from the Trend Viewer in the trend database. It also provides an open interface (API) for access to the data in the trend database.

The archiving component handles the periodical archiving of historical data from the trend database.

Event server

The event server provides all Desigo management station applications with a service for writing events to the log database. It adds missing information to the received log events if necessary.

Access to the log database is provided exclusively via the event server, that is, this server provides a service which enables all clients to read the log database. The provided data is filtered in accordance with the read access level of the user logged in the client PC.

The services for writing to the log database (for example, for engineering tools) and retrieving log data (for example, export for ADP) are available even when Desigo Insight is not running.

System monitoring

The System Supervisor is accessible from the taskbar and shows the free system resources and the system resources that are used by Desigo Insight.

Desigo Insight is a BACnet operator station. It is delivered with its own PICS (BACnet Protocol Implementation Conformance Statement).

See *BACnet Protocol Implementation Conformance Statement (PICS)* (CM110665).

ADP/CC

ADP (Advanced Data Processing) is a data analysis and reporting program for offline trend data.

CC (Consumption Control) manages and monitors energy costs in buildings.

PDM

PDM (Process Data Manager) is a server application that manages the common MS SQL database for the ADP/CC clients.

The Trend and Trend Archive databases, are linked to the PDM database for transferring data.

InfoCenter

InfoCenter analyzes and logs trend and system activity data. It is mainly used in critical environments, such as the pharmaceutical industry, for archiving, administering and logging critical data for compliance reporting.

In order for InfoCenter to collect data from Desigo Insight, Desigo Insight must be installed as a service and the Desigo Interface function must be enabled.

ADP, CC, PDM and InfoCenter are not part of Desigo Insight and must be purchased and installed separately.

15.1.3 Access and Security

User environment

The management station has a flexible mechanism for defining each user’s environment. You can define which users have access to which sites, which buildings and which Desigo management station applications they may operate.

Users in a building can be grouped logically according to their responsibilities (for example, caretaker, building supervisor, maintenance engineer), with each user group having its own set of privileges. Default user groups and copy functions are provided to speed up engineering and setup.

Access levels

There are eight access levels. Each level includes the access rights of all levels below it.

Scope

Scope is the general term for specific object access in the management station. A scope segments and implements certain rules for the user role in the project. A user only sees the area of the building assigned to him, for example, pumps, receives only alarms from this area in the event of an emergency and can only acknowledge those alarms. If an emergency occurs in an area that is not in the scope of this user, for example, ventilators, the user does not receive an alarm about this event.

Alarm messages to printers, mail, pagers or in files are forwarded by definition in the Alarm Router and are not influenced by scopes.

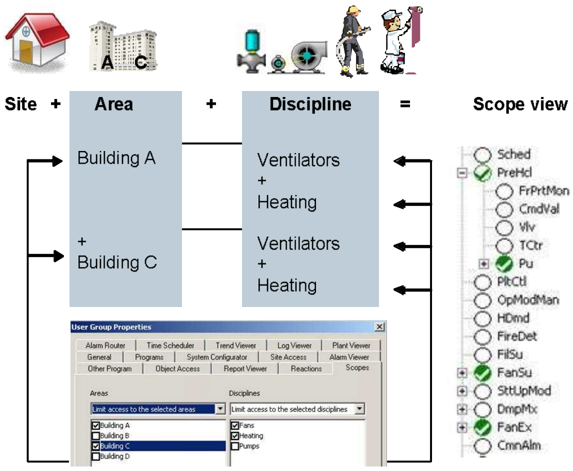


Figure 183: Scopes

User groups

Desigo Insight has six predefined user groups. The *Administrators* and *Expanded Server* groups are for managing and handling the system. The remaining four groups are reserved for end customers. Each of these user groups has a different access level.

The other four groups are:

- *Basic operation*: For the building operator and for security personnel who may operate and monitor the plant from time to time. This group may operate the Alarm Viewer, Time Scheduler, Object Viewer and Plant Viewer.
- *Standard operation*: For plant operators and trained personnel, who are familiar with the plant and all the associated inputs and outputs, are able to carry out minor repairs and servicing work (sensors, pumps, spare parts replacement), and can optimize the plant by fine-tuning its control action. In addition to basic applications, this group has access to the Alarm Router, Trend Viewer and Log Viewer.
- *Expert operation*: For service technicians and personnel responsible for the plants. The service technicians must operate and monitor all control functions. In addition to standard applications, this group has the right to run DB Import.
- *Service operation*: For Siemens service personnel and qualified plant technicians.

Engineering and runtime management

In the System Configurator you can engineer access rights, that is, configure user groups with users and associated access rights.

The access and security policy is defined in System Configurator for the individual user groups. Read and write levels for each object are stored in the system database and certain information may be hidden or write-protected, depending on the rights of the logged-in user.

Predefined user groups and a copy function help keep engineering work to a minimum.

15.1.4 Alarm Management

Alarms

An alarm is a notification that alerts the system user that an event has occurred or that a condition exists which is outside the defined limits. The Desigo Insight alarm management system alerts building operators to abnormal conditions and assists them in taking appropriate actions.

Alarm management

Alarm management in the building automation and control system comprises the following:

- Alarm generation and alarm message customization on the automation level in Desigo PX, on Desigo Room Automation or other subsystems
- Alarm notification and alarm handling in the operator units, that is, Desigo PXM20, the PX Web and all subsystems on the Desigo Insight management station
- Alarm routing

Alarm management in the Desigo Insight management station involves several modules:

- *Alarm Viewer* is the main alarm handling application.
- *Alarm Handler* (background process) displays and sends alarms to the user applications.
- *Alarm Server* (background process) serves tasks initiated by a user application.
- *Popup Viewer* directly alerts the user to a critical alarm.
- *Event Handler* logs all alarms in the log database, and the Log Viewer displays the event history.
- *Shell* shows a summary of the active alarms in order of priority and allows context-specific navigation to the Alarm Viewer.
- *Alarm Router* (Router Server) sends the alarm messages to the receivers.

Alarm handling is usually management station-specific. The automation system is responsible for routing alarms from devices to operator terminals, such as the Desigo Insight management station.

The Alarm Handler, Alarm Server, Event Handler and Router Server are components of the Insight Server.

Shared alarm database

All management stations connected to one Desigo Insight server share the same alarm database. An alarm is forwarded to a given management station, registered in the shared database and displayed automatically on all other management stations. Despite this, the alarms are processed on a management station-specific basis.

Only the management station defined as a destination for the alarm can forward an event and display an alarm pop-up window. Pop-up windows are configured specifically in the Alarm Router of each management station. To enable it to acknowledge or reset an alarm, a management station must be connected to the site to which the alarm object belongs.

Alarm strategy

The Alarm Viewer displays a detailed overview of pending alarms from all the sites and buildings in the system. When an alarm event occurs, this list is updated automatically, so that it always contains the current alarm state of the system. Each time a new physical connection to a site is established, the alarms in all the automation systems are updated (alarm refresh). This means that the alarm server reports all pending alarms to the management station level. The alarm server can also update alarms periodically.

Different alarm types are displayed according to the severity configured in the automation system:

- *Simple alarms* appear and disappear without user intervention.
- *Basic alarms* must be acknowledged.
- *Extended alarms* lock the plant and must be acknowledged and reset.

Engineering

You can configure basic alarm routing to the management station and its response and display in the Desigo PX or Desigo Room Automation automation station or in other subsystems.

In the system database, you can attach an alarm help text, which may contain extensive customer-specific information, such as operator instructions or hyperlinks to other documents, to an alarm-generating object on the management station.

Alarm notifications cannot be sent from one management station to another. If several management stations need to receive an alarm event (for example, to display an alarm pop-up window), you must configure it at the automation station level.

Alarm routing strategy

Alarm routing determines what alarm type is shown when, where and how.

You can define what alarm type (for example, priority) is shown when (for example, day, night, weekday, weekend, holiday), where (for example, tech-operator's office or doorman's desk) and how (for example, which printer, e-mail, SMS).

This ensures - if properly configured - that an alarm will always be received by someone. Alarms cannot be routed to a remote desktop nor a web client.

These principles apply to all event types: alarms, system, user and status events.

Although the routing of alarms is configured for a specific management station, it can be modified by any other management station in the same project. This requires a higher user access level.

The alarm receiver is independent of the alarm state display. All Desigo Insight management stations in your system display alarm states in the Alarm Viewer, irrespective of where the alarm messages are routed to.

15.1.5 Installation, Setup and Engineering

The Desigo Insight management station can be set up and engineered in the following steps:

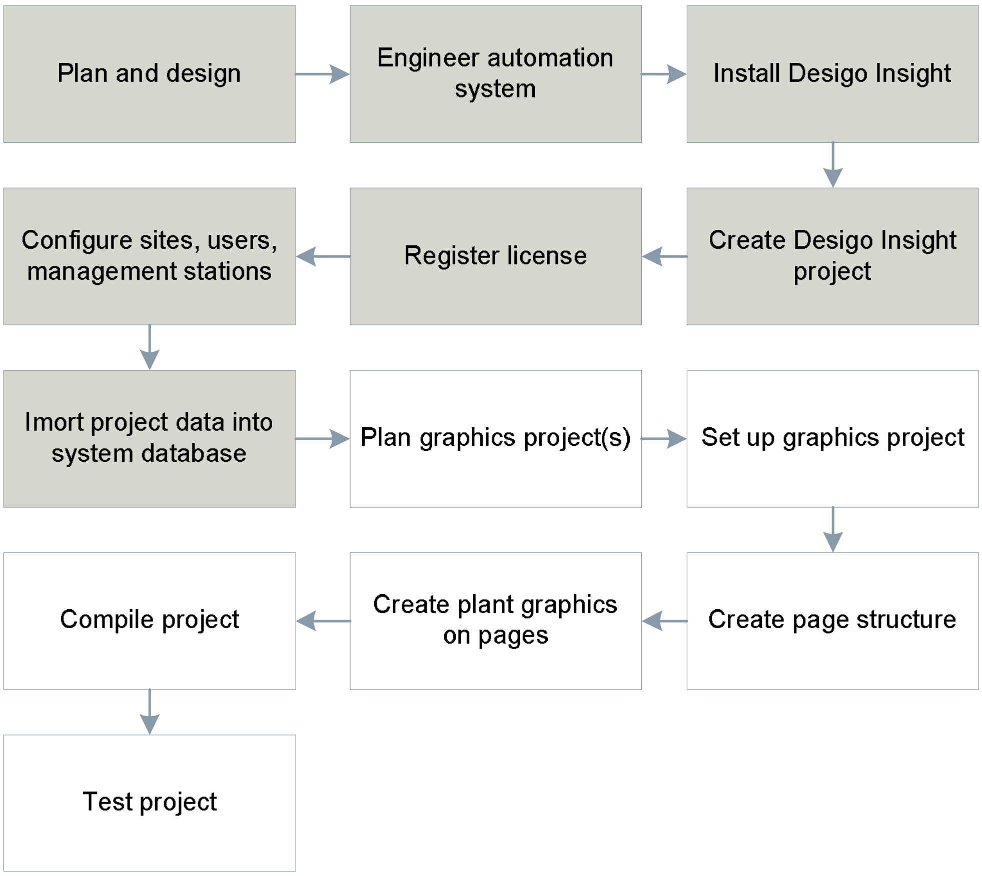


Figure 184: Installation, setup and configuration process

To keep the set up as simple as possible, comprehensive default settings are available.

DB import

Importing Desigo PX and Desigo Room Automation engineering data usually requires two steps:

1. Import metadata:

   Metadata describe the standard BACnet objects used in the Desigo PX automation system. For each object, the BACnet type and the associated properties are described. The metadata also comprise default values for the properties (for example, access levels) and the global texts.

2. Import project data:

   After the Desigo PX automation stations have been engineered, the project data is available in Xworks Plus (in ABT for Desigo Room Automation). The DB Import then transmits this data to the system database. When a project is modified, you only need to import the modified automation stations.

   The project data contains:

   – A description of the objects defined in every Desigo PX automation station
   – The System, Technical and User View of these objects (Object Viewer)
   – Site-specific, device-specific and project-specific text

Import BACnet third-party devices and Desigo S7

The DB Import tool accepts input files in predefined formats. The Desigo Excel Project Tool (DIEPT) is an Excel-based software tool available from HQ, which reads all data in any format that can be read by Excel and creates a file that DB Import can use.

See *Excel Project Tool DIEPT* (CM110634).

As for the Desigo PX data points, the third-party BACnet devices must be imported in two steps: first for the metadata and then for the project data.

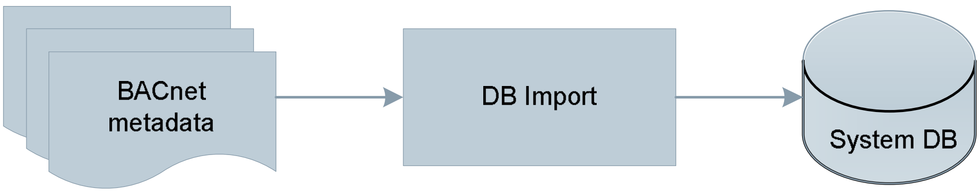


Figure 185: Importing third party BACnet devices

Expanded metadata, which almost covers the functional scope of Desigo PX, are available for Desigo S7.

Project engineers can use DIEPT to define the Technical and User Designations for BACnet objects.

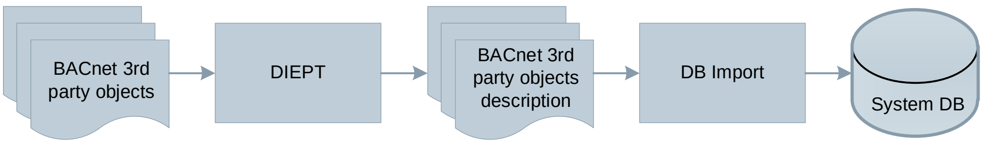


Figure 186: Importing via DIEPT

As an alternative, BACnet third-part devices can also be identified and imported via the online view of the Object Viewer.

15.1.6 Graphics Library

The Desigo Insight delivery contains libraries with standard graphic elements for PX/ PXC00(-E).D/PXX-L11/12//PX KNX. Genies and other standard graphic elements match the PX / Desigo Room Automation application compounds supplied, and allow easy plant graphics engineering with the Desigo Insight Graphic Generator.

Genies

Genies are highly functional graphical display objects in the Plant Viewer, which receive values from the automation station and display them. The genies can also receive commands (for example, clicking a button or changing a value) and send them to the automation station.

- *Nested genies* are genies that are used in other genies, for example, the alarm genie is used in all genies, which are in an alarm state. This reuse of genies ensures that graphic elements, such as alarms, have a uniform look and feel throughout the system.
- *Generic genies* adapt to the specific properties of a data point on the basis of its technical designation. During the compile process, additional information about the data point is retrieved from the system database, and the genie automatically alters its response. For example, one fan genie is available for all fan types. When the fan genie is used for a particular fan data point, it searches the system database for extra information and finds two fan speeds and a maintenance switch. When it is activated, the genie display automatically shows two speed levels and the maintenance switch.

The library is suitable for Desigo PX and Desigo Room Automation objects.

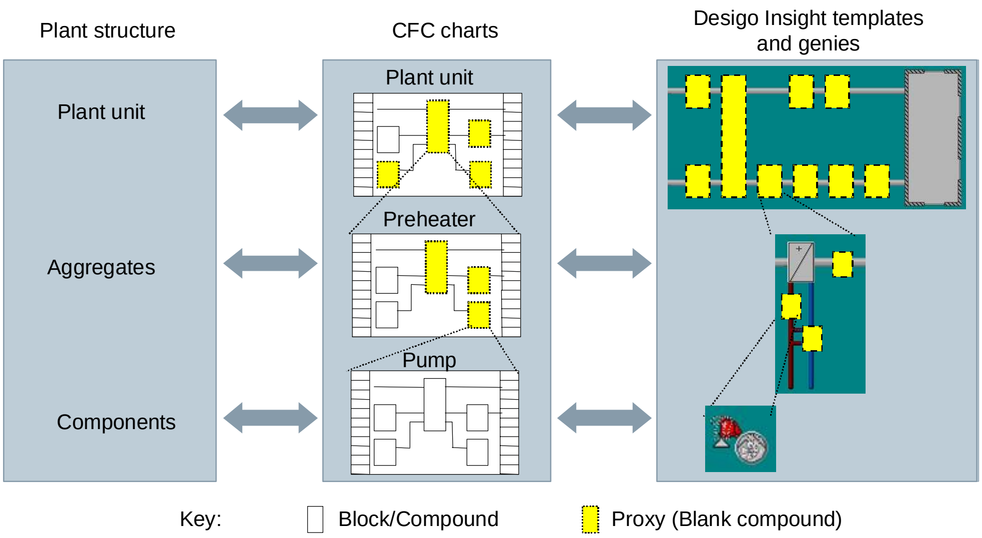
Access and security

In the System Configurator you can define the access and security policy for user groups. Read and write access levels for each object are stored in the system database. Depending on the rights of the logged in user, information can be hidden (not visible) or write-protected.

15.1.7 Graphic Generator

The Desigo Insight Graphic Generator is optimized for the use of Xworks Plus (XWP) and Automation Building Tool (ABT) with tested solutions from the Solution Browser. The Graphic Generator automatically creates and configures Desigo Insight pages based on the imported project data. This improves the efficiency of the project engineering for the entire Desigo system.

See *Graphic Generator* (CM110587).



15.1.8 High Availability Solution

Desigo Insight can be operated as a redundant system.

See *High availability solution* (CM1N9160).

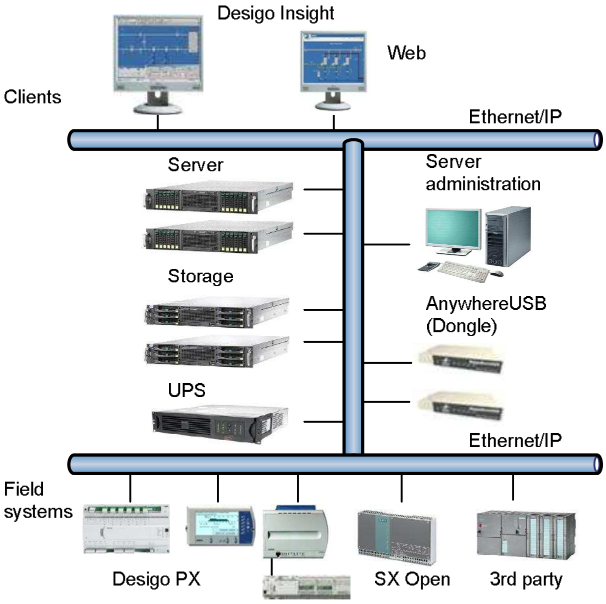


Figure 187: High availability solution

HA solution complexity

Depending on customer needs, the complexity of the solution may vary:

- If a geographic separation of the productive and backup systems is not required, the high availability solution already offers a storage system (Network Attached Storage, NAS) that provides significant security against a failure of the Desigo Insight management station.
- If a redundant design of the productive and backup system is required, a two NAS solution with data replication must be used.

HA solution functions

The high availability solution has the following functions:

- Uninterruptible monitoring of all physical servers in a resource pool and restart of virtual systems impacted by a service failure.
- Monitoring of the operating system for failure and automated restart of the impacted virtual systems.
- Periodic monitoring of Desigo Insight applications and automated restart of the system for failures.
- Recognition of server failures using the server heartbeat.
- Nearly immediate restart without human intervention of the virtual systems on an available server within the same resource pool.
- Report to operator for failover.
- VMware Infrastructure Manager (VIM) for server administration.

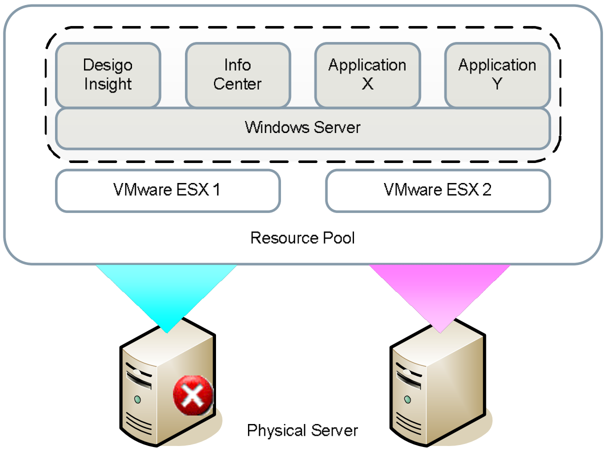


Figure 188: High availability solution with Desigo Insight and other applications

By using Desigo Insight and other applications (for example, InfoCenter) with the high availability solution the impact of hardware and software faults on linked server databases can be minimized.

See *High availability solution HA-300/HA-500* (CMI110797).

15.1.9 Desigo Room Automation Integration

Desigo Room Automation communicates directly with the management level. The PXC00-E.D. system controller can be used only for the Scheduler and Calendar.

Operation

Generic and engineered operation is available on the management station.

Generic operation

No additional engineering is required on Desigo Insight for operation in the Object Viewer. The Object Viewer allows the operation of standard BACnet objects. Operation can take place both via central functions or rooms and directly at the Desigo Room Automation application level.

Engineered operation in the Plant Viewer

Typically, room integration requires a graphical display of the building along with the various floors and rooms. Desigo Insight efficiently supports generating graphical images and integrating Desigo Room Automation. The Desigo Insight graphics library contains predefined supergenies for key data points for each Desigo Room Automation application.

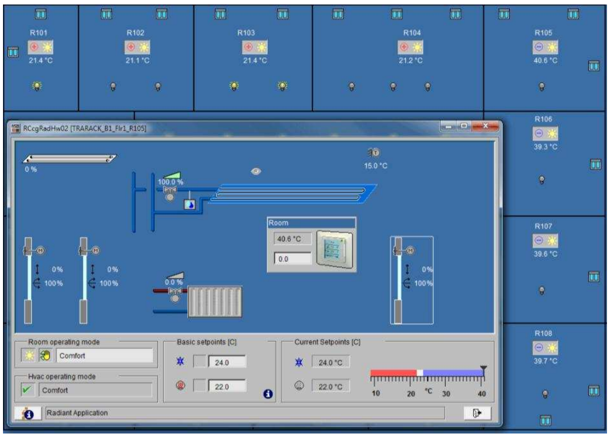


Figure 189: A possible Desigo Room Automation visualization on the management level

15.2 Desigo CC

Architecture

The Desigo CC management platform presents a single point of entry for users to operate, monitor and optimize building automation, fire safety and security systems or a combination thereof.

Desigo CC is a flexible, full client-server architecture allowing scalability from small and medium to large and complex systems. The platform provides customizable and market-specific distributions.

Desigo CC can be installed on one single computer, with full server and client functionality. Furthermore, Installed, Web, and Windows App Clients can also be added on separate hardware. Additional system connections can be made through systems installed with Desigo CC Front End Processors (FEP) configurations. Web interfaces provide the customer an increased flexibility for operation and future extensions, e.g. mobile applications for tablets and smart phones.

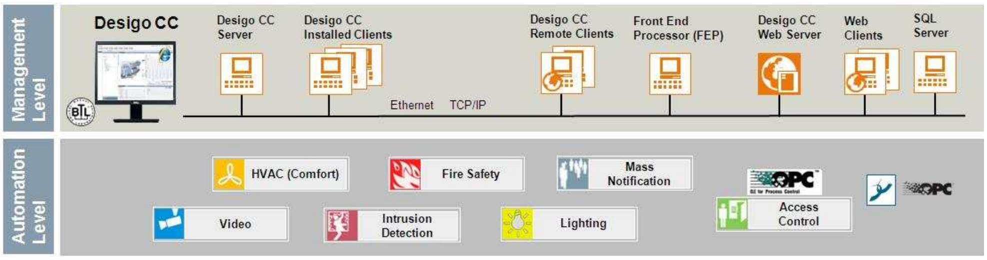


Figure 190: Desigo architecture

Main server

The main server contains the project database and the software that monitors and commands the system network. Clients connect to this server to monitor and control the facility. If the same computer runs Microsoft IIS, the installation provides web clients with access to the facility. The Desigo CC server installation always includes an installed client with a user interface for monitoring and controlling the facility. The main server has interface connections to the field (either directly or using FEP) and provides a centralized database and other services to the connected clients. The main server can support a number of clients that are connected using a network (LAN) or Intranet (WAN).

Installed client

The Installed Client is typically used for operators who are focused entirely on monitoring and managing building systems. In this configuration, software components used for event management are locked in place and cannot be moved or covered by other applications. This ensures that critical events are never missed or hidden. Installed Clients can optionally be configured to run in a closed mode where only Desigo CC and other specifically identified applications are allowed to run. In closed mode, the workstation is dedicated to running Desigo CC, with access to the Start menu or other operating system and customer applications available only to administrative users.

Web client (browser client)

The web client is deployed on the intranet with full trust and allows access to local resources. The system runs in the Internet Explorer browser (using HTTP or HTTPS as communication protocol) and is downloaded on demand each time the user launches the system as web application. When working in a browser, you can have the same capabilities as those working on an Installed Client, or can be restricted to have different access when connected remotely.

As web clients require low latency and high network bandwidth, they are appropriate for intranet use. We do not recommend it for internet use.

See *Desigo CC Installing the Web Client Application Certificate* (A6V10415479).

Windows app client (ClickOnce)

The Desigo CC Windows App Client looks like the standard system software, but is a light application that can be downloaded from the Desigo CC server when connecting through a browser. When the Windows App Client is downloaded, it runs like any other Windows application on the desktop. It can be launched from the Start menu, desktop icon, quick-launch toolbar, and so on. This deployment does not require administrative privileges. The Windows App Client runs in its own pane, without the overhead of the internet browser application and menus.

Web server

To use the Desigo CC Web and Windows App Clients, you must install the web server. To install the web server, you must first install Microsoft IIS on the web server computer. Usually the web server is on the Desigo CC server. It might be located on a separate computer, if the customer's IT department requires the web server to be installed in a separate controlled environment, or if it is preferred not to use the resources of the system server for the Microsoft IIS tasks.

The web server lets you to access the system using the intranet and a web browser. You can add only one web server. It lets you download all files required for the Web Client and Windows App Client environments. It provides a system web page to access the Web Client, the Windows App Client, and the system documentation in the Internet Explorer browser. It also represents the endpoint of the communication with the system server.

Front End Processor

A Front End Processor (FEP) is a computer that provides additional connections between building level devices (such as field panels) and Desigo CC. By providing additional connections to the building level network, an FEP enables load balancing for the network-based processing for a Desigo CC system.

15.2.1 User Functions

Graphics

The Graphics application allows you to view the configured graphics representing your facility or equipment. You can change the current state of an object's properties from a graphic, filter your view of a graphic by discipline and section and you can zoom in and out for greater detail or for a birds-eye overview.

Trends

All available process data of a system can be recorded and applied to operational optimization. This lets you record information on plant states, temperature curves, switching states, and counter values in a form that is suitable for your purposes. The measured value data can be displayed and evaluated graphically.

Online trend records real-time values from your plant and displays them graphically in a Trend View. If a value changes, the data values are sent to the trend application. Offline trend data is used for the longer-term storage and retrieval of historical data for the analysis of entire plants or single processes. With offline trend, data is recorded directly in the automation station.

Trend and system activity data is stored in a Microsoft SQL Server database. Microsoft SQL Server Express is included with the Desigo CC software, and can be upgraded as required. The Trend Comparison View lets you time-shift the trend view to compare data at different times for quick analysis of changing conditions.

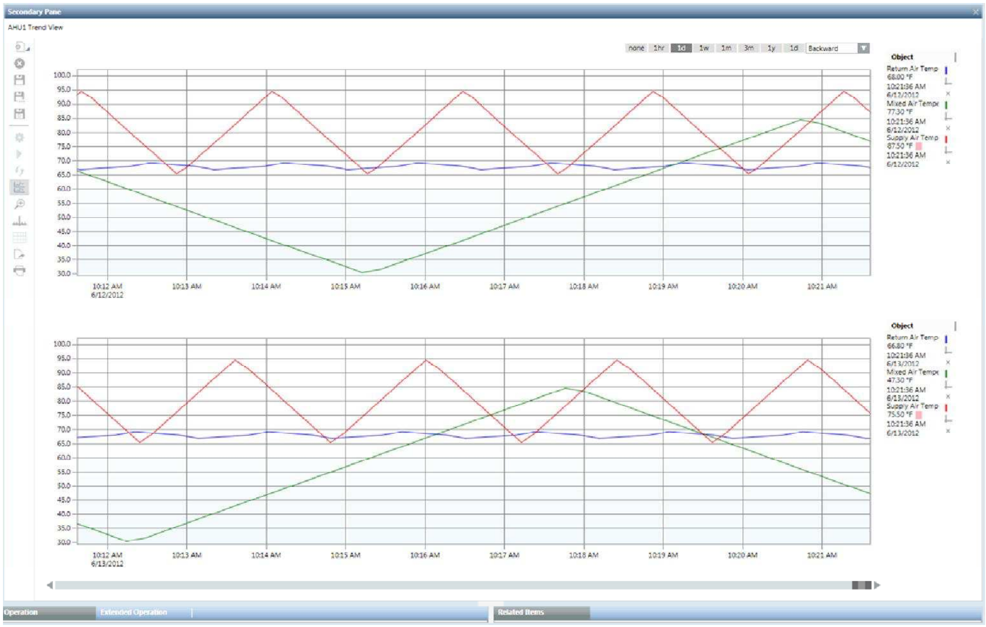


Figure 191: Trends

Scheduling

The Scheduler allows you to schedule events for management stations and field panels at your facility. You can create daily or weekly schedules for management stations and BACnet devices. You can fully configure and monitor standard BACnet schedules, calendars, command objects, and workstation-based schedules that can be used to support systems without built-in scheduling capabilities. Schedules are automatically associated with systems they control, so you can quickly navigate to the schedules of any selected object. A Timeline Viewer lets you view the details of multiple management station and field panel schedules simultaneously, spanning a range of time.

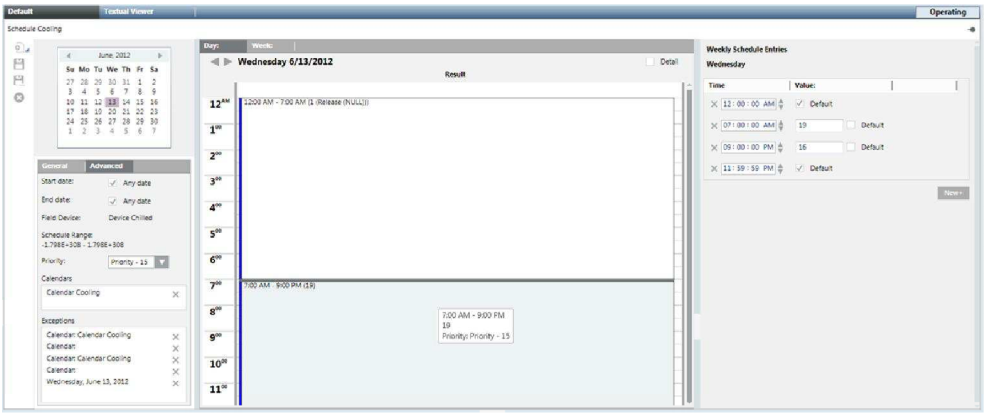


Figure 192: Scheduler

Reports

The Desigo CC reporting tool includes standard reporting templates and lets you create fully configurable reports with custom logos, headers, footers, and layouts that include tabular and graphical system information. You can schedule reports and save them in CSV or PDF formats.

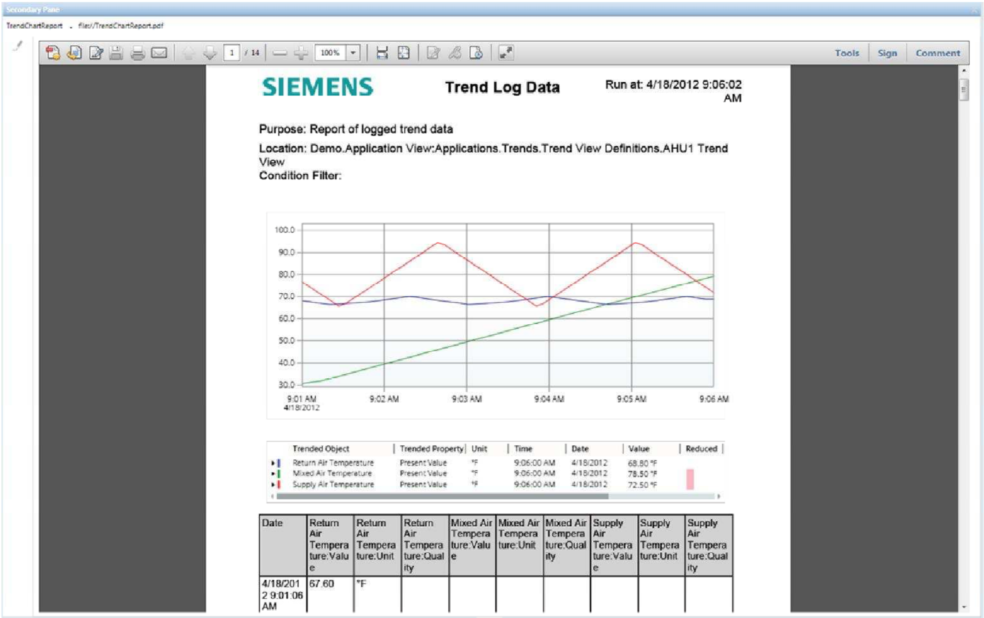


Figure 193: Reports

Event management

Event management allows you to manage events throughout the system. You can monitor and manage the progress of each event from initiation through resolution. The full history of each event issue is recorded, and you can generate event-related reports that you can view, save, and print.

Log Viewer

The Log Viewer application provides an historic log of all user and system events and activities that have occurred. You can retrieve these historic events and activities for further analysis and investigation using sorting and filtering. Log views can be saved and exported if required.

Detailed log

The detailed log allows users to view the most recent records for any selected object. The same content filtering and sorting functionality available in the Log Viewer is possible in the detailed log.

Remote notification

You can configure Desigo CC to automatically or manually send email or SMS messages to specific recipients.

You can specify:

- What events the recipients should be notified for and when
- How notifications are escalated from one recipient to another until a notification message is responded to
- If a message is periodically sent to the operators stating that the system is running normally
- Which devices are used for the notification

Macros

Macros are predefined lists of commands that enable a user to send out a group of commands to specified devices with a single action. Some macros can be started manually while others may be part of schedules defined for time-based functions or automatic reactions. Macros are also used by the system to perform multiple command actions. These predefined system macros are applied to specific control actions, such as block commands to fire control panels and system backup functions.

Reaction Processor

Reactions are automations programmed in the system, so that when a specific situation occurs on site, a command or a series of commands is automatically executed.

You can define actions to be executed automatically when specific conditions are verified. Conditions can be based on time, on events, on a change of values, or on a combination of some or all. When conditions are met, the Reaction Processor executes a pre-configured list of commands.

Document management

Desigo CC can handle the different types of document templates used in the project. You can configure document templates in PDF, RTF, TXT, XLS, and HTML format.

15.2.2 Main Components

System Manager

The System Manager lets you navigate the system, view and override current conditions, analyze historical operations, and configure the system. The System Manager contains the System Browser, Primary, Operation and Related Items panes that interact via built-in workflows. Multiple system management session can be concurrently used.

Figure 194: System Manager

System Browser

The System Browser displays objects in the building control system through various views. You can search and filter objects, display object names and descriptions, and drag objects into Trends, Schedules, and Reports.

Historical data is stored in an access-controlled MS SQL Server database. The System Management Console lets you create a project History Database (HDB)

History Database (HDB)

and link it to the active Desigo CC project on the main server. The history database is used to log a wide range of user and system activities, such as:

- User and system activities
- Alarms and their treatment
- Faults that have occurred and are handled as batch messaging
- Values that are logged as trends

Project database

The runtime data (process image) and the engineering data are stored in a file-based database in a subdirectory of the project directory. The data is unencrypted and database access can only be prevented by restricting access to the database files. The project directory needs to get shared when deploying installed clients. It is therefore important to restrict access on the *db* folder in the project directory to the Windows account running the Desigo CC main server.

Microsoft SQL Server

Desigo CC uses the Microsoft SQL database software. Microsoft SQL Express is included on the product installation DVD (Microsoft SQL Server 2008 R2 Service Pack 2, Express Edition, version 10.50.4000.0). Alternately, you can use an existing Microsoft SQL Server installation (same version 10.50.4000.0). In this case, the Desigo CC Installer will skip the Microsoft SQL Server installation. In both cases, Microsoft SQL must first be installed and running on the computer where the Desigo CC main server will be installed.

Microsoft IIS server

A Microsoft Internet Information Services (IIS) server for Web Clients and Windows App Clients can be installed on the Desigo CC server or on a separate installation (web server).

License Manager

Licensing ensures the operation of the system within the agreed system limits. Only the system is allowed to change license data.

If a license becomes temporarily unavailable (for example, due to network connection issues) the system continues to run fully operational for a grace period. The system continues to check for the license and shuts down at the end of the grace period, if none of the license checks succeed.

Exceeding the limits of the license (for example, by integrating more field system data points than stated in the license) puts the system into courtesy mode. Phases of courtesy mode accumulate until a total duration of 30 days is exceeded, then the server shuts down. Unless new licenses are made available, after a manual restart the system again goes into courtesy-mode exceeding and shut down.

Any unauthorized attempt to modify system license data directly in the database (for example, changing the remaining time of a specific license mode) shuts down the system.

15.2.3 Access and Security

User management

User privileges can be assigned to users and to workstations, allowing users to be granted the same access from everywhere or different access depending where they're logged on. The user interface displays only elements, such as menus, buttons, list items, tree nodes, where the user has at least read access.

Access privileges can be assigned to resources/groups, such as workstations, features, applications, system objects, system object properties and logical groups of these resources.

User authorization

User access rights in Desigo CC are determined by four main factors:

- The system must know the user (authentication).
- The user must be assigned to a user group.
- The user must have the appropriate application rights.
- The user must have the appropriate scope rights.

If all of these conditions are met, the user can log on to Desigo CC, and read/write objects and execute tasks, depending on the assigned rights.

See *Desigo CC Engineering Manual* (A6V10415473).

Scopes

Scope is the general term for specific object access in the management station. A scope segments and implements certain rules for the user role in the project. A user only sees the area of the building assigned to him, for example, pumps, receives only alarms from this area in the event of an emergency and can only acknowledge those alarms. If an emergency occurs in an area that is not in the scope of this user, for example, ventilators, the user does not receive an alarm about this event.

Communication security

In general, communication channels are non-encrypted due to performance reasons. Exceptions are communication channels for file transfer using web and video transfer. Sensitive data (passwords during authentication or user management configuration) is transferred as encrypted message content.

Wireless input devices (especially keyboards) use radio transmission that is often not or inadequately cryptographically protected. Even from greater distances, it is possible to listen in or even plant external data in the system.

We recommend that you do not use wireless input devices. If you must use wireless input devices, use only devices with proven encryption.

Communication ports and protocols

Which ports are used depends on the actual deployment and subsystem integration of the whole system.

See *Desigo CC System Description* (A6V10415500).

15.2.4 Event Management

Desigo CC lets you quickly, easily, and accurately respond to any event.

Summary Bar

The Summary Bar contains a summary of the events occurring in the system and lets you quickly access functions, such as the Event List. It also displays information, such as the system status, the logged in user, etc. Depending on the client profile in use, the Summary Bar can be docked on the desktop or freely opened and closed as needed.

Event List

The Event List provides a complete and easily filtered list of events under control of the management station. When the Event List is expanded, it clearly shows each event source, severity, current status, custom messages and suggested action steps through the use of text, color, and icon representations. You can acknowledge, silence, and reset alarms from the Event List.

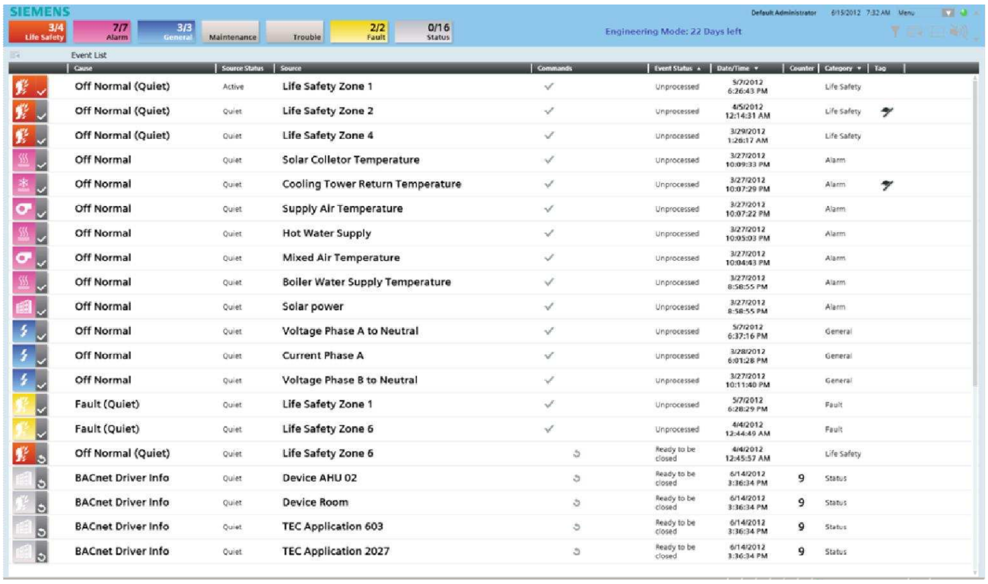


Figure 195: Event List

Event Bar

When using profiles for critical event management, you can collapse the Event List into a condensed list of event buttons in an area called the Event Bar, that remains docked on the desktop for easy access. This lets you keep an eye on the current situation at all times.

Client profiles

To ensure the correct level of event management support for users in any situation, a workstation and/or users can be easily assigned predefined profiles supporting casual, intermediate, or dedicated event notification and management.

Fast treatment

From the Event List or Event Bar, you can quickly select an event and perform all the commands (for example, Acknowledge, Reset, Close or Suspend) from the Event Detail Bar and Event List, without looking at treatment steps, viewing live video or a map of the alarmed area, etc. The event descriptor (visible when the Event List is expanded) contains a short description of the next action (which command to select).

When event treatment is in progress, you can send the available commands to the source object causing the event or suspend treatment.

Investigative treatment

From the Event List or Event Bar, operators can quickly open the System Manager with focus on the source of the event, and all information (live video, recent history, schedules, etc.) related to the event source.

Operating procedures

Operating procedures consist of a sequence of steps or actions, which the operator must, or is suggested to perform with the assisted treatment. For each step of a procedure, the system provides instructions and operating tools. With appropriate permissions, you can create, view, edit, or delete operating procedures.

Assisted treatment

From the Event List or Event Bar, operators can quickly open the assisted treatment to guide the operator through pre-configured operating procedures. Each operating procedure is composed of steps - some of which may be mandatory - for the user to complete (for example, to see the graphic of the object in alarm, fill-in a treatment form, or automatically print the information of the event).

15.2.5 Installation, Setup and Engineering

The installation program installs the Siemens License Management Utility (LMU) on every management station in a Desigo CC network. The LMU enables and manages licenses and holds the installed licenses for Desigo CC. The operating state of Desigo CC, the number of seats, the point count, and all functions are controlled through the LMU. Each Desigo CC management station must be

License Management Utility (LMU)

licensed locally. Licenses can be activated, repaired, returned and renewed through the LMU.

After you install the LMU, you must activate the Desigo CC licenses using the following licensing methods:

- Online: Licensing carried out via the internet or intranet on the back office license server.
- Certificate/Dongle (including remote dongle engineering): Licensing carried out via certificate files representing the license.
  - For Dongle-bound licenses, dongles and licenses can be obtained individually and subsequently tied to each other and loaded onto the PC.
  - Engineering licenses are always dongle-bound. Where a physical connection of the dongle to the PC is not possible, for example, during a remote support session, the engineering license can still be used for a limited time.
- Manual: Manually returning a license based on XML request/response files.

See *Desigo CC Installation Manual* (A6V10376166).

System Management Console (SMC)

The Desigo CC server hosts the System Management Console (SMC), a stand-alone tool which is installed on the main server only, and can only be launched locally. Once Desigo CC is installed successfully, the field engineers must first perform the typical system administration operations, such as configuring system users, projects, and history database in the SMC, before being able to launch a Desigo CC client.

Profiles, schemas and templates

Client profiles define the appearance and behavior of the system functions involved in event management, such as Summary Bar, Event List, Event Detail Bar, event filters, and event treatment. Every project template has a matching client profile, and every client profile has a matching event schema. To a ensure a consistent configuration, the project template, the client profile and the event schema must match.

Subsystem integration

Representative data points in Desigo CC can be created manually, imported through data exchange files, or uploaded through a selective auto-discovery mechanism depending on the type of system being connected. A unique, extensible object modeling approach allows Desigo CC to normalize information brought in through any interface, and to provide the same look, feel, and operation through a common set of applications, without concern for the source of the data.

Desigo CC lets you configure connected subsystems directly and perform typical automation station functions, such as scheduling and event generation, at the management station for connected systems that do not support those functions directly.

Desigo CC supports the following subsystems:

- Desigo Building Automation system (Desigo PX V5.1 SP; V6)
- Desigo Room Automation system (TRA V1.16; V1.2)
- Simatic S7 (S7-300; S7-400)
- Siclimat-X V4.1
- Sinteso Fire Safety System (FS20 EN MP5.2; FS20 DE MP5.2)
- Sinteso Fire Safety System (STT20 Centralisateur de Mise en Sécurité Incendie)
- Intrunet Intrusion System (SPC MP3.4, connections using TCP-IP or UDP-IP supported)
- Video through Milestone Video Management System
- Mass Notification System (Version 2.0) For a list of compatible Mass Notification devices, please refer to the MNS documentation
- Third-party Building Automation and Fire Safety systems based on BACnet/IP
- Third-party subsystems through OPC (OPC DA V2.05/V3.00 standard)
- Third-party subsystems through Modbus/IP

- Integration through SNMP
- APOGEE Building Automation system (Apogee BACnet V3.1.2; V3.2.4; V3.3; V3.4)
- XNET FireFinder XLS and MXL fire safety systems (FireFinder XLS V8 and newer)
- Desigo Fire Safety FS20 UL systems (FS20 UL MP1.x, MP2.0)

Auto discovery

Auto discovery lets you discover and import devices, which are already on the network, into Desigo CC. You can set filters and detect your devices on the network, which then display in the System Browser. You would typically use this method for existing jobs, where field panels are already installed and online.

OPC server

OLE for Process Control (OPC) is a widely accepted industrial communication standard that enables the exchange of data between multi-vendor devices and control applications without any proprietary restrictions. OPC is a client-server technology and Desigo CC can acts as the server providing data to third party clients.

Web services

Using RESTful technology, Desigo CC provides alarm, object and time series data via web based services to supervision management stations or other third-party external applications.

Language packs

The Desigo CC software is delivered in English and can be extended with additional languages. The following software language packs are supported:

- Arabic
- Chinese (simplified)
- Chinese (traditional)
- Czech
- Danisch
- Dutch
- English (default)
- Finnish
- French
- German
- Italian
- Korean
- Norwegian
- Polish
- Portugese
- Russian
- Spanish
- Swedish
- Turkish

You can install 3 languages simultaneously. Every user can define his user interface language.

Project and HDB backup

Backing up Desigo CC requires saving independent parts on different servers or PCs. We recommend that you save the backups of your project data to a different machine from where they originally reside.

Two parts must be backed up:

- The entire customer project data, including all libraries, configurations, object data (project backup).
- The historic data collected in the history databases (HDB backup).

Backups can be done either manually or by applying a macro in combination with a management station scheduler.

See *Desigo CC System Management Console* (A6V10415497).

15.2.6 Graphics Libraries

Desigo CC contains libraries with symbols and graphic templates for easy plant graphics engineering. The Graphic Library Browser shows all the available symbols and graphic template objects in your project libraries.

Symbols

A graphics symbol is a reusable graphic image that represents a piece of equipment, floor, or any component or entity. Symbols are stored in a library and are used to display system object values. Symbols can be associated with one or more object types in the Models & Functions application and bound to object type properties to create substitutions in your graphics that provide a dynamic, visual representation of changing values from Desigo CC.

In its simplest form, a symbol is a graphic made up of drawing elements on the graphic canvas in the Graphics Editor. Each drawing element has a series of associated properties. These properties can be used to create substitutions. Symbols can be associated with an object type

An object type is associated with a symbol in the Models & Functions application. When you drag-and-drop the symbol onto a graphic, the symbol displays the system object values in runtime mode and in the Graphics Viewer. Animation is supported through a series of graphics. Pre-defined symbols are stored in library folders. These symbols are visible and editable from the Graphics Library Browser. Advanced users can create their own symbols.

Generic symbols

A generic symbol is a concept that allows you to create one type of symbol that can support an object that has one or several properties with changing values. Depending on the object, the symbol will not display the elements of the graphic that do not have a data point associated them.

Graphic templates

Desigo CC provides standard BACnet TEC graphics for various applications. You can also create template graphics for TEC applications.

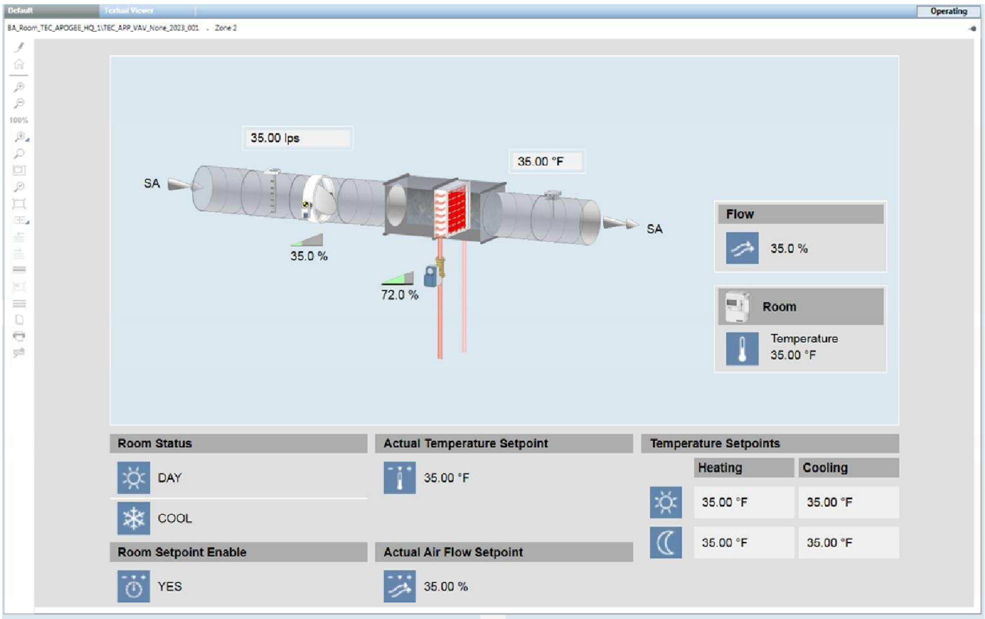


Figure 196: Graphic templates

See *Desigo CC Getting Started* (A6V10415475) and *Desigo CC User Guide* (A6V10415471).

15.2.7 Graphics Engineering

Desigo CC graphics are built using smart objects that know how they are used and how to represent themselves graphically. Smart objects let you create graphics by dragging objects onto a page, without manually binding an object to graphical symbols.

The Graphics application allows you to create, view, store, and command large graphics representing equipment, floors, buildings, facilities, and entire campuses. These graphical representations can contain dynamic elements to represent devices or values you want to monitor or control. The Graphics application consists of:

- Graphics Viewer
- Graphics Editor
- Graphics Library Browser

Graphics Viewer

The Graphics Viewer lets you view the graphics representing your facility or equipment. You can change the current state of an object's properties from a graphic. You can filter your view of a graphic by discipline, section, or you can zoom in and out for greater detail or for a birds-eye overview.

Graphics Editor

The Graphics Editor lets you create dynamic graphical representations of your plants, buildings or equipment. You can test and simulate your dynamic graphics before going online with them.

See *Desigo CC Graphics Editor* (A6V10415487).

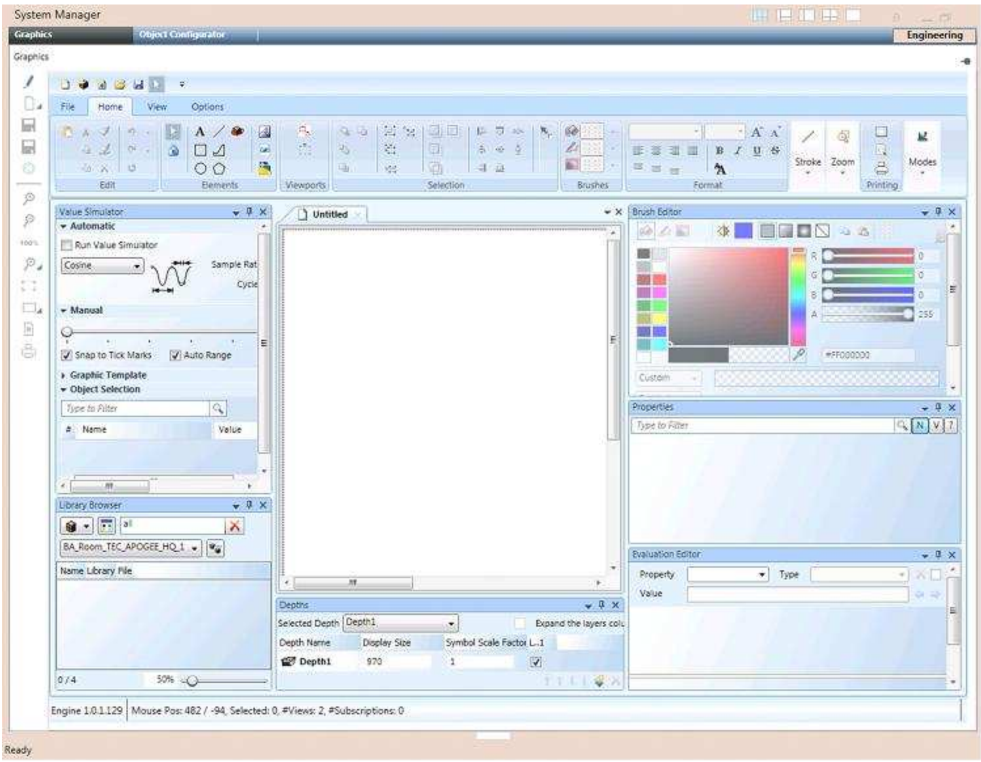


Figure 197: Graphics Editor

Graphics Library Browser

The Graphics Library Browser lets you toggle between a view that displays all the available symbols and graphic template objects in your project libraries.

AutoCAD import

You can import AutoCAD drawings and select and manipulate the layers of the AutoCAD drawings during and after the import process.

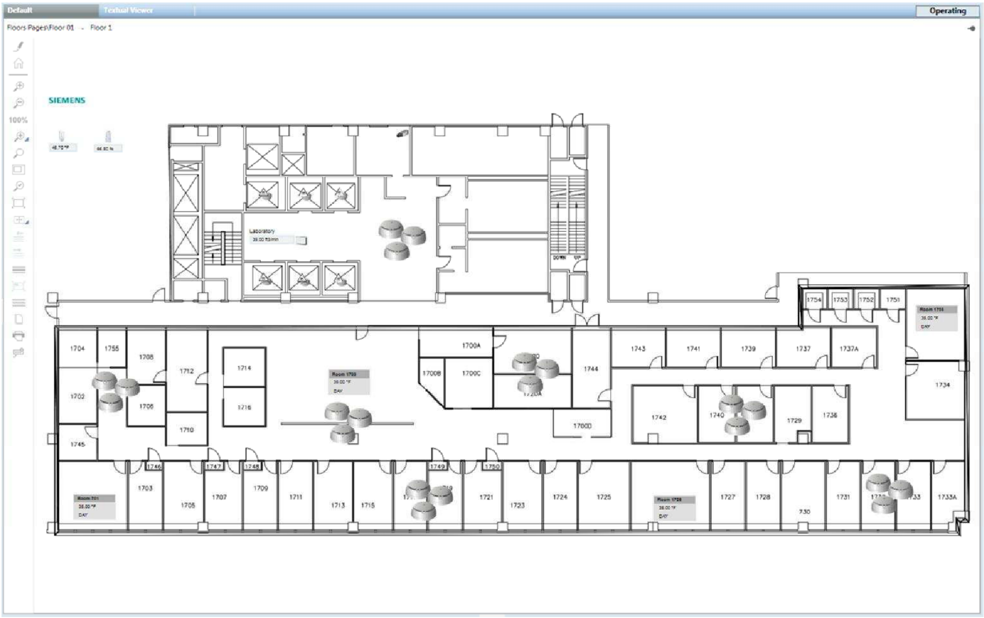


Figure 198: An imported AutoCAD drawing

15.2.8 Virtual Environment

Desigo CC is compatible with following Virtualization software packages:

- VMware®:
  - Virtualization platform: VSphere 6.0
  - Fault-tolerant software: ESXi 6.0b (build 2809209) managed by VCenter Server Appliance v6.0.0 (build 2793784)
- Stratus®:
  - Virtualization platform: KVM for Linux CentOS v7.0
  - Fault-tolerant software: everRun Enterprise 7.2
  - Virtualization platform: Citrix XenServer 6.0.2
  - Fault-tolerant software: everRun MX 6.2 HotFix4 (build 6.2.9125.825-HF:EA)

16 Automation Stations

The Desigo PX range is based on freely programmable automation stations. They provide the infrastructure to accommodate and process system-specific and application-specific functions. The PX range of automation stations comprises the compact and modular series.

See *Desigo PX - Automation system for HVAC and building services - System overview* (CM110756), *Automation stations modular series PXC..D, PXC..-E.D, PXA40-..* (CM1N9222) and *Automation stations compact model PXC..D* (CM1N9215).

Control Functions

The D-MAP programming language lets you program and parameterize plants, using function blocks and compounds. The graphics-based data-flow programming in Xworks Plus (XWP) lets you implement all the necessary control strategies for optimum operation.

System Functions

The distributed functions, which ensure the overall functioning and inter-operation of all plants, are described in the following chapters and documents:

- For alarm strategy, see chapter *Alarm Management*.
- For time scheduling, see chapter *Calendars and Schedulers*.
- For access rights and user designations, see *IT Security in Desigo Installations* (CM110663).
- For emergency operation and forced control, see chapter *Control Concept*.
- For wiring tests with Desigo Point Test Tool, see chapter *Desigo Workflow, Tools and Programming*.

Cyclical Processing

One PX automation station contains one downloaded D-MAP program. A D-MAP program cannot run on two automation stations, that is, there are no overlapping programs across automation stations. A downloaded D-MAP program does not run automatically. It must be started explicitly and is executed in accordance with the cyclical processing principle, that is, all D-MAP blocks in an automation station are processed in a repeating cycle.

Cycle time

A minimum and maximum cycle time is defined for each automation station. If the processing of all blocks is:

- Shorter than the minimum cycle time, the next processing cycle is delayed until the minimum cycle time has elapsed.
- Longer than the maximum cycle time, the next processing cycle starts as soon as possible.

The processing order of the individual blocks:

- Does not depend on their arrangement on the plan (D-MAP program)
- Can be set explicitly when creating the D-MAP program

Process image

The values at the physical inputs and outputs are displayed in the automation station via the process image. There are two instances of the process image:

- The frozen process image does not change during a processing cycle. D MAP programs only read from or write to this instance of the process image.
- The active process image is continuously connected to the real plant.

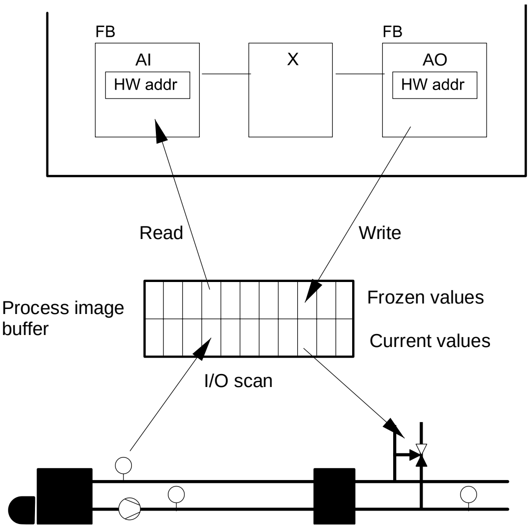


Figure 199: Process image

Values read in cycle 1 are processed in cycle 2. Output values calculated in cycle 1 are transferred to the peripherals in cycle 2.

16.1 Device Object

Each automation station contains a device object. The device object:

- Contains the device and system information for the automation station
- Is based on the standard BACnet object as defined in the BACnet standard, and contains additional proprietary properties
- Is always present and is set up in the automation station with initial values
- Is not programmed in the CFC Editor as a function block and is not loaded with the program

You can monitor property values through a BACnet client (management station, XWP, PXM20). You can change default values. You cannot read changed values back into Xworks Plus (XWP). When an automation station is replaced, you must reenter any changes made to property values.

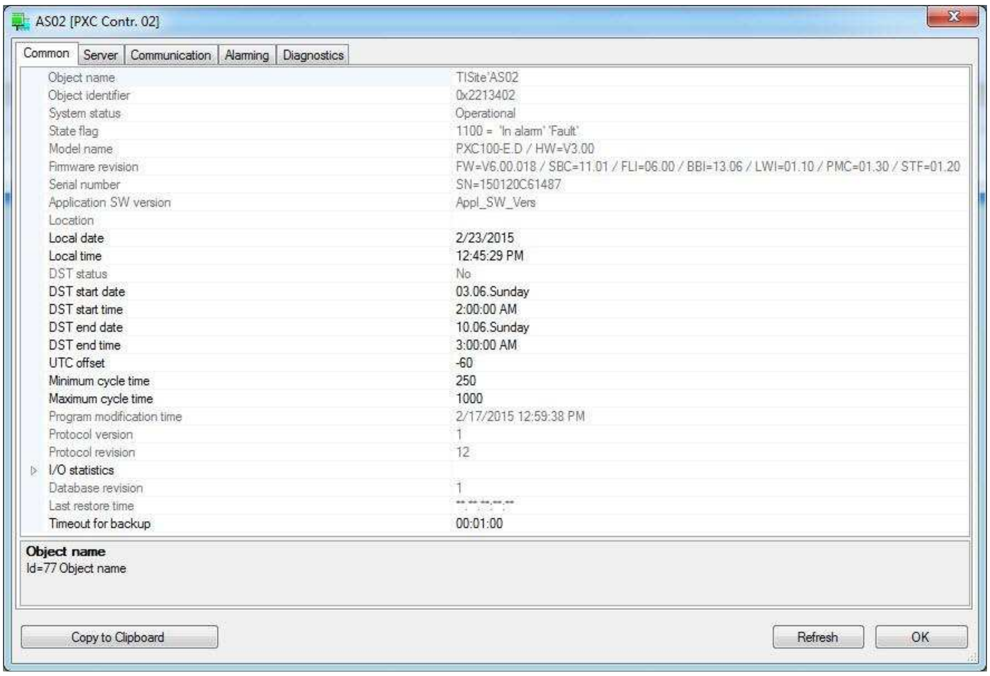


Figure 200: Common tab

The serial number in the row *Serial number SN=150120C61487* consists of:

- 15 = Year
- 01 = Month
- 20 = Day
- C = Hardware version
- 61487 = Consecutive number

Division into groups

The properties of the device object can be divided into groups based on category, for example:

- BACnet communication and BACnet interoperability
- Global properties and system functions
- Local functions and settings
- Statistics and diagnostics

Properties for BACnet communication and interoperability

These properties ensure communication and interoperability between BACnet devices, and are specified in the BACnet standard, for example, Protocol version [ProtVn] and Vendor name [VndrNam]. Individual properties such as Object identifier [ObjId] are set up by XWP during the commissioning process on the network side.

Global properties

Individual properties of the device object are defined as global properties, because, from the system perspective, all automation stations on one site must have the same value. Global properties are only adjustable on the primary server.

Local properties

The device object contains local properties, which are necessary for the parameterizing and functional scope of global objects and for functions, such as life check, time synchronization and the replication of global objects. Local properties also include properties for the system status of the automation station, the time stamp for the generation of the program and the setting of the buffer size of the alarm queue.

These properties can be reviewed in the **Online Properties** window in the Network Configurator or CFC Editor in XWP.

Properties for statistics and diagnostics

These properties contain statistical and diagnostic information and can be reviewed in the **Online Properties** window in the Network Configurator or CFC Editor in XWP.

16.2 Device Info Object

The Device Info Object is a proprietary BACnet object and contains the alarming function for the automation station.

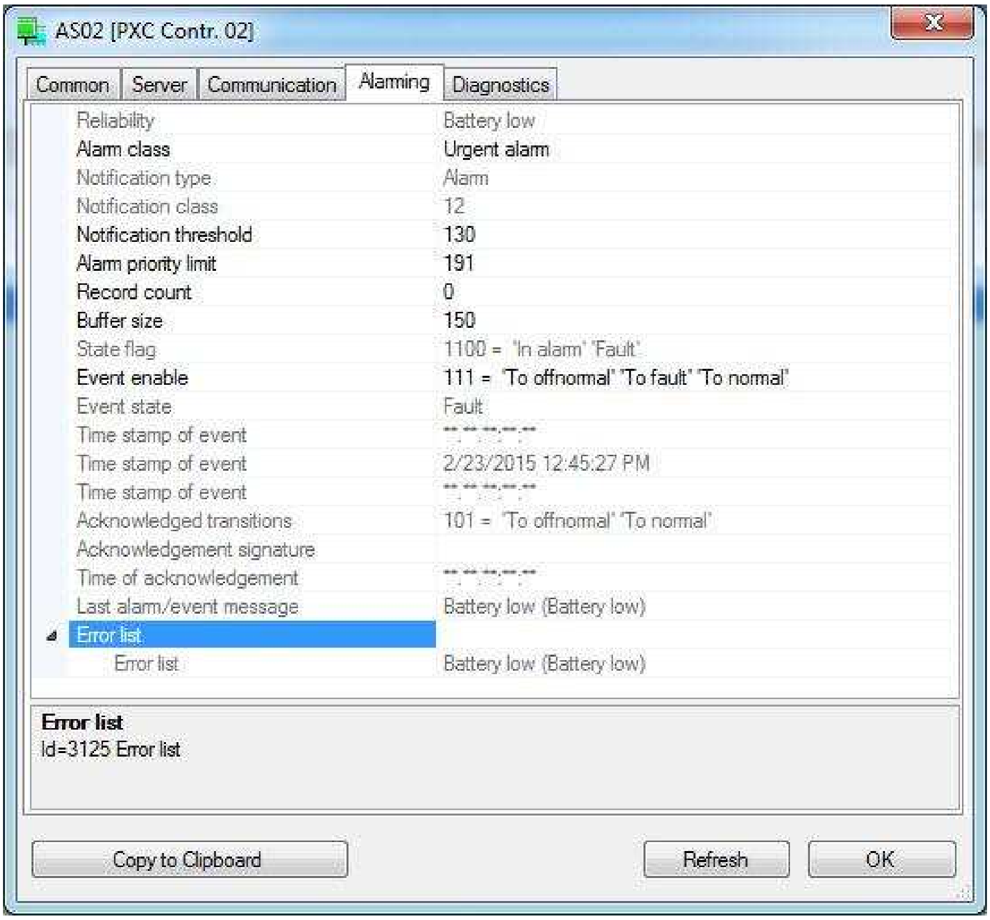


Figure 201: Alarming tab

Properties for system alarms and system events

The device object has an alarm mechanism, because system alarms and system events, which cannot be assigned to a data point, may occur in an automation station. The alarm state machine and alarm-relevant connections are mapped to the BACnet properties of the device object.

16.3 Error Sources and Monitoring Functions

There are various error sources, for example:

Error	Effect
Memory error, for example, faulty flash memory	Desigo PX stops working.
Battery failure	Desigo PX continues working.
Failure of backup server recognized by primary server	Desigo PX recognizes the fault and transmits the relevant alarm.

Table 61: Errors and effects

Non-critical errors / configuration errors

Non-critical hardware and software errors are identified by Desigo PX and registered as a device object alarm.

Critical errors

When a critical hardware or software error occurs, the automation station tries to restart. If the same error is detected three times within 15 minutes, the automation station switches to the COMA operating state. If the **Fault** LED is lit, the automation station is in the COMA operating state.

Online properties for diagnostics

The values in the **Online Properties** window in Xworks Plus (XWP) give clues about the operation of the automation station.

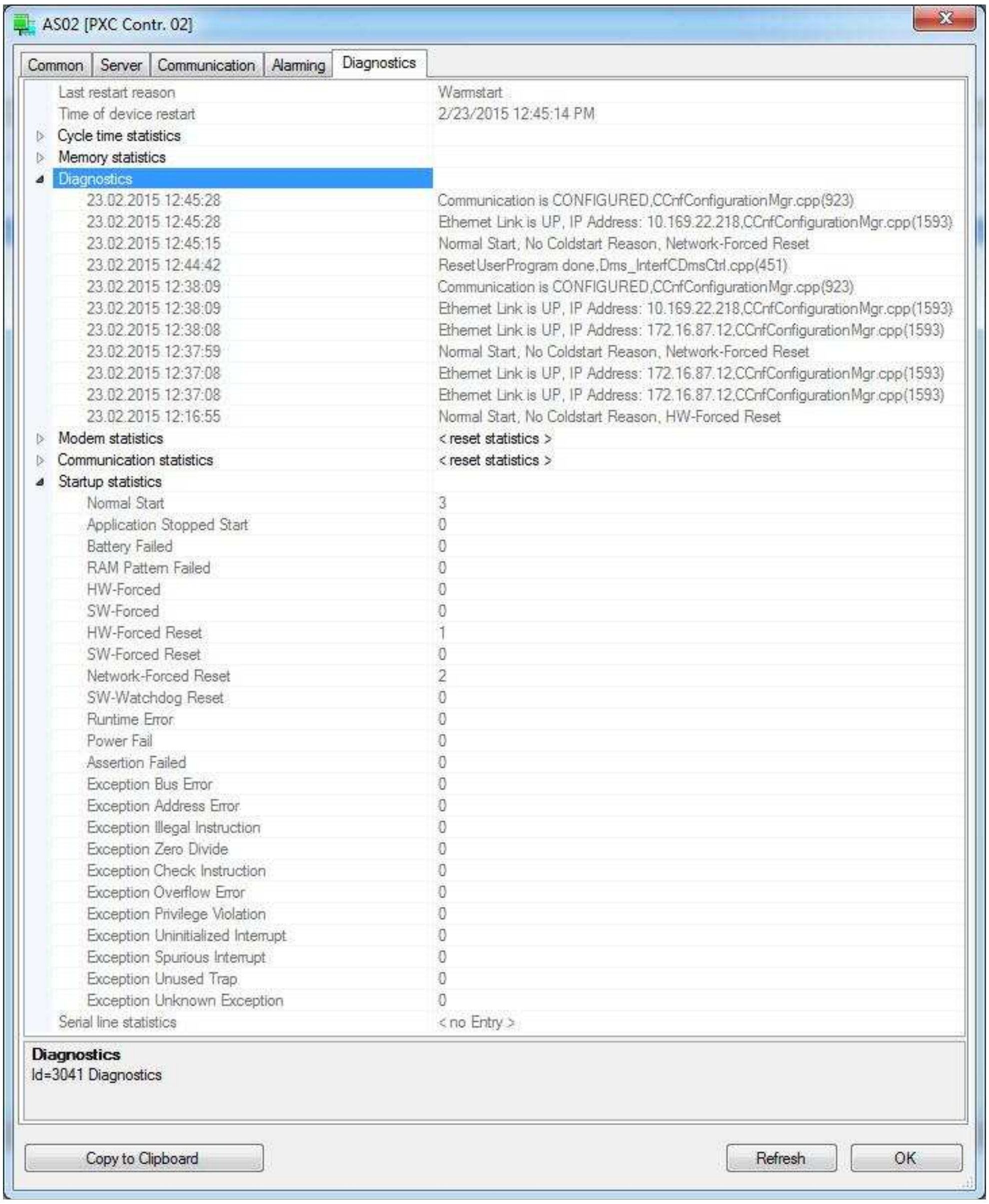


Figure 202: Diagnostics tab

16.4 Operating States

A PX automation station has the following operating states:

- *STOP*: The D-MAP program is stopped.
- *RUN*: The D-MAP program runs.
- *KOMA*: The automation station is in a prolonged sleep mode.

The following figure shows the operating states and the associated transitions:

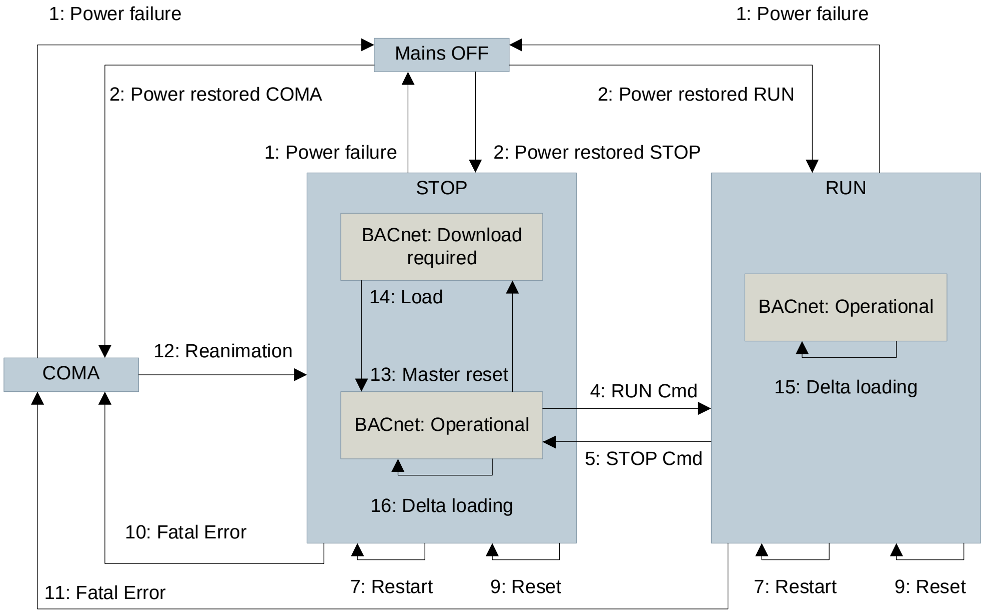


Figure 203: Operating states and transitions

Operating states

Mains off

- No power supply

STOP

- I/O scan active
- Ready for wiring test (only possible without D-MAP program loaded) (PXM20, for PTM modules only)
- D-MAP program processing stopped
- Communication with XWP: Master reset, complete loading and delta loading allowed
- BACnet communication with management station & PXM20 (clients): ReadProperty, WriteProperty, Who-Has, COVs, EventNotification, AcknowledgeAlarm GetEventInformation
- COVs: For values changed by the operator, values cannot be changed by the program
- Alarming: Alarm monitoring inactive, no new alarms or events are generated (the device info object can still generate alarms and system events). Notification of saved alarms and events is possible if recipient lists are set up. GetEventInformation and AcknowledgeAlarm possible.
- Primary server in the STOP state: Primary server is not active, that is, no life check, no time synchronization and no replication of global objects
- Backup server in the STOP state: The backup server is not active, that is, no time synchronization and no replication of global objects by primary server. The backup server will not accept changes to global objects by a client.

RUN

- I/O scan active
- Wiring test not allowed
- D-MAP program processing active
- Communication with XWP: Master reset and complete loading not allowed, delta loading allowed
- BACnet communication with Desigo Insight & PXM20: ReadProperty, WriteProperty, Who-Has, COVs, EventNotification, AcknowledgeAlarm GetEventInformation.
- COVs: For values changed by the program and operator

- Alarming: Alarm monitoring active, notification of alarms and events, GetEventInformation and AcknowledgeAlarm
- Primary server in the RUN state: Primary server is active, that is, life check, time synchronization and replication of global objects
- Backup server in RUN state: The backup server is active, that is, time synchronization and replication of global objects by primary server. The backup server does not accept changes of global objects by a client.

COMA

- I/O scan not active
- Communication with XWP not active
- BACnet communication not active
- Wiring test not possible
- D-MAP program processing stopped

Transitions

1 Power failure

Power failure

2 Power restoration STOP

Power restoration. Operating state before power failure was STOP.

Actions (cold start response):

- Cold start I/O scan: Default values for output modules
- Cold-start variable function blocks: Volatile variables are initialized with initial value. Non-volatile variables retain their last value.

The STOP state is reached when the I/O scan is finished.

3 Power restoration RUN

Power restoration. Operational status before power failure was RUN.

Actions (cold start response):

- Cold start I/O scan: Default values for output modules
- Cold-start variable function blocks: Volatile variables are initialized with initial value. Non-volatile variables retain their last value.
- System event: Power restoration.

D-MAP processing starts when the first I/O scan is finished.

4 RUN Cmd

Explicit command via dialog in XWP or BACnet (DeviceObject, Out of service property [OoServ])

Actions (warm start action):

- Implicit warm start I/O scan: I/O scan continues to run
- Implicit warm-start variables function blocks: All variables retain their last value
- System event: Change to operating state

D-MAP processing starts.

5 STOP Cmd

Explicit command via dialog in XWP or BACnet (DeviceObject, Out of service property [OoServ])

Actions:

- System Event: Change to operating state
- Stop D-MAP processing at the end of current cycle

I/O scan continues.

6 Restart

Restart of the automation station due to software error.

Actions (cold start response):

- Cold start I/O scan: Default values for output modules
- Cold start function block variables: Volatile variables are initialized with initial value. Non-volatile variables retain their last value.

The STOP state is reached when the I/O scan is finished.

7 Restart

Restart of the automation station due to software error.

Actions (cold start response):

- Cold start I/O scan: Default values for output modules
- Cold start function block variables: Volatile variables are initialized with initial value. Non-volatile variables retain their last value.
- System event: Restart

D-MAP processing starts when the first I/O scan is finished.

8 Reset	Explicit reset of automation station via hardware push button. Actions (cold start response): • Cold start I/O scan: Default values for output modules • Cold start function block variables: Volatile variables are initialized with initial value. Non-volatile variables retain their last value. The STOP state is reached when the I/O scan is finished.
9 Reset	Explicit reset of automation station via hardware switch. Actions (cold start response): • Cold start I/O scan: Default values for output modules • Cold start function block variables: Volatile variables are initialized with initial value. Non-volatile variables retain their last value • System event: Reset D-MAP processing starts when the first I/O scan is finished.
10, 11 Fatal Error	Restart due to fatal error in the software or in the D-MAP program. Criterion: Same error occurs three times within 15 minutes. Actions (cold start response): • Stop I/O scan If possible: Loss of hardware output values for compact and modular automation stations • Stop BACnet communication • Stop XWP communication D-MAP processing is stopped.
12 Reanimation	Only possible by deleting the D-MAP program (press ForceFWDownload pin and reset the automation station). Actions (cold start response): • Change of required operating state to STOP • Cold start I/O scan: Default values for output modules The STOP state is reached when the I/O scan is finished.
13 Master reset	Deletion of D-MAP program on automation station with XWP. • Cold start I/O scan: Default values for output modules D-MAP program data including system and event queue is deleted.
14 Load	Complete loading of a new D-MAP program. • Before downloading, a master reset must be carried out. Function block variables are loaded with initialized values.
15 Delta download	D-MAP program changes are loaded.
16 Power restoration - COMA	Power restored. Operating state before power failure was COMA. Actions (cold start response): • Stop I/O scan • Stop BACnet communication • Stop XWP communication D-MAP processing is stopped.

Summary

Every time the automation station restarts (Powerfail, Reset) a cold start is carried out.

The operating state is stored as a non-volatile variable.

The operating state is mapped as follows to the system status [SysSta] property of the device object:

Operating mode	System status property [SysSta]
STOP (no D-MAP program loaded)	DOWNLOAD_REQUIRED
STOP (D-MAP program loaded)	NON_OPERATIONAL
RUN (D-MAP program loaded)	OPERATIONAL

Table 62: Operating modes and system status property [SysSta]

16.5 Data Storage

The following memory types are used in the automation station:

- RAM: The content is lost during a cold start. Read and write access is possible any time without any special action.
- Battery supported RAM: Operating hours and trend data are preserved during a cold start if the battery is loaded.
- Flash memory: The content is retained during a cold start. Read access is possible at any time. Write access is only possible via a special driver and with restrictions (access time, sequential only).

The data and code of a D-MAP program are saved in the flash memory during the download process. A copy of the data is always stored in the RAM so that the D-MAP program can access data efficiently for processing purposes. This means, that all changes to the program data must be updated both in the RAM and in the flash memory.

The following figure shows the various sequences:

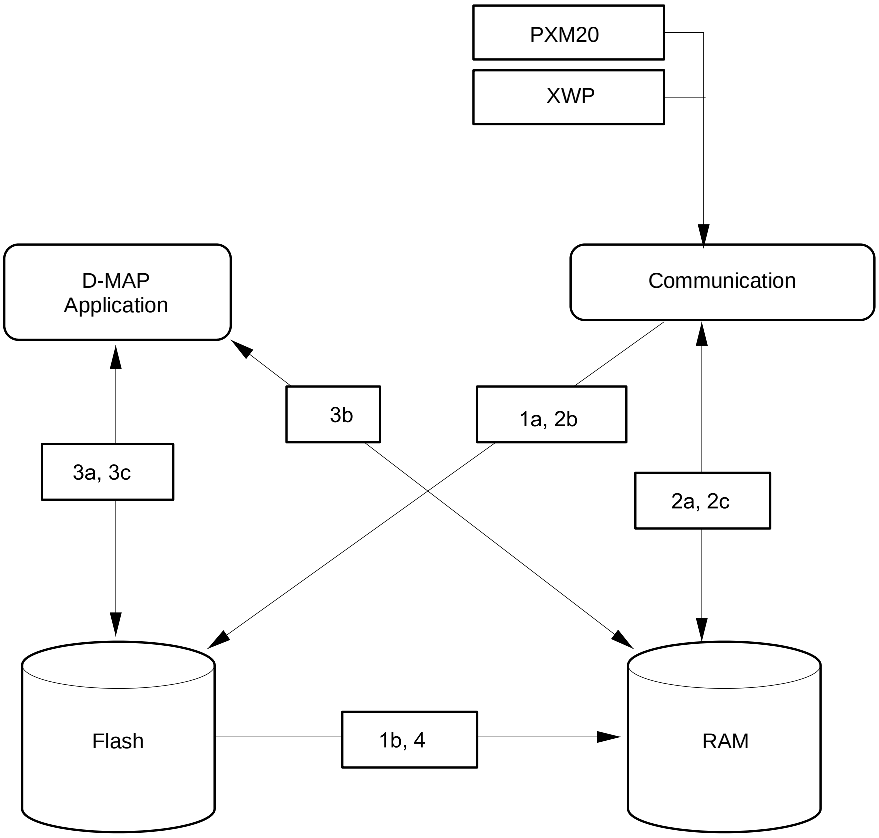


Figure 204: Data storage process

Downloading the D-MAP program

1. The D-MAP program (code and data blocks) is copied to the flash memory (1a). A copy of the data blocks is created in the RAM (1b) for later modification by the D MAP program.

Read/Write via communication system

2. When writing data, the data is written to the RAM (2a) and the flash memory (2b). Read access to the data is via the RAM (2c).

Processing the D-MAP program

3. The D-MAP program code is read from the flash memory (3a). The program data is modified in the RAM (3b). Non-volatile process variables (for example, adaptive control parameters, hours run, etc.) are written by the function blocks into the flash memory (3c) at regular intervals (once per day) or saved in the battery supported RAM.

Starting the automation station

4. At each restart of the automation station, a copy of the data (data blocks) is created in the RAM (4) from the flash memory (including all communication and D-MAP changes).

17 Logical I/O Blocks

I/O blocks are used to register and transmit raw data to and from the plant, and to convert, process and integrate it into the program.

The following options are supported:

- Raw data from or to the input or output modules.
- Raw data from or to the PPS2 interface (room units) (not for Desigo S7 and the modular series PXC…D)
- Data referenced via the Technical Designation (TD) and accessed either in the same automation station (without a connection), or peer-to-peer via BACnet services.
- Data made available via a Discipline I/O of a room automation station or third-party device (not for Desigo S7).

The term I/O blocks refers collectively to the individual input blocks and output blocks.

- Input blocks are used to enable an input signal (for example, a measured value) in the program to be handled as a process value.
- Output blocks are used to enable a process value to be transmitted as an output signal (for example, a positioning command).

Value blocks act as a link between program pins, and are used to temporarily store a process value, and if necessary, to display it on a client operator station. A special version of the value block, the Value block for operation provides a simplified means of operation from an operator client (without the facility to override values manually).

Counter Input blocks (CI blocks) are used to enable a counter value (for example, from a gas or electricity meter) to be processed in the application as a real-number process value. In this process, the counter value (pulse) is converted in the block into the associated physical variable.

Integration I/Os (Discipline I/O blocks) are used, for example, to integrate room automation or third-party devices

Input blocks	Output blocks	Value blocks	Value blocks for operation
Analog Input (AI, AI RED)	Analog Output (AO, AO RED)	Analog Input (AVAL)	Analog Input (AVAL_OP)
Binary Input (BI, BI RED)	Binary Output (BO, BO RED)	Binary (BVAL)	Binary (BVAL_OP)
Multistate Input (MI, MI RED)	Multistate Output (MO, MO RED)	Multistate (MVAL)	Multistate (MVAL_OP)
Counter Input (CI)			
Accumulator (CI ACC)			
Discipline I/O			

Table 63: I/O blocks

Program view and system view

I/O blocks are displayed in two different views:

- The program view shows an I/O block with the pins and attributes required for configuration purposes and to create the program. This is the display format used in Xworks Plus (XWP).
- The system view shows the I/O blocks as standard BACnet objects. These BACnet objects and the associated properties are then available to clients from where they can be operated and monitored.

Desigo S7

In Desigo S7 the Step 7 Manager is used with CFC instead of XWP. PXM20 cannot be used. Use the management station as a client.

All the blocks listed above are implemented in accordance with the BACnet standard. Therefore additional functions are available, such as alarm management. These blocks incorporate a mechanism which acts as an alarm source for blocks available as standard BACnet objects in the BACnet network. By use of various

BACnet functions

BACnet services, a given event is displayed as an alarm event on the relevant clients (for example, PXM20) from where the alarm can be processed, that is, viewed, acknowledged and/or reset.

In XWP these functions can be tracked via the relevant values at the block pins in online test mode.

17.1 General Functions

Blocks: AO, BO, MO, AVAL, BVAL, MVAL

This section describes the general functional scope shared by many of the I/O blocks. Each subsection includes a list of the blocks to which that subsection applies. Any block-specific details which are not shared by other blocks are described together with the block concerned.

Priority mechanism

Basic function

In order to evaluate the various defined setpoints received from the BACnet command system and via the data flow connections, the AO, BO, MO, AVAL, BVAL and MVAL blocks each incorporate a priority array [PrioArr].

All external sources write their defined setpoint and information bit (enable signal) into this [PrioArr]. The block then evaluates these entries continuously, in order to determine the valid present value [PrVal].

The [PrioArr] holds up to 16 different entries, each consisting of a setpoint definition and the associated information bit (enable signal). The input number also indicates the priority of the entry, where 1 is the highest and 16 the lowest priority. Each priority level has a predefined meaning.

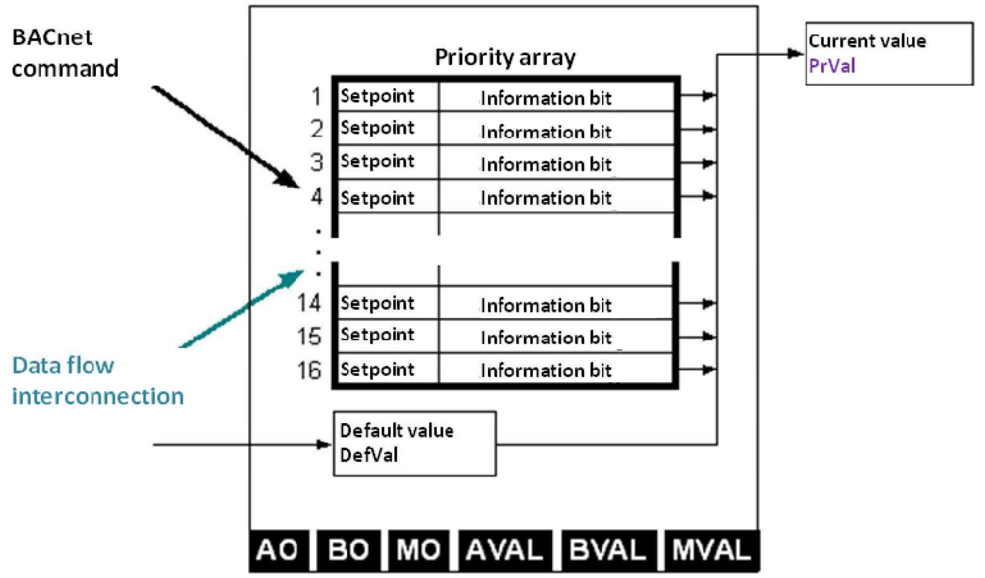


Figure 205: Priority arrayx

Determining [PrVal]

The block continuously evaluates the valid present value at the output [PrVal]. It selects the value that has the highest priority of those whose information bit (enable signal) is also set. If none of the information bits is set, the default value [DefVal] is processed.

Structure of the Priority Array [PrioArr]

Each priority level has a predefined meaning.

In the [PrioArr], two adjacent priority levels each are reserved for life safety, manual operation and plant operation.

- The higher priority (lower number) of each pair is reserved for local control and monitoring, close to the plant (priority 1, 4, 7 and 15).
- The lower priority (higher number) of each pair is reserved for higher level control and monitoring (priority 2, 5, 8 and 16).
- Priority level 6 is specifically designed for switch-on and switch-off delays and to maintain minimum ON and OFF times.

This ensures that, for example, an on-site EMERGENCY OFF command, initiated at the plant level, takes priority over a safety function from a higher-level subsystem.

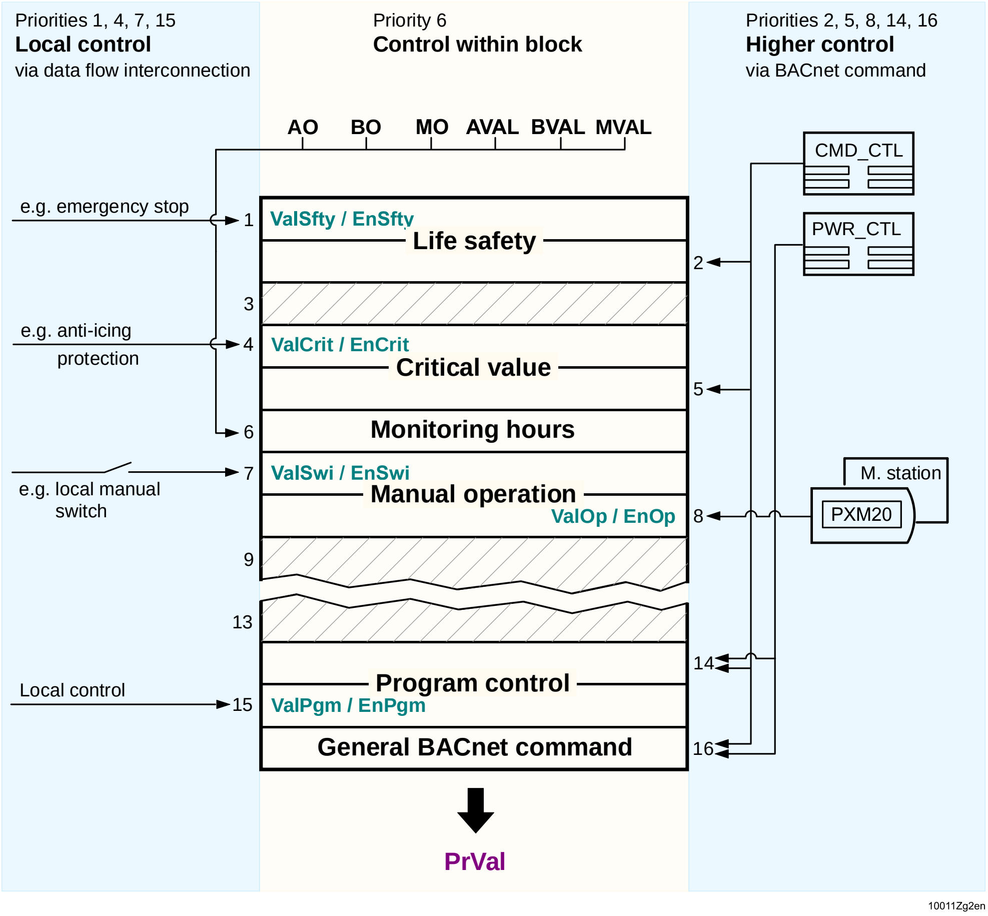


Figure 206: Structure of the Priority Array [PrioArr]

Priority 6

Priority entry 6 is used to forward the switch commands resulting from [PrioArr] to the [PrVal] output after a delay. This enables you to implement both switch-on and switch-off delays and minimum ON and OFF times.

For this purpose, the internal block logic imports the Present value [PrVal] into the priority 6 entry. While the delay times referred to above are running, priority 6 is set to active and so takes priority over priority levels 7…16. Outside these delay times, priority 6 is always inactive.

Locating this function in the [PrioArr] between priorities 1…5 and 7…16 has the following consequences:

- Commands with a priority level of 1…5 are always executed immediately, irrespective of any currently active delay times.
- Commands with a priority level of 7…16 are always overridden by any currently active delay times.

Unlike all the other entries in [PrioArr], the commands and information bit for priority 6 are generated exclusively by the BO, MO, BVAL and MVAL blocks. A priority 6 entry cannot be written from an external source.

The switch-on and switch-off delay

As soon as one of the commands with a priority of 7…16 determines the [PrVal] which will therefore cause the present state of [PrVal] to change, the entry for priority 6 is set up as follows:

If the switch-on delay [DlyOn] or switch-off delay [DlyOff] is greater than 0:

1. Priority 6 adopts the still unchanged present value [PrVal].
2. Priority 6 is set to active.
3. The switch-on or switch-off delay timer starts.
4. After expiry of [TiOnMin] or [TiOffMin], priority 6 is set to inactive.

If the delay times [DlyOn] or [DlyOff] are equal to 0, no action is taken.

If the new value which determines [PrVal] is the same as the current [PrVal], then, here too, no action is taken.

The minimum on/off time

For each change at the output [PrVal] from OFF to Stage n or from Stage n to OFF, the entry for priority 6 is set up as follows:

If the minimum ON-time [TiOnMin] or OFF-time [TiOffMin] is greater than 0:

1. Priority 6 adopts the new present value [PrVal].
2. Priority 6 is set to active.
3. The timer for the minimum on-time or off-time is started.
4. After expiry of [TiOnMin] or [TiOffMin], priority 6 is set to inactive.

If the minimum switch-times [TiOnMin] / [TiOffMin] are set to 0, no action is taken.

Constraints

- The functions described above are supported only by the BO, MO, BVAL and MVAL blocks.
- With multistage switch commands, the monitoring periods are enabled only when switching from OFF to Stage n or from Stage n to OFF. When switching from one stage to another (for example, Stage 1 to Stage 2), the timer times are not enabled.
- However, any timer times already running will continue to run.

Application

- Unnecessary on/off switching operations can be prevented by activating minimum switch-on or switch-off times.
- Activating switch-on or switch-off delays ensures that run-on time delays are maintained.

Information bit

In order for a given value to be included in the evaluation of [PrioArr], its information bit must be set.

The following applies to priority 1,4,7 and 15 (data flow connection): The relevant information bit is set via pins [EnSfty], [EnCrit], [EnSwi] and [EnPgm].

The following applies to priority 2, 5, 8, 14 and 16 (BACnet command system): When a given value is commanded via BACnet, the value concerned is entered in the [PrioArr] and the associated information bit is set automatically.

The following applies to priority level 6: Both the value and the information bit are handled by the block concerned.

<table>
<tr><th>Prio</th><th>Meaning</th><th>Use</th><th>Access via</th></tr>
<tr><td>1</td><td rowspan="2">Safety value (life safety)
Reserved for the initiation of safety functions (1 = highest priority).
If priority 1 or 2 becomes the determining value for [PrVal], then the value concerned is transmitted immediately to the [PrVal] output. It is not subject to the delay times defined for priority 6.</td><td>Local safety function, for example:
- Fire
- EMERGENCY OFF
- Service switch
- Gas alarm
- Thermal package</td><td>Data flow interconnection via pins: [ValSfty] and [EnSfty].
Normally, [ValSfty] is a constant and [EnSfty] can be enabled/disabled.</td></tr>
<tr><td>2</td><td>Higher-level safety function, for example:
- Smoke extraction</td><td>BACnet command system.
Access via the CMD_CTL block.</td></tr>
<tr><td>3</td><td colspan="3">Not used in Desigo.</td></tr>
</table>

Prio	Meaning	Use	Access via
4	Critical value (plant protection) Reserved for monitoring critical plant states. If priority 4 or 5 becomes the determining value for [PrVal], then the value concerned is transmitted immediately to the [PrVal] output. It is not subject to the delay times defined for priority 6.	Local monitoring of critical plant states, for example: - Frost protection (protection from excess cooling) - Interlock of aggregates - Icing protection	Data flow interconnection via pins: [ValCrit] und [EnCrit]. Normally, [ValCrit] is a constant and [EnCrit] is enabled/disabled.
5		Higher-level monitoring of critical plant states: - Frost in ventilation system (close dampers, stop fans, switch pump on and open valve)	BACnet command system. Access via the CMD_CTL block.
6	Minimum switch-on/off time Prevent unnecessary switching operations. Switch-on/off delay Can be used to ensure that run-on delay times are implemented.		No access! Commands are only generated internally in the block. The timer periods [TiOnMin], [TiOffMin], [DlyOn] and [DlyOff] can be configured in blocks BO, MO, BVAL and MVAL.
7	Operating value Reserved for manual operation.	Local manual operation, for example: - Manual switch - Mode selector switch	Data flow interconnection via pins: [ValSwi] und [EnSwi].
8		Higher-level manual operation, for example: - Management station - PXM20 - Web client	BACnet command system. Access via: - PXM20 - Management station - Web client
9...13	Not used in Desigo.		
14	Program value Reserved for normal plant operation with monitoring and control.	Superposed control and monitoring of the plant.	BACnet command system. Access is via blocks: - CMD_CTL - PWR_CTL (if control enable signal = Fixed)
15		Local control of plant.	Data flow interconnection via pins: [ValPgm] and [EnPgm]. If the program value is a controller variable, then [EnPgm] = True and [ValPgm] = controller variable. If the program value is not a controller variable, then [EnPgm] = False.
16	Program value Reserved for general cross-PX commands via BACnet references.		BACnet command system. Access via blocks: CMD_CTL PWR_CTL (if control enable signal is = Released) Cross-PX via various blocks, for example, ASCHED, BSCHED, MSCHED (name reference list).
17	Default value [DefVal] If none of priorities 1…16 is active, then the default value [DefVal] is processed instead.	The influence of [DefVal] depends on the state of the block concerned: Out-of-service [OoServ=False]: [DefVal], like the values of priorities 7…16, is subject to the delay times of priority 6. [OoServ=True]: [DefVal] is transmitted immediately to the [PrVal] output.	BACnet command system. Access via: - CFC - PXM20 - Web client

Table 64: Priorities

Example: Effect of priorities 7...16 on [PrVal]

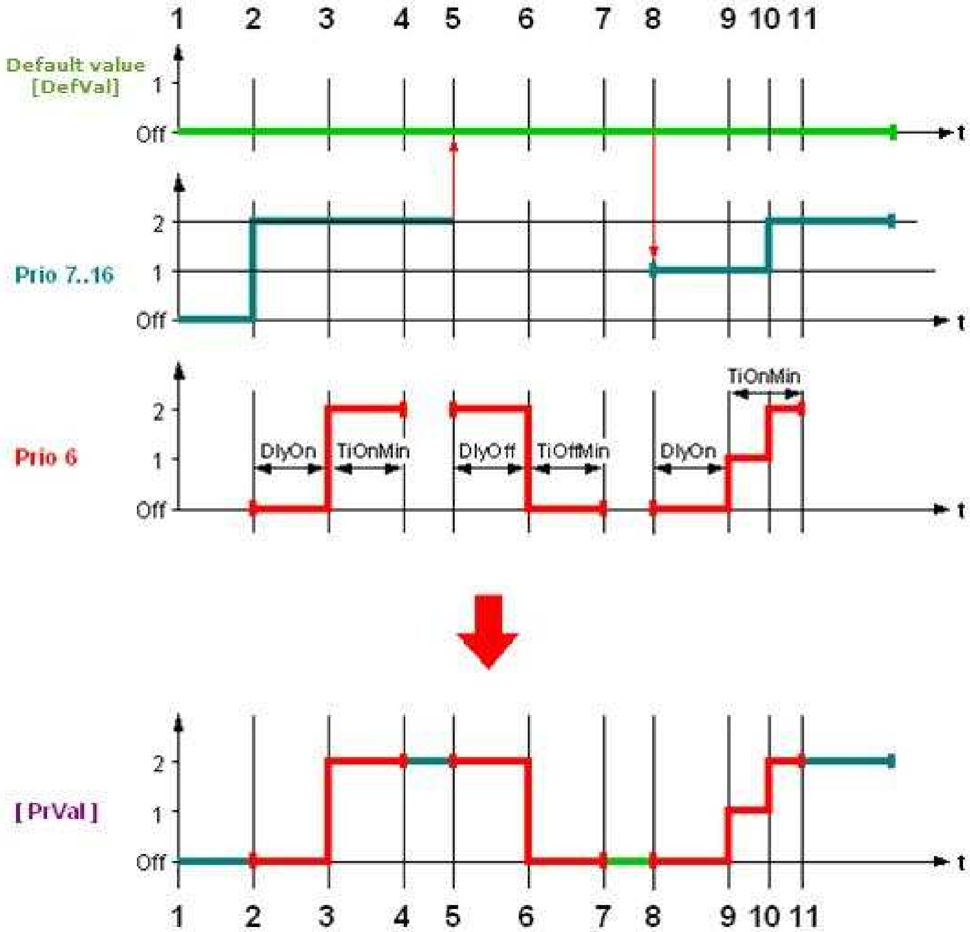


Figure 207: Effect of priorities 7...16 on [PrVal]

Prio	Use	
1	Prio 7…16	Assumption: The effective switch command from priority (7…16) is *Off* and is set to active.
	Prio 6	Assumption: Priority 6 is not active.
	[PrVal]	Assumption: The [PrVal] output is set to *Off*.
2	Prio 7…16	The effective switch command from priority (7…16) switches from *Off* to *Stage 2*.
	Prio 6	Priority 6 adopts the (still unchanged) present value [PrVal=Off] and is set to active. At the same time, the switch-on delay [DlyOn] starts. Throughout the delay time, priority 6 remains active – the associated value remains *Off*.
	[PrVal]	Since priority 6 overrides the effective switch command from priority (7…16), the [PrVal] output remains *Off*.
3	Prio 7…16	n/a
	Prio 6	1. After expiry of the switch-on delay [DlyOn], priority 6 is released. 2. The effective switch command *Stage 2* from priority (7…16) is transmitted to the [PrVal] output. 3. Priority 6 adopts the new value of [PrVal] and is set to active again. At the same time, the minimum switch-on time [TiOnMin] is started. Priority 6 remains active throughout this monitoring time.
	[PrVal]	The [PrVal] output changes from *Off* to *Stage 2*.
4	Prio 7…16	n/a
	Prio 6	The minimum switch-on time [TiOnMin] has expired. Priority 6 is released.

Prio	Use	
	[PrVal]	When priority 6 ceases to take effect, the [PrVal] output is once again determined by the effective switch command from priority (7…16). [PrVal] remains at *Stage 2*.
5	Prio 7…16	None of the information bits for priorities (7…16) is active. The resulting switch command is therefore determined by the default value [DefVal].
	Prio 6	The block starts the switch-off delay [DlyOff]. Throughout this monitoring time, priority 6 is set to active – the associated value remains at *Stage 2*.
	[PrVal]	Since priority 6 overrides the effective switch command [DefVal], the [PrVal] output remains at *Stage 2*.
6	Prio 7…16	n/a
	Prio 6	1. After expiry of the switch-off delay [DlyOff], priority 6 is released. 2. The effective switch command *Off* from [DefVal] is transmitted to [PrVal]. 3. Priority 6 adopts the new value of [PrVal] and is set to active again. At the same time, the minimum switch-off time [TiOffMin] is started. Priority 6 remains active throughout this monitoring time.
	[PrVal]	The [PrVal] output changes from *Stage 2* to *Off*.
7	Prio 7…16	n/a
	Prio 6	The minimum switch-off time [TiOffMin] has expired. Priority 6 is released.
	[PrVal]	Since neither priority 6 nor any of the information bits for priority entries (7…16) is active, the effective switch command is determined by [DefVal]. The output value [PrVal] remains at *Off*.
8	Prio 7…16	At least one of the information bits for priorities (7…16) is active again. The effective switch command from priority (7…16) is *Stage 1*.
	Prio 6	Priority 6 adopts the (still unchanged) present value [PrVal=Off] and is set to active. At the same time, the switch-on delay [DlyOn] starts. Throughout the delay time, priority 6 remains active – the associated value remains *Off*.
	[PrVal]	Since priority 6 overrides the effective switch command from priority (7…16), the [PrVal] output remains *Off*.
9	Prio 7…16	n/a
	Prio 6	1. After expiry of the switch-on delay [DlyOn], priority 6 is released. 2. The effective switch command *Stage 1* from priority (7…16) is transmitted to the [PrVal] output. 3. Priority 6 adopts the new value of [PrVal] and is set to active again. At the same time, the minimum switch-on time [TiOnMin] is started. Priority 6 remains active throughout this monitoring time.
	[PrVal]	The [PrVal] output changes from *Off* to *Stage 1*.
10	Prio 7…16	The effective switch command from priority (7…16) switches from *Stage 1* to *Stage 2*.
	Prio 6	The minimum switch-on time [TiOnMin] is still active. Changeover from *Stage m* to *Stage n*. With multistage switch commands, the monitoring periods are enabled only when switching from OFF to *Stage n* or from *Stage n* to OFF. When switching from one stage to another (for example, *Stage 1* to *Stage 2*), the monitoring periods are not enabled. However, monitoring periods which have already started remain active – priority 6 adopts the new target value.
	[PrVal]	A change from *Stage 1* to *Stage 2* would not activate priority 6. However, since the minimum switch-on time [TiOnMin] is still active, priority 6 still overrides the effective switch command from priority (7…16). The [PrVal] output changes from *Stage 1* to *Stage 2*.
11	Prio 7…16	n/a
	Prio 6	The minimum switch-on time [TiOnMin] has expired. Priority 6 is released.
	[PrVal]	When priority 6 ceases to take effect, the [PrVal] output is once again determined by the effective switch command from priority (7…16). The [PrVal] output remains at *Stage 2*.

Table 65: Effect of priorities 7...16 on [PrVal]

Example: Effect of priorities 1...5 on [PrVal]

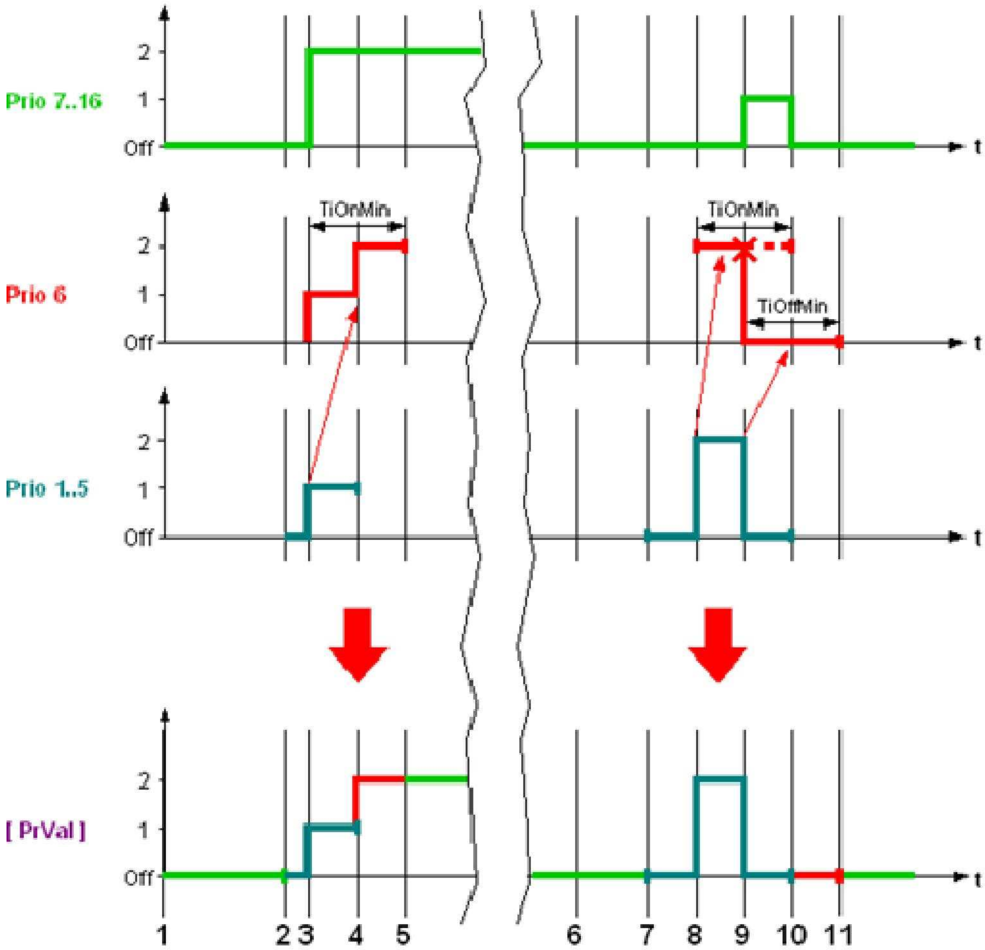


Figure 208: Effect of priorities 1...5 on [PrVal]

Prio	Use	
1	Prio 1…5	Assumption: All information bits for priorities 1…5 are inactive.
	Prio 6	Assumption: Priority 6 is not active.
	[PrVal]	Assumption: The [PrVal] output is set to *Off*.
2	Prio 1…5	At least one of the information bits for priorities (1…5) is active again. The effective switch command from priority (1…5) is *Off*.
	Prio 6	Since the effective switch command for priority (1...5) does not cause a change in the [PrVal] output, priority 6 remains inactive.
	[PrVal]	The output value [PrVal] remains at *Off*.
3	Prio 1…5	The effective switch command from priority (1…5) switches from *Off* to *Stage 1*.
	Prio 6	Priority 6 adopts the new present value [PrVal=Stage 1] and is set to active. At the same time, the minimum switch-on time [TiOnMin] starts without waiting for the delay time [DlyOn]. Note: Entries for priorities (1…5) initialize only the minimum switch-on or switch-off times [TiOnMin] and [TiOffMin] respectively, but not the switch-on and switch-off delays. [TiOnMin] and [TiOffMin] times for which the timer has already started only take effect when all priorities (1…5) are inactive, that is, when the [PrVal] will be determined by one of priorities (7…16).
	[PrVal]	Priorities 1…5 are reserved to implement safety functions, and are executed immediately, irrespective of any priority 6 monitoring periods which may already be running. The [PrVal] output is switched immediately from *Off* to *Stage 1*.
4	Prio 1…5	None of the information bits for priority entries (1…5) is active.
	Prio 6	The minimum switch-on time [TiOnMin] is still active. Priority 6 adopts the new target value from priority (7…16).

Prio	Use	
	[PrVal]	The effective switch command is determined from priority 6. The [PrVal] output changes from *Stage 1* to *Stage 2*.
5	Prio 1…5	n/a
	Prio 6	The minimum switch-on time [TiOnMin] has expired. Priority 6 is released.
	[PrVal]	Since neither priority 6 nor any entries for priorities (1…5) are active, the output [PrVal] is now again determined by the effective switch command from priorities (7…16). The [PrVal] output remains at *Stage 2*. Note: Switching from *Stage 1* to *Stage 2* does not re-start the minimum switch-on time [TiOnMin].
6	Prio 1…5	Assumption: All information bits for priorities 1…5 are inactive.
	Prio 6	Assumption: Priority 6 is not active.
	[PrVal]	Assumption: The [PrVal] output is set to *Off*.
7	Prio 1…5	At least one of the information bits for priorities (1…5) is active again. The effective switch command from priority (1…5) is *Off*.
	Prio 6	Since the effective switch command for priority (1...5) does not cause a change in the [PrVal] output, priority 6 remains inactive.
	[PrVal]	The output value [PrVal] remains at *Off*.
8	Prio 1…5	The effective switch command from priority (1…5) switches from *Off* to *Stage 2*.
	Prio 6	Priority 6 adopts the new present value, [PrVal=Stage 2] and is set to active. At the same time, the minimum switch-on time [TiOnMin] starts without waiting for the delay time [DlyOn]. Note: Entries for priorities (1…5) initialize only the minimum switch-on or switch-off times [TiOnMin] and [TiOffMin] respectively, but not the switch-on and switch-off delays. [TiOnMin] and [TiOffMin] times for which the timer is already running only take effect when all priorities (1…5) are inactive, that is, when the [PrVal] will be determined by one of priorities (7…16).
	[PrVal]	Priorities 1…5 are reserved to implement safety functions, and are executed immediately, irrespective of the switch state and of any priority 6 monitoring periods which may already be running. The [PrVal] output is switched immediately from *Off* to *Stage 2*.
9	Prio 1…5	The effective switch command from priority (1…5) switches from *Stage 2* to *Off*.
	Prio 6	Priority 6 adopts the new present value [PrVal=Off]. The still-running minimum switch-on time [TiOnMin] is cancelled. The block re-starts the minimum switch-off time [TiOffMin].
	[PrVal]	Priorities 1…5 are reserved to implement safety functions, and are executed immediately, irrespective of the switch state and of any priority 6 monitoring periods which may already be running. The [PrVal] output is switched immediately from *Stage 2* to *Off*.
10	Prio 1…5	All information bits for priorities 1…5 are inactive.
	Prio 6	The minimum switch-off time [TiOffMin] is still active.
	[PrVal]	The effective switch command is determined from priority 6. The output value [PrVal] remains at *Off*.
11	Prio 1…5	n/a
	Prio 6	The minimum switch-off time [TiOffMin] has expired. Priority 6 is released.
	[PrVal]	Since neither priority 6 nor any entries for priorities (1…5) are active, the output [PrVal] is now again determined by the effective switch command from priorities (7…16). The output value [PrVal] remains at *Off*.

Table 66: Effect of priorities 1...5 on [PrVal]

Switch types [SwiKind]

Blocks: BO, MO, BVAL, MVAL

All switching I/O blocks have a configurable switching response. The switching response determines the functioning of the block. The switching functions are subject to the priority mechanism in the [PrioArr] and the switch command delay.

- *Normal*: Direct switching in stages taking into account runtimes (for example, motors, burners, dampers, etc.).
- *Motor*: Switching in stages for rotating aggregates taking into account ramp-up and ramp-down times (fan-belt protection).
- *Trigger*: Event-driven switching, *last command takes precedence*; integration of a data point (EIB, LONMARK)
- *Switch*: Generation of an ON/OFF pulse of a defined duration.
- *Push button with delay*: Generation of an ON/OFF pulse of a defined duration. The pulse can be extended whenever required.
- *Release (Release Command)*: Issuance of a subsystem-specific release value instead of Present_Value (=Relinquish_Default), if no priority is active in the output object.

[SwiKind]	BO	MO	BVal	MVal
Normal	•	•	•	•
Motor		•		
Trigger	•	•		
Switch	•		•	
Pushbutton with delay	•		•	
Release		•		

Table 67: I/O block switch types

Normal

Normal handling of the process values in the [PrioArr]. The configured runtimes are active. The outputs can be switched directly or in stages.

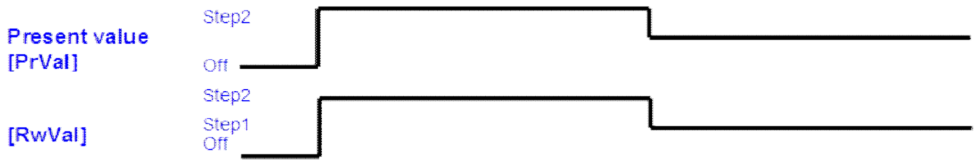


Figure 209: Control of a multistage aggregate without configured runtimes

Motor

The *Motor* setting is used when there is a need to allow for ramp-up and ramp-down times due to a rotating centrifugal mass. The programmed times in this setting can be used, for example, to avoid overloading the fan belt when starting a fan motor.

When the motor is switched down, the system checks on the basis of the ramp-up time whether or not the current motor speed has been reached. The switch-down command is not executed until the motor speed is stable. During the ramp-down period, the effective command to the hardware is *Off*. When the ramp-down time has elapsed, the new command is transmitted to the hardware.

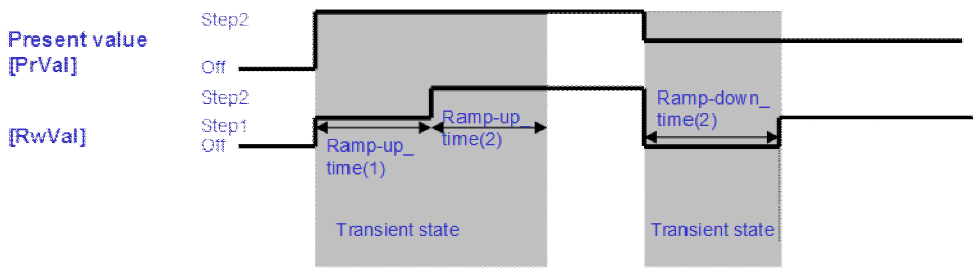


Figure 210: Control of a multi-speed motor with configured runtimes

Trigger

In the *Trigger* setting, the source of the last command takes precedence. The valid value is written from the [PrioArr] to the [DefVal] and transmitted to the output. The priority is then released again.

In this setting, Priorities 7…16 are treated equally; Priorities 1…5 have a blocking effect.

The trigger function is used, for example, for the integration of LON data points. Owing to the event mechanism, this function is not used for P-bus objects.

Switch

The *Switch* setting is used to generate an ON or OFF pulse of a predefined duration. A command via BACnet, or the activation of an Enable signal in one of Priorities 7…16 via the data flow connection initiates an associated pulse (event). The minimum switch-on time [TiOnMin] and/or minimum switch-off time [TiOffMin] must be set. Setting both times can prevent fast switching operations. Priorities 1…5 have a blocking effect.

Pushbutton with delay (time extension)

The *Pushbutton with delay* function is like the *Switch* function, except an active pulse can be extended by another pulse at any time.

Runtimes and monitoring periods

The I/O function blocks are designed for the runtimes and monitoring periods required in HVAC engineering, and can therefore be used directly as components (motors, dampers, fans, etc.).

Different runtimes and monitoring periods can be set, depending on the function concerned.

Runtimes:

- Switch-on/off delay
- Minimum switch-on/off time
- Ramp-up/-down time

Monitoring periods:

- Feedback time with switch-on/off
- Feedback signal deviation during operation

Runtimes

Switch-on/off delay

Blocks: BO, MO, BVAL, MVAL

The switch-on/off delay when applied to the switching I/O blocks causes a delayed output if the switch command was written via Priority 7…16. The delay time affects Priority 6 as described. Switch commands via Priorities 1…5 are executed without a delay.

Minimum switch-on/off time

When applied to the switching I/O blocks, the minimum switch-on/switch-off time causes the output to be blocked for a period of time if the switch command was written via Priority 7…16. The minimum switch-on/off time affects Priority 6 as already described in Section 24.2.1.3. However, switch commands via Priorities 1…5 are executed immediately irrespective of the minimum switch-on/off time.

Ramp-up/down time

The ramp-up/down times (run-up/-down times) can be defined in a table for each stage. These times apply to the two switch types [SwiKind] *Normal* and *Motor*.

The ramp-up time is the time taken by a motor when changing from a lower speed to the next higher speed, to reach the new speed. This limits the current consumption of the motor.

The ramp-down time is the time taken by the motor when switching down from a higher speed, to reach the lower speed. This prevents feedback to the mains supply network and protects the fan belt and the motor.

As a rule, the ramp-up and ramp-down times depend on the centrifugal mass involved, and must be determined separately for each project.

Especially with single-speed motors, the times can be used as Open/Close runtimes (for example, damper actuator from 0…100%). A moving damper can thus be mapped in the system and the transition signal can, if required, be used for control purposes.

Monitoring periods

Feedback monitoring / process value monitoring

Blocks: BI, MI, BO, MO, BVAL, MVAL

The I/O objects have a monitoring function. The output objects monitor the feedback signal from the plant. For this purpose, an address string must be entered for the [FbAddr] feedback parameter [FbAddr] and the alarm function must be enabled.

The input and value objects can monitor reference values. For this purpose, the relevant reference values must be configured and the alarm function must be enabled.

Deviation monitoring

If the feedback value deviates from the output value [PrVal], a deviation alarm is generated after a configurable time period, and the block status changes to *In Alarm*. When the two values match again, and the configured time period has expired, the alarm and status are reset. There is otherwise no automatic block reaction, that is, if a switch response in the plant is required as a reaction to this alarm, this response must be programmed in CFC via the Disturbance output [Dstb].

Switch-on/off feedback monitoring

It is also possible to configure the time period during which the maximum deviation of the feedback signal may occur after a switch-on/off operation. If the deviation persists after the monitoring time has expired, an alarm is generated and the status of the block changes to *In alarm*. When the two values match again, and the configured time period has expired, the alarm and status are reset. There is otherwise no automatic block reaction, that is, if a switch response in the plant is required as a reaction to this alarm, this response must be programmed in CFC via the Disturbance output [Dstb].

No feedback monitoring

If no feedback monitoring is required, and the address string is left blank, the monitoring periods are used by the block for the internal generation of the transient state [TraSta]. This means that the transient state signal for the switch-on/off operation is set for the preset period of time. This is how a moving actuator, for example, a damper, is displayed in the system.

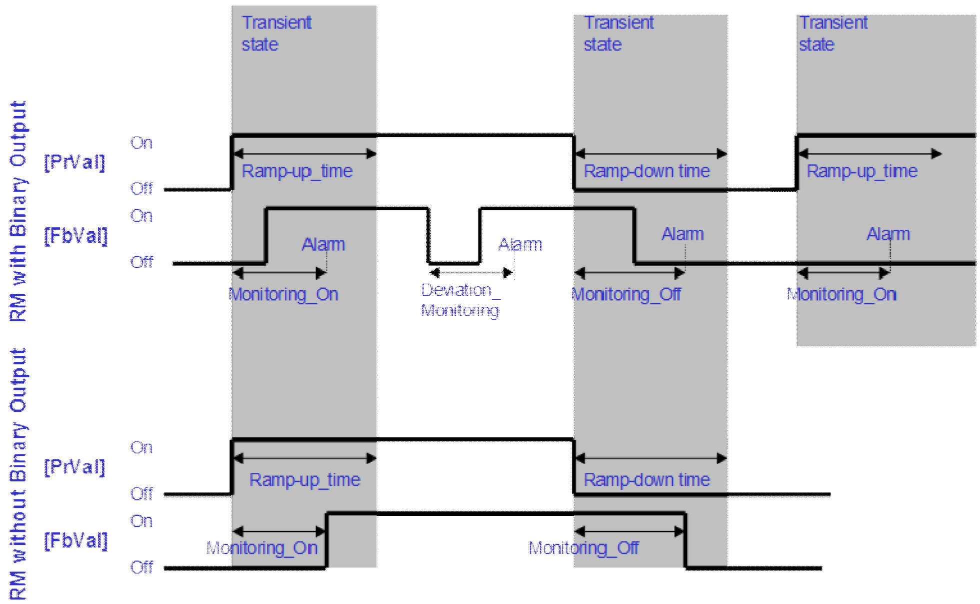


Figure 211: No feedback monitoring

Limit monitoring

Blocks: AI, AO, AVAL

In the case of the analog I/O blocks, the present value [PrVal] can be monitored for a high/low limit. If the alarm monitoring feature is enabled, a deviation alarm is generated after a configurable time period, and the block status changes to *In Alarm*. When the present value is within the limits again and the configured time period has expired, the alarm and status are reset. There is otherwise no automatic block reaction, that is, if a switch response in the plant is required as a reaction to this alarm, this response must be programmed in Xworks Plus (XWP) via the disturbance output [Dstb].

Override via client

The input, output and value blocks can be overridden via BACnet clients (for example, the PXM20 operator unit) or in XWP (CFC) in online test mode.

User override of an input value

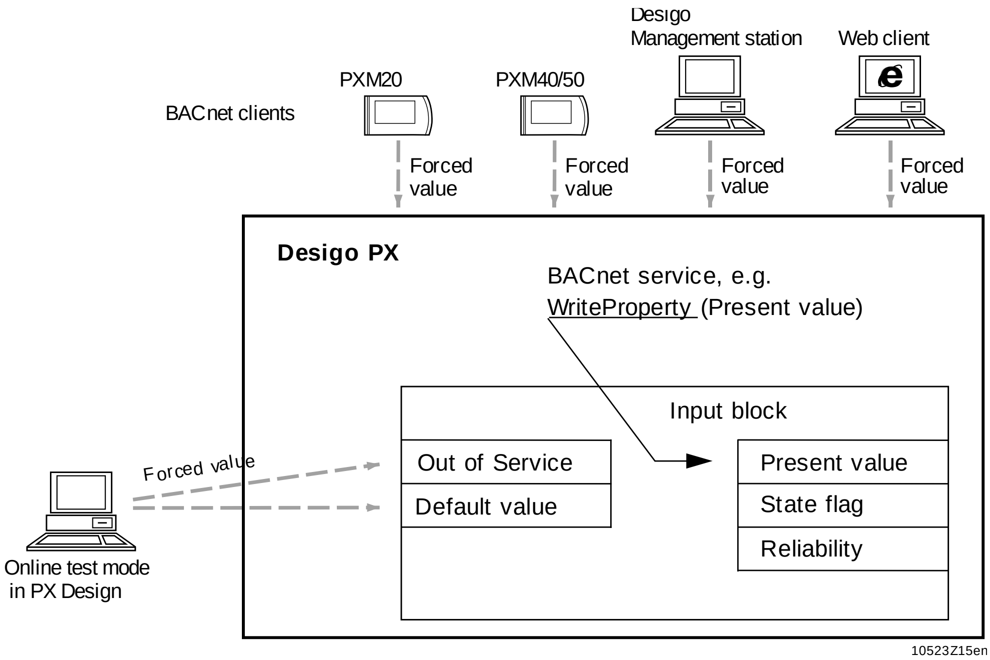


Figure 212: Override of input blocks

There are two options:

1. Override via a BACnet client:

A BACnet client is overridden with a BACnet service.

Input objects are overridden by setting the out-of-service parameter [OoServ] and writing the desired present value [PrVal]. The default value [DefVal] is automatically set to the same value as [PrVal]. (You can also overwrite [DefVal], in which case [PrVal] is automatically used instead).

There is no need to follow these rules when using the PXM20 to override a value, as the operator unit observes them automatically.

Overridden input objects are not reset automatically. To do this, reset [OoServ] first. [DefVal] remains at the last overridden value and [PrVal] is again derived from the physical input.

2. Override via online test mode in CFC:

Overrides with CFC are carried out via a proprietary service.

Outputs of a block cannot be overwritten.

To overwrite [PrVal] the out of service state in [OoServ] must be set to TRUE, after which the default value [DefVal] can be modified. This value is then adopted (or applied) as the present value and is made available under [PrVal].

User override of an output value

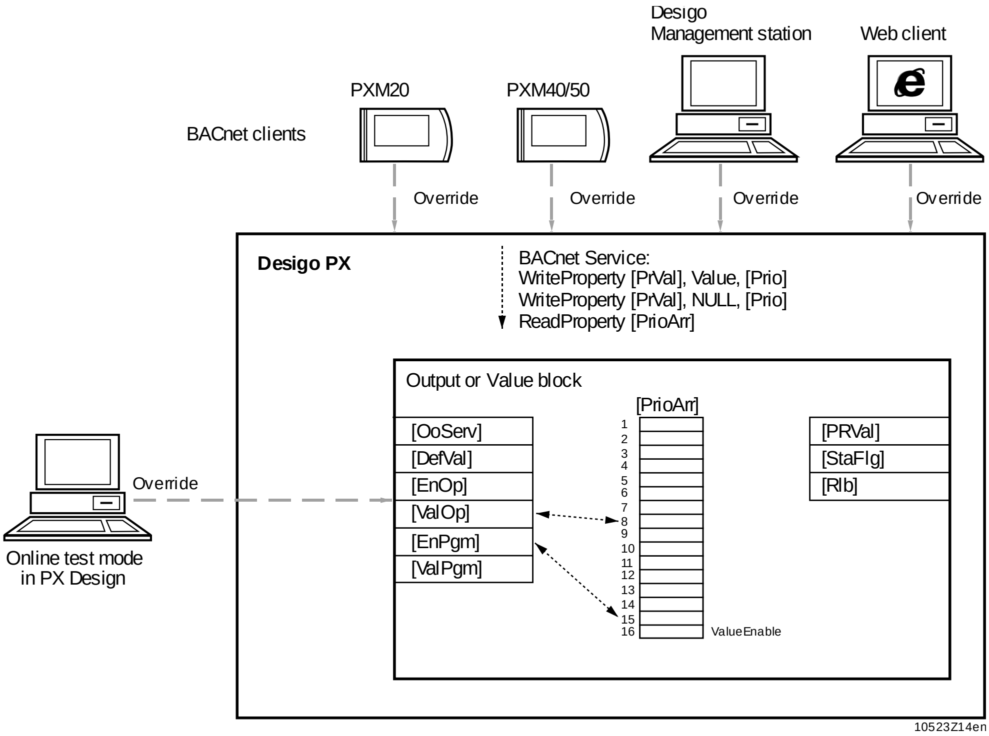


Figure 213: Override of output blocks

There are two options:

1. Override via a BACnet client:

The override of an output or value object is based on the priority array [PrioArr] in the object. Priority 8 is reserved for the operator, that is, an override from the PXM20 and PX Web is written to the Priority 8 entry. Other BACnet clients can write to other priority entries.

The value (Value or Null) is stored in the [PrioArr]. After processing in the object, the value, other than NULL, with the highest priority is transmitted to [PrVal]. If there is no active priority, the [DefVal] is transmitted.

2. Override via the online test mode in Xworks Plus (XWP):

[PrVal] is an output and can therefore not be modified. In this case the value under [EnOp] must first be set, after which the modifiable value under [ValOp] is written to Priority 8 in [PrioArr]. After processing in the object, the value, other than NULL, with the highest priority is then transmitted to [PrVal]. If there is no active priority, the [DefVal] is transmitted.

Runtime totals

Runtime totalization can be implemented in the binary input, binary output and multistate input and output blocks (BI, BO, MI and MO). Part of the overall range of functions is defined by the BACnet standard. In order to provide the complete range of runtime totalizing functions required in the field of building automation and control, certain proprietary enhancements have been added here.

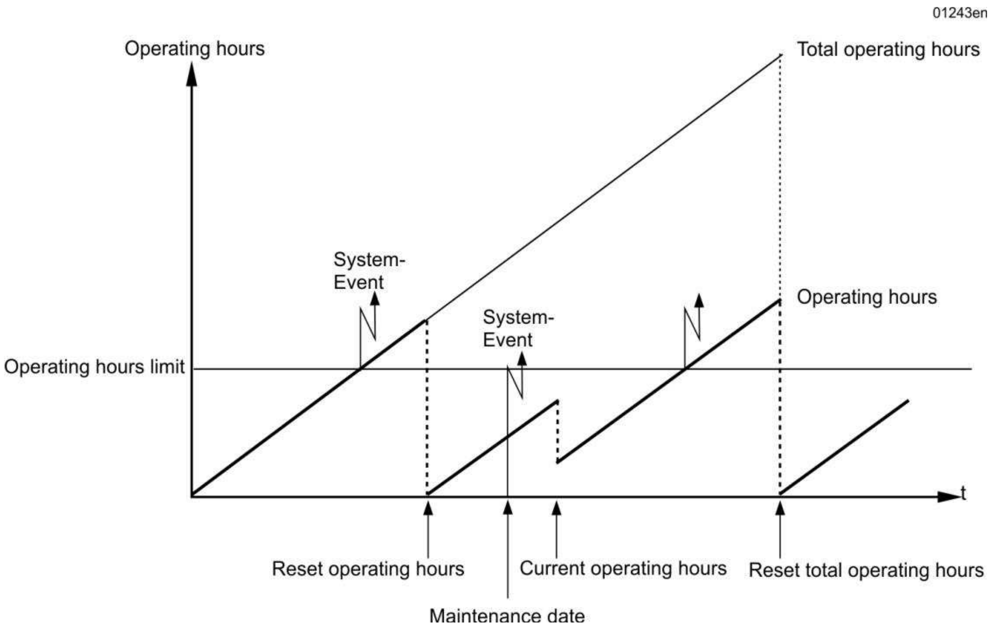


Figure 214: Runtime totals

Function

With a binary input object, the operating hours are determined on the basis of the ON state of [PrVal] (that is, by measuring the time for which this value is active). For multistate blocks, you can configure how many states are to be totalized. These are combined and added in a totalizer (the various states cannot be evaluated individually). In contrast to the input object, the output objects of the ON state for [FbVal] is logged (not [PrVal]) to operating hours message of the output objects.

There are two separate totalizers for runtime totalization:

- Runtime totalizer
- Overall runtime totalizer

Release

Runtime totalization can be enabled via the [EnOph] pin (Enable operating hours count). This is a binary value for binary objects, for multistate objects a list of values released for counting.

Runtime totalizer

Maintenance messages (events) are generated via the runtime totalizers. These are typically reset when the maintenance has been carried out. The present operating hours [PrOph] output can be used to connect the runtime totalization feature for further use in the program (for example, for changeover of pumps or boilers based on operating hours).

Resetting the runtime total

The operating hours [Oph] input is used to reset the current runtime total. In online test mode in Xworks Plus (XWP) via a BACnet client such as the PXM20, the present value can be reset by overwriting it with a new value (usually 0). This reset does not affect the total operating hours count (pins [OphTot] and [PrOphTot], total operating hours and present total operating hours respectively).

Overall runtime totalizer

The total operating hours count records the total hours run by an aggregate. It is only reset when the aggregate is replaced. The [PrOphTot] output is available for further interconnection in the program.

Resetting the operating hours total

The [OphTot] input is used to reset the total operating hours. In online test mode in Xworks Plus (XWP) or via a BACnet client such as the PXM20, the present value can be reset by overwriting it with a new value (usually 0). This reset procedure simultaneously sets the runtime totalizer (pins [Oph] and [PrOph]) to the same value.

This is necessary, for example, for an aggregate which is installed as a replacement item, but which has previously been in operation elsewhere for some time.

Maintenance message

A maintenance message (event) can be generated either after a specified period of operation or on a specified date. The operating hours limit value and the maintenance date [OphLm]/[MntnDate] can be configured for this purpose. An event message is generated when the limit value is exceeded or at 13:00 hours on the preset date. At the same time, the binary output [MntnInd] (maintenance indication) is set to active for further use in the program. After the operating hours reset, this output reverts to inactive. At the same time, the time stamp of the last reset is stored in the time stamp operating hours reset pin [TiStmOph].

Feedback value

The following applies to output blocks: When a feedback is configured, operating hours count is done based on the feedback value and not based on present value.

The maintenance interval can be further connected via the output present total operating hours limit [PrOphLm].

Value range for run time totalizing

The hours run are registered in 32-bit format, giving a maximum value of 4,294,967,296. With a resolution in seconds, this gives a value range of over 49,000 days (more than 136 years).

Out of Service [OoServ]

The physical input/output is disconnected from the I/O block via the out-of-service pin [OoServ]. This out of service function is normally used in cases where a hardware module is faulty or temporarily not required, for example, sensor not connected or faulty. This is a way of suppressing reliability problems and the associated FAULT alarms.

Input block

If the out-of-service property of an input block is set [OoServ=True], the physical input is disconnected from the present value ([PrVal] = [DefVal]) and any changes in the physical input will not be transmitted to [PrVal]. Furthermore the reliability [Rlb] and status flag [StaFlg] are also disconnected from the physical input. In this state, the properties [PrVal] and [Rlb] can be modified for test purposes.

Output block

If the out-of-service property for an output block is set [OoServ=TRUE], the physical output is disconnected from [PrVal]. Changes in [PrVal] will not be transmitted to the physical output, which retains its last value. Furthermore, the reliability [Rlb] and status flag [StaFlg] are also disconnected from the physical output. In this state, [PrVal] and [Rlb] can be modified for test purposes. Other functions that depend on these properties are not dependent on the [OoServ] property. The [PrVal] is set in accordance with the priority array [PrioArr], but the value is not transmitted to the physical output.

Alarm and event functions

Each input, output and value block can be enabled and disabled as an alarm source. The blocks are configured by setting the relevant values at the block pins. See Alarm Strategy.

Reliability [Rlb]

The reliability of the present value and of the physical input/output is represented by the reliability pin [Rlb]. This makes it possible to detect and signal faults and errors, such as addressing errors, sensor problems (short-circuit or open circuit) and module faults (missing or incorrect modules). See Reliability Table.

Commissioning State [ComgSta]

The state of the I/O can be entered at [ComgSta], the commissioning state pin, in the commissioning phase. The setting does not affect the program; it merely serves as a kind of notepad for commissioning purposes.

The following states are available for selection:

- Checked
- Not Checked [DefVal]
- Periphery Defect or Missing

- Cable Defect or Missing
- I/O Defect or Missing

As these states are static, they must be set manually during commissioning.

Status Flag [StaFlg]

The status flag [StaFlg] indicates the state of the I/O block. This pin consists of four Boolean values:

- IN_ALARM: Logic 1 (TRUE) if the event state pin [EvtSta] does not display NORMAL as its value.
- FAULT: Logic 1 (TRUE) if the [Rlb] pin does NOT display the value NO_FAULT_DETECTED.
- OVERRIDDEN: Logic 1 (TRUE) if the block point was overridden locally (for example, manual switch on I/O module). If this flag is set, [PrVal] and [Rlb] will no longer display any changes in the physical input/output.
- OUT_OF_SERVICE: Logic 1 (TRUE) if the out-of-service pin [OoServ] is active.

Default Value [DefVal]

For an input block, [DefVal] is transmitted to [PrVal] when [OoServ] is set to TRUE.

For an output block, value [DefVal] is transmitted to [PrVal] when none of the priorities (1…16) is active.

17.2 Input Blocks

An input block is used to enable an input signal (for example, a measured value) in the program to be handled as a process value.

Analog Input (AI)

The analog input is the logical image, or memory map, of an analog measured value and describes its properties. The raw data is converted and made available in the form of a current value (Present Value) at the block output for further processing within the program.

The following functions are integrated in the block:

- Conversion of the input signal with slope [Slpe] and intercept [Icpt].
- Interruption of input signal [OoServ] and replacement with [DefVal]
- Limit value monitoring (OFFNORMAL alarm)
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)

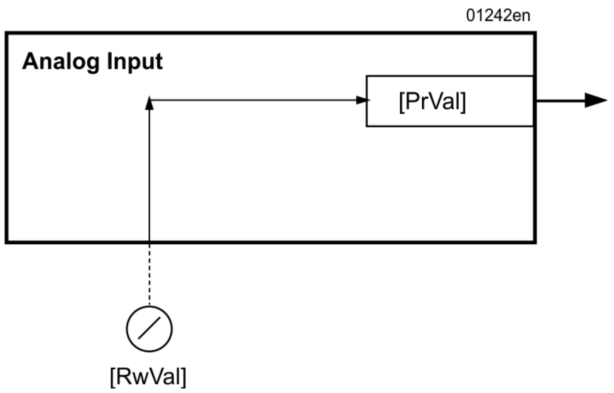


Figure 215: Analog Input block

Processing and displaying the current value

The measured raw value is converted into the measured present value in accordance with a conversion curve. This present value is available at [PrVal] for further processing within the program.

Slope/Intercept

The conversion curve is a linear function which takes the following form:

[PrVal] = Raw value * Slope + Intercept

The values for slope [Slpe] and intercept [Icpt] must be defined specifically for the application concerned in accordance with the I/O system in use and the signal type.

For slope and intercept values for SBT products, see *Slope [Slpe] and Intercept [Icpt]*. For sensors not listed, the following applies:

Calculating [Slpe] and [Icpt]

The values for [Slpe] and [Icpt], which are to be entered in the block, must first be calculated. These values are derived from the individual [Slpe] and [Icpt] values of the signal type and the signal transducer in accordance with the following formula:

[Slpe] = (Slope $_{\text{SignalType}}$ / Slope $_{\text{SignalTransducer}}$)

[Icpt] = (Intercept $_{\text{SignalTransducer}}$ / Slope $_{\text{SignalTransducer}}$) + Intercept $_{\text{SignalType}}$

[Slpe] is calculated on the basis of:

[Slp] = (InterpolationPoint_y2 – InterpolationPoint_y1) / (InterpolationPoint_x2 – InterpolationPoint_x1)

Binary Input (BI)

The binary input block is the logical image, or memory map, of a binary switch value and describes its properties. The parameters of the physical value are set via the polarity [Pol], and the value is then available as the present value for further processing. The Present Value is monitored for a given state. For commissioning and test purposes, or in the event of an error, the Present Value can be dissociated from the process and overwritten with a replacement value.

The following functions are integrated in the block:

- Inversion of the input value
- Interruption of input signal [OoServ] and replacement with [DefVal]
- Alarm value monitoring (OFFNORMAL alarm)
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)
- Runtime totalization and maintenance messages

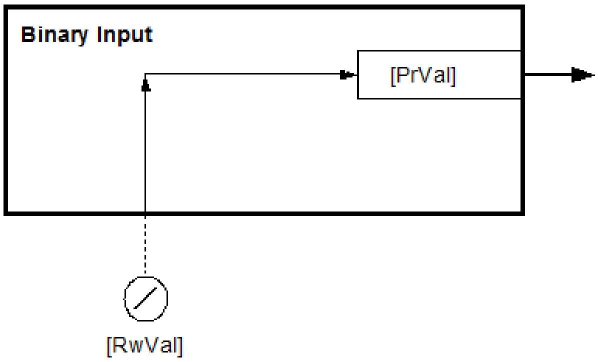


Figure 216: Binary Input block

Multistate Input (MI)

The multistate input block is the logical image, or memory map, of several binary switch values or a direct hardware multistate value, and describes its properties. The multistate capability is achieved by interconnecting a number of individual binary states. The binary states are evaluated and mapped as integers. Each integer in the series is allocated a text label which is further processed and interconnected within the program as a current value. For commissioning and test purposes, or in the event of an error, the Present Value can be dissociated from the process and overwritten with a replacement value. As an auxiliary function, the runtime total for this multistate input can be registered and evaluated.

The following functions are integrated in the block:

- Interruption of input signal [OoServ] and replacement with [DefVal]
- Alarm value monitoring (OFFNORMAL alarm)
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)
- Runtime totalization and maintenance messages
- Hardware mapping

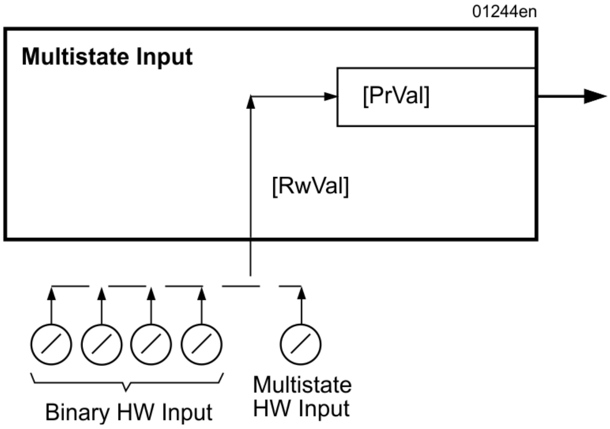


Figure 217: Multistate Input block

Pulse converter (pulse counter)

The pulse converter object cumulates pulses for a meter. The Pulse converter object is used where meter values already manipulate in a meter object or where changes of values are required to further process control programs. Applications include: Establishing 24-hour/7-day/monthly meters, transmission by the minute of meter values to peak load programs, etc. Precision and round off error based on real arithmetic is possible.

Specific properties

The counter value is scaled as a REAL number directly in the object using the scaling factor. COV forming the Present_Value can be value or time-related and a timestamp with the logged time is always provided with the Present_Value. Reduction of Present_Value by a value (subtraction) is supported as a standard. You can set it to a pre-defined value using a trigger function (proprietary expansion).

The Pulse Converter object can be used in two different manners: Counting or metering. The type of application is parameterized using the FnctMod parameter.

The referenced object, for example, an external device provides the pulse value:

- Present_Value for the pulse converter object represent the pulse count of the referenced object: The difference to the last read value is added for each record.
- Present_Value can be set via the system.
- After start-up, the pulse converter object encompasses the last stored counter value:
- After a change in counter, the pulse converter object encompasses a false counter value.
- Typical application: On-board I/O with pulse logging.

The referenced object, for example, an external device provides the absolute pulse value:

- Present_Value from the pulse converter object represents the absolute counter value of the referenced object.
- Under no circumstance may the Present_Value be set via the system.

- After start-up or a change in counter, the pulse converter object after includes the correct counter value.
- Typical applications:
  – Access to an accumulator or pulse converter object is another BACnet device
  – I/O Open module or M-bus with counter value integration
  – Integration of a device via LON
- Incorrect applications: I/O module with pulse recording

Accumulator object (counter value)

The accumulator object can map counter states unchanged and free of errors due to rounding off or add the counter pulse without loss and scale the same. The accumulator object is suitable to displaying meter values that justify monetary performance. For this type of counter values, manipulations such as monthly values, etc., must never be made directly in the meter object.

The addition of counter pulses and scaling without loss is accomplished using whole-number operations with residual value processing. The conversion of physical pulses can be adapted using a presale parameter. The resulting Present_Value is a scalable variable.

Present_Value depends on the function mode to synchronized adjustable to any value using a physical meter with the last value prior to setting saved with a date/time stamp.

17.3 Output Blocks

An output block is the logical image or memory map of a command, and describes its properties. Within the program, the Present Value is made available to the block as a program value. The block converts the program value and transmits the raw data to the physical I/O.

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If an output is deleted from an existing system in the course of a modification, the I/O module will retain the last valid value which it received from the system. You can return the I/O channel to the default status by switching the power off and on again. This problem can be avoided by performing a complete download.

Binary Output (BO)

The binary output block is the logical image, or memory map, of a binary switch command and describes its properties. Within the program it is made available to the block as a program value, and its parameters are set via the "Polarity" pin. The block converts this program value and transfers the raw data to the physical I/O, where it is converted into a digital signal, for example, which drives the field device via a contact.

The following functions are integrated in the block:

- Evaluation of the priority array [PrioArr]
- Inversion of the switch value and the feedback value (Polarity of feedback [Bop])
- Interruption of the output signal [OoServ]
- Feedback monitoring (OFFNORMAL alarm)
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)
- Configurable switch types (Normal, Trigger, Pushbutton, Pushbutton with delay)
- Runtimes and monitoring periods
- Switch-command delays

- Process monitoring [StaFlg]
- Runtime totalization and maintenance messages

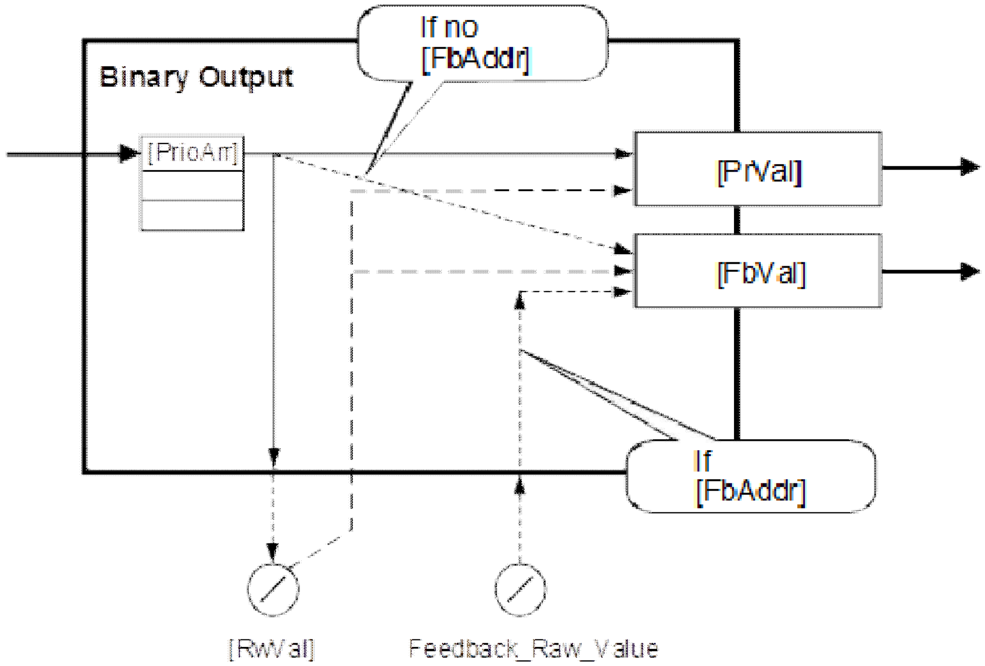


Figure 218: Binary Output block

Feedback monitoring for dampers with one end switch

To monitor the damper position of dampers with one end switch, the switch position must be set by defining the polarity of the feedback signal [Bop].

OPEN end switch -> Feedback polarity [FbPol] set to NORMAL

CLOSED end switch -> Feedback polarity [FbPol] set to INVERTED

Feedback monitoring for dampers with two end switches

The monitoring of dampers with two feedback signals (Open/Closed) is implemented via the address string of the Feedback Address [FbAddr]. The first address in the string must be that of the end switch which indicates that the damper is closed. The end switch indicating that the damper is open is set in the second part of the address string.

Example with PX modular:

P= M1.K1; M2.K2 (D20)

- 1. 1st address: Damper-CLOSED switch
- 2. 2nd address: Damper-OPEN switch
- Feedback polarity [FbPol] NORMAL

M1.K1 = True; M2.K2 = False -> Feedback value: Closed

M1.K1 = False; M2.K2 = True -> Feedback value: Open

When the damper is being driven to the OPEN or CLOSED position, this transient state [TraSta] is displayed. If the preset monitoring time is exceeded, an alarm is initiated. If the damper fails to reach an end position, the alarm is reset again after the monitoring time has expired. There is otherwise no automatic block reaction, that is, if a switch response in the plant is required as a reaction to this alarm, this response must be programmed in CFC via the disturbance output [Dstb].

Multistate Output (MO)

The multistate output is the logical memory map of a multi-state switching command, and describes its properties. Within the program, the current value is made available as a program value to the block and transmitted after conversion into raw-data format to the physical I/Os. Here the raw data is converted into a digital signal, for example, which drives the field device via a contact. It is also possible to connect a multistate feedback signal, which is used for alarm evaluation.

The following functions are integrated in the block:

- Evaluation of the priority array [PrioArr]
- Interruption of the output signal [OoServ]
- Feedback monitoring (OFFNORMAL alarm)
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)
- Configurable switch type (Normal, Motor, Trigger)
- Runtimes and monitoring periods
- Hardware mapping (refer to Section 0)
- Runtime totalization and maintenance messages
- Process monitoring [StaFlg]

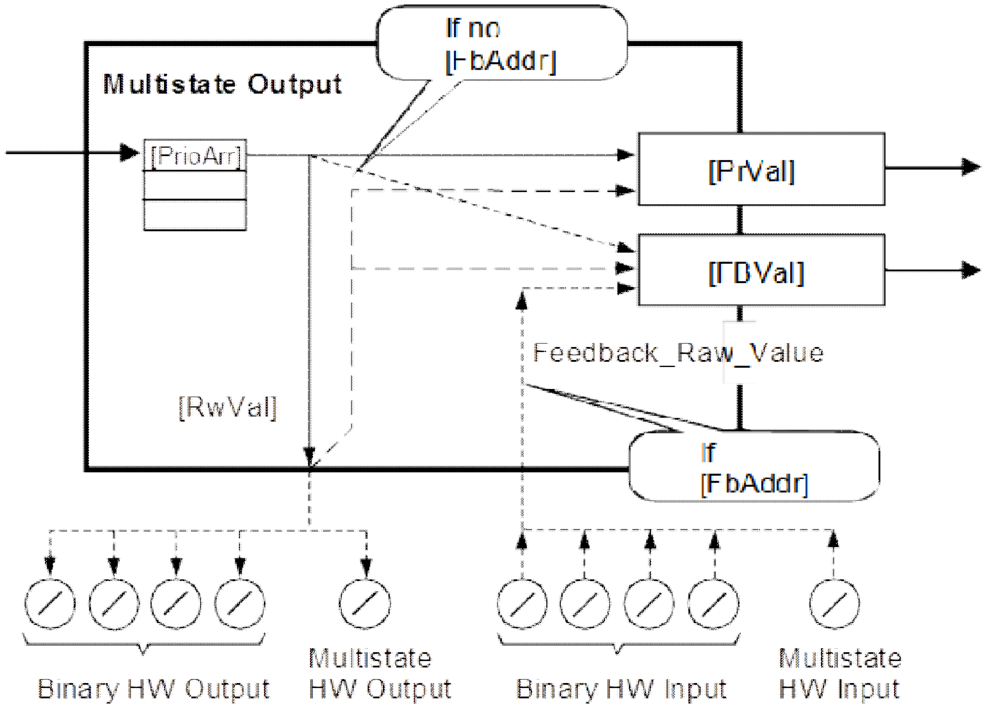


Figure 219: Multistate Output block

Analog Output (AO)

The analog output is the logical image, or memory map, of an analog control command and describes its properties. Within the program, the Present Value is made available to the block as a program value. The block converts the program value and transfers the raw data to the physical I/O, where it is converted into a 0…10 V signal, for example, to drive a field device.

The following functions are integrated in the block:

- Evaluation of the priority array [PrioArr]
- Interruption of the output signal [OoServ]
- Conversion of the process value and feedback signal with slope [Slpe] and
- intercept [Icpt]
- Configurable switch type (Normal or Trigger)
- Limit value monitoring (OFFNORMAL alarm)
- Deviation monitoring
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)
- Process monitoring [StaFlg]

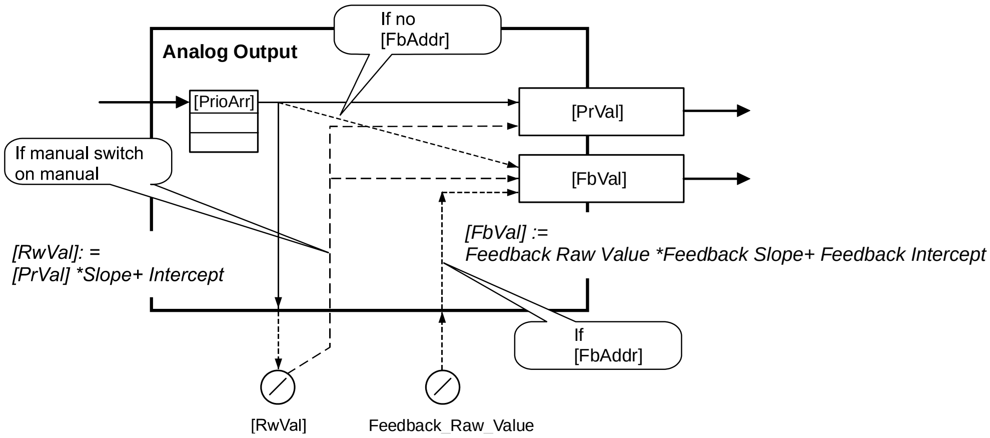


Figure 220: Analog Output block

The value [PrVal] from the program is converted into the physical positioning value by use of a conversion curve. This present value is then available at [PrVal] for further processing in the program while at the same time, the raw data is transmitted to the associated I/O system, where it is converted into an electrical signal to drive the field device.

The conversion curve is a linear function which takes the following form:

Raw Value [RwVal] = [PrVal] * Slope + Intercept

The values for slope [Slpe] and intercept [Icpt] must be defined specifically for the application concerned in accordance with the I/O system in use and the signal type.

For slope [Slpe] and intercept [Icpt] values for SBT products, see *Slope [Slpe] and Intercept [Icpt]*.

17.4 Value Objects

Value objects can be seen as virtual data points which are defined in the BACnet standard and have the same functions as the I/O blocks.

- Analog value block
- Binary value block
- Multistate value block

The only difference, in the case of value blocks, is that it is not possible to define physical connections to sub-components or components (for example, to I/O modules) in the plant. The value objects BVAL, AVAL and MVAL are used in the program whenever BACnet-defined functions, such as commands, alarm generation and runtime totalizing are required, or when a value is to be modified via an operator unit. Value blocks look like all other blocks, and can be connected with other blocks.

Typical applications

Value objects are used typically in aggregates as command control links (PWR_CTL or CMD_CTL). The command control mechanism passes the commands to the value object and derives the status from the BACnet referencing system.

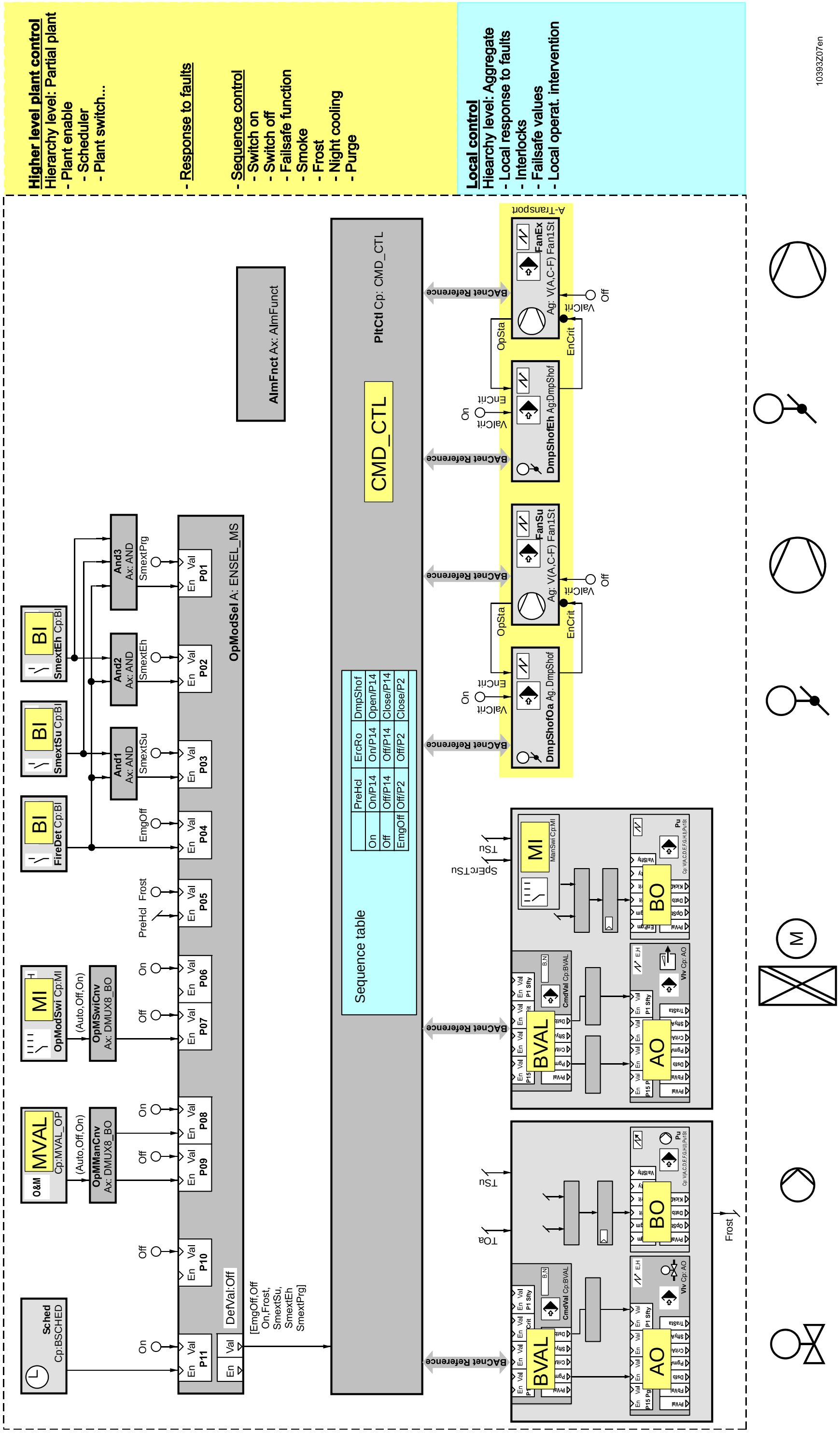


Figure 221: Use of the value blocks

Furthermore, the value objects can be used for alarm monitoring (reference values or high/low limit value), or to determine and monitor operating hours. The value objects designed specially for operation via BACnet client can be used, for example, as a simple way of enabling the user to operate setpoints and switch commands.

Analog Value (AVAL)

The analog value block provides access to the dataflow, that is, to signals and pins with a Real number as the data type. The value objects can be inserted into the program structure and interconnected in any configuration.

This block is used when, for example:

- An alarm is to be created within the CFC chart as a commandable interface of an aggregate (for example, limit monitoring of an output value of an aggregate).
- Access from the operator unit is required, in order to modify a value

The following functions are integrated into the block:

- Evaluation of the priority array [PrioArr]
- Interruption of the output signal [OoServ]
- Limit value monitoring (OFFNORMAL alarm)
- Deviation monitoring
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)
- Process monitoring [StaFlg]

Binary Value (BVAL)

The binary value block provides access to the dataflow, that is, to signals and pins with a Boolean number as the data type. The value objects can be inserted into the program structure and interconnected in any configuration.

This block is used when, for example:

- An alarm is to be generated as the commandable interface of an aggregate (for example, monitoring of logic operations)
- The hours run are to be totalized after a logic operation
- Access from the operator unit is required, in order to modify a value
- Configurable switch types (normal, switch, pushbutton with delay)

The following functions are integrated into the block:

- Evaluation of the priority array [PrioArr]
- Interruption of the output signal [OoServ]
- Process value monitoring (OFFNORMAL alarm)
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)
- Configurable switch types (normal, switch, pushbutton with delay)
- Runtimes and monitoring periods
- Switch-command delays
- Process monitoring [StaFlg]
- Runtime totalization and maintenance messages

Multistate Value (MVAL)

The multistate value block provides access to the dataflow, that is, to signals and pins with a Multistate number as the data type. The value objects can be inserted into the program structure and interconnected in any configuration.

This block is used when, for example:

- An alarm is to be generated as the commandable interface of an aggregate (for example, for limit monitoring)
- Access from the operator unit is required, in order to modify a value
- Hours run are to be totalized

The following functions are integrated in the block:

- Evaluation of the priority array [PrioArr]
- Interruption of the output signal [OoServ]
- Process value monitoring (OFFNORMAL alarm)
- Reliability monitoring [Rlb] (FAULT alarm)
- Change of state messages (events / system events)
- Runtimes and monitoring periods

- Runtime totalization and maintenance messages
- Process monitoring [StaFlg]

17.5 Value Objects for Operation

To simplify operation, use the value objects BVAL_OP, AVAL_OP and MVAL_OP. The blocks are specifically intended for the operation of setpoints via BACnet clients. They do not require a manual override from the operator unit (for example, PXM20). Value objects look like all other blocks, and can be connected with other blocks. The blocks do not include alarm generation or runtime totalization.

17.6 Addressing the I/O Blocks

Hardware independence

Logical I/O blocks allow the standardization of the inputs and outputs irrespective of the hardware. The relationship between a given logical I/O and its physical equivalent is established by assigning the address of the I/O system concerned.

This independence has the advantage that the functions of the block, as defined by the BACnet standard and the specific Desigo PX enhancements, do not change. The number of different I/O systems or physical I/Os can be expanded freely.

Identical compound libraries

Another advantage is that the compound libraries are always identical. In the engineering phase, they are adapted to the I/Os in the project by assigning the appropriate addresses. The process values (0…10V, 0…25mA, signal contacts, etc.) from the connected field devices are registered directly at the physical inputs. The physical outputs deliver the process values (0…10V, switching stages 0 / I /II / III, etc.) directly to the connected field devices.

The process values are transmitted in the form of raw data via the relevant medium (for example, PPS2); the conversion of the raw value takes place within the block.

Rules:

- Values from the plant are measured and processed in Input blocks (Analog, Binary or Multistate).
- Values to the plant are processed and transmitted by Output blocks (Analog, Binary or Multistate).

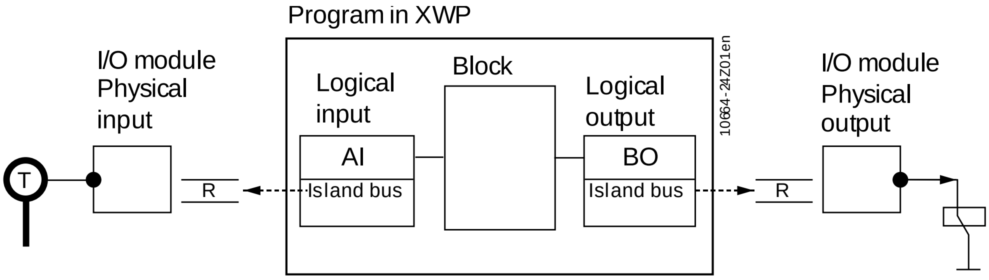


Figure 222: Addressing the I/O blocks

I/O systems

To enable the process value of the logical I/O block to be allocated to the appropriate physical I/O, the relevant address must be assigned. The address is assigned as follows:

- Via automated assignment by the Point Configurator to the CFC
- Direct allocation to the I/O block in Xworks Plus (XWP)

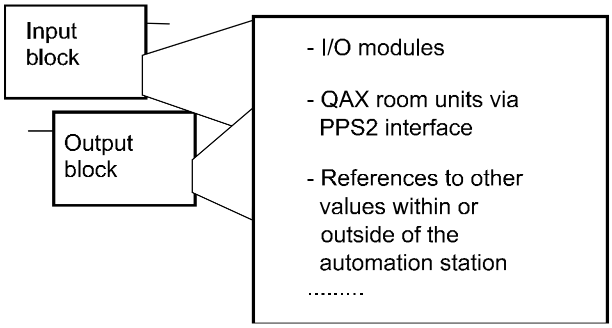


Figure 223: Assigning the address

The logical I/O blocks are designed for universal use in various I/O systems. The specific address structures and hardware definitions are determined by the I/O system, for example, the failsafe control value for the island bus.

In Desigo, they are as follows:

- Physical I/Os
- Values in a Desigo room unit, accessible via the PPS2 interface (does not apply to Desigo S7)
- Data in the same or in another automation station, referenced by its Technical Designation and accessed without a connection, peer-to-peer via BACnet services.

For addressing I/O from Desigo S7, see Desigo S7.

Address prefix

The addressing syntax indicates the origin of the raw value. The syntax must correlate with the actual physical inputs.

The prefixes for the various subsystems are as follows:

- "T=" for TX-I/O modules on an island bus-capable automation station PXC....D
- "C=" for on-board I/Os of the Desigo PX compact automation stations
- "B=" for referencing to BACnet objects
- "Q=" for QAX room units
- "L=" for LonWorks addressing
- "S=" for Simatic S7 addressing
- "M=" for PX-OPEN addressing
- "D=" for PX Open Diagnostic Addressing

For addressing with "P=", see *Addressing Entries for PXC…-U, PTM and P-Bus*.

For addressing with "S=", "M=" and "D=", see the corresponding expert documentation.

For more information on TX-I/O, see *TX-I/O Assortment overview* (CM2N8170) and *TX-I/O Functions and operation* (CM110561).

Addressing entries PX Modular (PXC100/200..D)

For PX compact, the TX-I/O module at the [IOAddr] pin start with a "T" (prefix: "T=").

Address syntax:

T= Module.I/O point (signal type)

Example: T=2.1 (Y10S)

The parameters no longer appear in the I/O address string for direct island bus integration, but rather in the IOC (I/O configuration).

The only exception is the Info LED which must have the prefix "C=", because the fixed address, 8.1, which is used for the Info LED may also be used by an I/O module.

The Info LED for PX KNX and PX Open can also be addressed with C=8.1.

The following table shows the various address entries required when using the modular series automation station in conjunction with TX-I/O-I/O modules.

Signal types shown in *italics* are used to map virtual modules for use with TX OPEN at module level. Signal types AIS, AOS, DIS and DOS deliver a 16 bit value with status information, while signal types AISL, AOSL, DISL and DOSL deliver a 32 bit value with status information. All other signal types deliver a 16/32 bit value without status information.

While all the module types listed may be connected to any island bus addresses, not all module types have 16 points.

Type	Module addressing	I/O point
Desigo TX-I/O	1...120	1...16
PX Info LED	8	1

Table 68: Addressing entries

Module type	Signal type	Example
Analog Input	R1K, P1K, P100, U10, I25, I420 R2500, R250 (only TX-I/O) T1, NTC10K, NTC100K (only TX-I/O)	T=1.1 (R1K)
	AI, AIS, AIL, AISL	T=2.1 (AIS)
Analog Output	Y10S	T=2.1 (Y10S)
	Y250T PWM	T=3.1 (Y250T)
	Y420 *AO, AOS, AOSL, AOL*	T=34.1 (Y420) T=36.1 (AOS)
Binary Input	D20, D20S D42, D250 (only PT-I/O)	T=25.2 (D20)
	DI, DIS, DIL, DISL	T=26.3 (DIS)
Counter Input	C	T=38.1 (C)
Info LED	Q_LED	C=8.1(Q_LED)
Binary Output	Q250_P, Q250A_P	T=12.1 (Q250_P)
	Q250 QD, Q250B, (only PT-I/O)	T=1.1 (250) T=14.1 (Q250) + T =15.1(D20)
	DO, DOS, DOL, DOSL	T=15.2 (DOS)
Multistate Input	D20 D42, D250 (only PT-I/O)	T=1.1 (D20) + T=1.2 (D20) --
	DI, DIS, DIL, DISL	T=7.1 (DIS)
Multistate Output	Q250-P1 ... Q-P5	T=1.1 (Q250-P3)
	Q-M1 ... Q-M4 QD-M2 (only PT-I/O)	T=1.1 (Q-M3) --
	DO, DOS, DOL, DOSL	T=26.3 (DIS)

Table 69: Addressing entries

Parameter values

Parameters are entered in the I/O address editor.

See *Automation stations modular series PXC..D, PXC..-E.D, PXA40..* (CM1N9222).

Addressing entries PX Compact (PXC…)

The addressing procedure is almost identical for Desigo PX compact and for Desigo PX modular. However, the valid address ranges and signal types are not the same as those used for the addressing of individual TX-I/O modules.

For PX compact, the "on-board" I/O modules at the [IOAddr] pin start with a "C" (prefix: "C="). Address syntax:

C=Module.Channel (signal type, parameter)

Example: C=2.1 (Y10S, NO)

The table below shows the available address ranges and signal types, which vary according to the Desigo PX compact automation station (each with its own integrated, fixed configuration of I/Os) type.

PX compact up to V4.0	PXC12.D PXC12-E.D		PXC22.D PXC22-E.D		PXC36.D PXC36-E.D		Signal type
	Module	Channel	Module	Channel	Module	Channel	
UI Universal Input	1	1..4 UI5..UI8	1	1..12 UI5..UI16	1	1..18 UI7..UI24	R1K, U10, T1, N1K, P1K, C, D20, D20S
–	2	–	2	–	2	–	
DI Binary Input	3	1..2 DI1..DI2	3	–	3	1..4 DI1..CI4	D20
UO Universal Output	4	1..4 AO1..AO4	4	1..4 AO1..AO4	4	1..6 AO1..AO6	Y10S, Q250
DO Binary Output	5	1..2 DO1..DO2	5	1..6 DO1..DO6	5	1..8 DO1..DO8	Q250
Internal LED	8	1	8	1	8	1	Q-LED
PPS-2	1..5	[1]	1..5	[1]	1..5	[1]	R1K, U10, D20

Table 70: Addressing entries PX compact up to V4.0

Key:

[1] Syntax for PPS-2 signal: Q = Room device number.object number (profile number). Up to five devices can be connected.

PX Compact from Desigo V5.0

The existing UI and AO can be configured as AI, DI, CI, or AO.

Signal type of no application is loaded (wiring test):

PXC12..D, U1…U4: xx = Y10S, U5…U8: xx = R1K

PXC22..D, U1…U4: xx = Y10S, U5…U16: xx = R1K

PXC36..D, U1…U6: xx = Y10S, U7…U24: xx = R1K

PX compact from V5.0	PXC12.D PXC12-E.D		PXC22.D PXC22-E.D		PXC36.D PXC36-E.D		Signal type
	Module	Channel	Module	Channel	Module	Channel	
UIO Universal I/O	1	1..4 U5..U8	1	1..12 U5..U16	1	1..18 U7..U24	R1K, U10, T1, N1K, P1K, C, D20, D20S
UIO Universal I/O with Q250	4	1..4 U1..U4	4	1..4 U1..U4	4	1..4 U1..U6	R1K, U10, T1, N1K, P1K, C, D20, D20S, Q250

Table 71: Addressing entries PX compact from Desigo V5.0

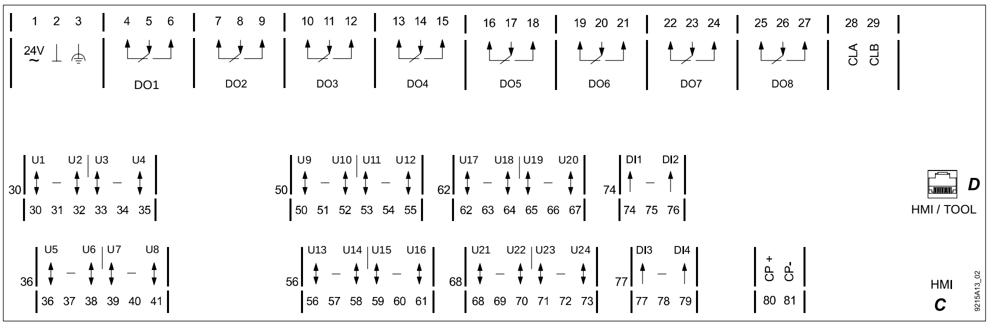


Figure 224: Layout of PXC36D housing with address ranges

See *Automation stations, compact model PXC..D* (CM1N9215).

Multiple use of sensors

Multiple use of I/O signals

Multiple use by addressing the physical I/Os in two or more logical I/O blocks (as shown in the following figure) is not allowed.

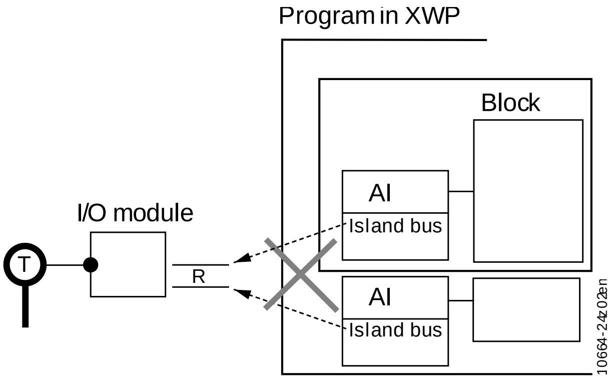


Figure 225: Avoid this multiple use configuration

If you wire it as in the figure above, Xworks Plus (XWP) determines multiple use and generates an error message.

For the multiple use of output blocks, the plant will malfunction, because there will then be two or more sources acting on one switching command. The effective switching command (at the output) is the last one received (determined by the rule "the last command takes precedence"). In other words, the order of processing determines which source or origin will be linked to the output.

In CFC the same address can be allocated to two or more input or output blocks. This multiple address allocation goes undetected when the program is compiled; the automation station also fails to recognize the error (a reliability error is generated and an error message is transmitted only in the case of multiple address allocation with two different signal types).

Solution 1

Many systems include a requirement for the multiple use of sensors. A typical example of this is an outdoor air temperature sensor shared across systems. The following example illustrates the simplest form of the multiple use of sensors:

In CFC the current value is transmitted for further use in the program by interconnecting the blocks. The logical I/O block (Analog Input, {AI}) occurs in the program once only, and its hardware-specific parameters only need to be set once.

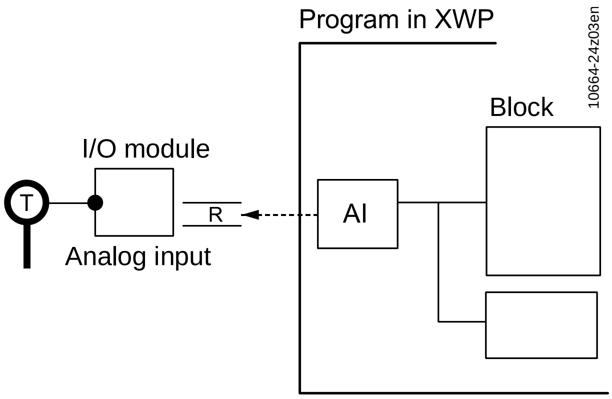


Figure 226: Multiple use via data flow

Solution 2

The multiple use function can be implemented with a BACnet reference to the first analog input block (Partial plant 1). In other words, the first block will receive the island bus address at the [IOAddr] pin. The second analog input block (Partial plant 2) references the first AI (B=…) via the technical designation.

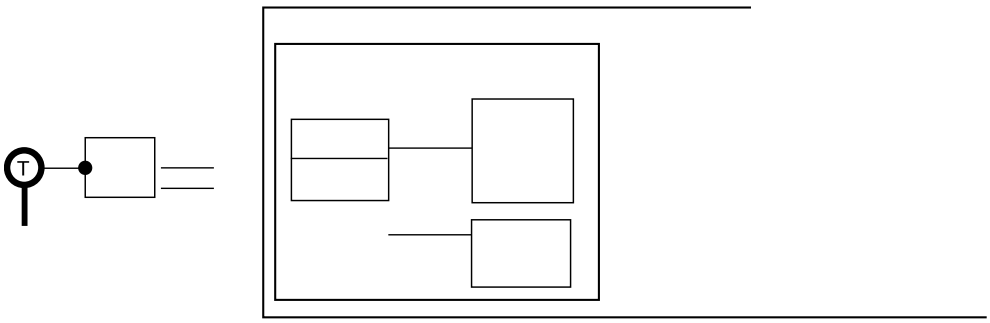


Figure 227: Multiple use via BACnet reference

Addressing multistate I/Os

Multistate input

The multistate value is made up of several separate binary measured values.

Addressing is via the input/output address [IOAddr]. In both the modular and the compact series, the logical and physical I/O must be "located" in the same automation station, but they do not need to be contiguous (for example, C=5.1;5.3;5.5;5.6(Q250) is valid). The addressing cannot extend across automation stations. The addresses must be on the same module for TX-I/O.

For information about adressing multistate I/Os with PTM, see *Addressing Multistate I/Os with PTM*.

Simple mapping

Syntax: T=Module.I/O point;Module.I/O point;Module.I/O point;Module.I/O point

Examples:

- T=1.1
- T=1.1;1.2
- T=1.1;1.2;1.3
- T=1.1;1.2;1.3;1.4
- T=10.3

Up to four binary status values (for example, Off/St1/St2/St3/St4) can be registered. The signals to be registered, which are addressed via Module.Channel, must always be of the same hardware signal type. With the simple mapping procedure, to enable the multistate input to interpret the current binary signals correctly, only one binary signal may be present at any one time. If several binary signals are present at once, this is displayed as an error at the [Rlb] pin.

The examples below show a possible application for multistate input blocks in conjunction with the physical I/O modules. The example on the left of the diagram is a multiple I/O module, while the one on the right shows the mapping of several individual I/O modules in one multistate input block.

Multistate output

The multistate value from the program is converted in the Multistate Output block into a switching command. Addressing is via [IOAddr]. For PX modular, the syntax is as follows:

Syntax: T=Module.channel

Examples:

- Q-M1: T=1.1
- Q-M2: T=1.1
- Q-M3: T=1.1
- Q-M4: T=1.1
- Q250-P3: T=10.1
- DOS: T=24.7

Values with up to four stages can be processed. The signals to be registered, which are addressed via Module.Channel, must always be of the same hardware signal type. In the case of a multistate output on the hardware side, there is one address only (this is only possible with PXC modular automation stations).

Error handling

If an automation station does not support a given address (for example, incorrect syntax) or a given I/O system, this will lead to a reliability error, which will be displayed at the [Rlb] pin.

Advanced mapping (Multistate Input)

The manual switch can be encoded on the PX Compact in various ways, for example:

- (Auto/Off/On) or (Off/Auto/On)
- (Auto/Off/S1/S2) or (Off/Auto/S1/S2)

So avoid having to keep adapting the data types and text groups in the system, the manual switch must always be represented in the same way within the system:

- (Auto/Off/On)
- (Auto/Off/S1/S2)

A prerequisite for this approach is that it must be possible in the multistate input block to configure the hardware coding and mapping to the standardized manual switch. This is made possible with parameters in the address.

1_n-Mapping (Multistate Input and Output)

Syntax:

T = Module.channel

C=Module.channel;Module.channel;Module.channel;Module.channel (signal type, a,b,c,d,e)

a represents [PrVal] for HW-I/O (0,0,0,0)

b represents [PrVal] for HW-I/O (1,0,0,0)

c represents [PrVal] for HW-I/O (0,1,0,0)

d represents [PrVal] for HW-I/O (0,0,1,0)

e represents [PrVal] for HW-I/O (0,0,0,1)

Example: T=2.1

For the TX I/O addressing no additional information in the address string is added. All information (signal type, mapping table, mapping rules, for example, up-down, etc.) is configured in the I/O Address Editor and loaded in the automation station with the IOC file.

Example: C=2.1;2.2;2.3;2.4 (D20, *2*, *1*, *3*, *4*, *5*)

[PrVal]	Addr1	Addr2	Addr3	Addr4	Comment / Text group
2	0	0	0	0	Off
1	*1*	0	0	0	Auto
3	0	*1*	0	0	Stage 1
4	0	0	*1*	0	Stage 2
5	0	0	0	*1*	Stage 3

Table 72: Example: C=2.1;2.2;2.3;2.4 (D20, 2, 1, 3, 4, 5)

Example: C=2.1;2.2;2.3;2.4 (D20, *2*, *1*, *5*, *7*, *9*) ;-- with holes

[PrVal]	Addr1	Addr2	Addr3	Addr4	Comment / Text group
2	0	0	0	0	On
1	*1*	0	0	0	Off
5	0	*1*	0	0	Comfort
7	0	0	*1*	0	Eco
9	0	0	0	*1*	StandBy

Table 73: Example: C=2.1;2.2;2.3;2.4 (D20, 2, 1, 5, 7, 9) ;-- with holes

UpDown Mapping (Multistate Input and Output)

Syntax:

Application: Connecting/disconnecting further stages.

Example: Electric heating registers, multi-stage burners.

T=Module I/O point

C=Module.channel;Module.channel;Module.channel;Module.channel (signal type, UPDOWN)

Example: T=2.1

For the TX I/O addressing no additional information in the address string is added. All information (signal type, mapping table, mapping rules, for example, up-down, etc.) is configured in the I/O Address Editor and loaded in the automation station with the IOC file.

Example: C=5.1;5.2;5.3;5.4(Q250,UPDOWN)

Example: C=2.1;2.2;2.3;2.4(D20,UPDOWN)

[PrVal]	Addr1	Addr2	Addr3	Addr4	Comment / Text group
1	0	0	0	0	Off
2	*1*	0	0	0	Stage 1
3	*1*	*1*	0	0	Stage 2
4	*1*	*1*	*1*	0	Stage 3
5	*1*	*1*	*1*	*1*	Stage 4

Table 74: Example: C=5.1;5.2;5.3;5.4(Q250,UPDOWN) and C=2.1;2.2;2.3;2.4(D20,UPDOWN)

With Up/Down mapping, more than one hardware input or output may be active.

Binary Mapping (Multistate Input and Output)

Application: Output of an integer in binary form.

Example: Binary electric heating coil.

Syntax: C=Module.channel;Module.channel;Module.channel;Module.channel (signal type, BINARY)

Example: C=5.1;5.2;5.3;5.4(Q250,BINARY)

Example: C=2.1;2.2;2.3;2.4(D20,BINARY)

[PrVal]	Addr1	Addr2	Addr3	Addr4	Comment / Text group
1	0	0	0	0	Off
2	*1*	0	0	0	Stage 1
3	0	*1*	0	0	Stage 2
4	*1*	*1*	0	0	Stage 3
5	0	0	*1*	0	Stage 4
6	*1*	0	*1*	0	Stage 5
...					
16	*1*	*1*	*1*	*1*	Stage 15

Table 75: Example: C=5.1;5.2;5.3;5.4(Q250,BINARY) and C=2.1;2.2;2.3;2.4(D20,BINARY)

With binary mapping, more than one hardware input or output may be active.

BACnet addressing

Peer-to-peer communication

Data can be exchanged via peer-to-peer communication.

The exchange takes place using the BACnet services defined in the BACnet standard. The process employs mechanisms engineered in CFC which can be tracked in online test mode, but which are based on BACnet objects and BACnet services.

Engineering

When engineering the exchange of data in CFC, it is important to take note of the following:

- Addressing is via [IOAddr].
- Data is exchanged only between BACnet objects. The attributes of the I/O blocks and pins must be defined appropriately, and the information must also be made available in the form of a BACnet object. For this purpose, the attributes of this block or I/O must be defined correctly.
- In BACnet terminology, the I/O block is a client which fetches the required value from an object defined as the server. This process is carried out using services defined by BACnet, for example: The client subscribes to the relevant object (the server) using the SubscribeCOV service. The server then supplies the value via the BACnet service COVReporting whenever it changes by the programmed value, COVIncrement. ReadProperty (polling) is another BACnet service. Here, the value is read at regular predefinable intervals.
- Addressing is carried out via the Technical Designation (TD). Note, however, that this Technical Designation must first be made known to the client in the form of a reference address.
- The data is exchanged both within a given automation stations, and across automation stations.

Address syntax

Addressing takes place via the input/output address [IOAddr] and always starts with the prefix "B=".

The BACnet reference address is the same as the Technical Designation (TD) of the value. The BACnet addressing syntax is as follows:

B=BACnetReference (BACnetConfig)

Example: B=Geb6'Lft3'FanSu'Mot'MntnSwi.PrVal(0)

Polling or COV procedure

The FB variable PollCyc is used instead of the prior BACnetConfig parameter in the I/O address syntax, to distinguish between COV or polling:

FB variable IOAddr. FB variable PollCyc

BACnetConfig = 0 -> COV (Change of Value)

BACnetConfig = 1…65535 -> Polling in seconds

In an automation station operating as a BACnet device, the maximum number of simultaneously supported COV subscriptions is limited to 400.

The BACnet Device as BACnet Server supports a maximum of 400 subscriptions from BACnet clients (PXM20, Web client, management station) or from other BACnet devices via the BACnetReference.

A BACnet device operating as a BACnet client can also accommodate a maximum of 100 subscriptions to other values via the BACnetReference.

If the COV procedure is selected, COVIncrement is used for analog objects to define the value by which the present value must change to initiate a COV event.

Data output using WriteProperty

Output objects can write their Present_Value to the properties of other objects or command other value or output object.

Write without priority: Optional address string-Par(P=Number) no available.

Command with priority: Optional address string-Par(P=Number) available.

COV across sites

The value subscribed to must be available in the same BACnet network. Avoid a COV across sites.

The DeviceID is used to access and subscribe freely to values in different BACnet devices (especially in the case of third-party integration). The syntax is as follows:

B=[DeviceID]Objectname – where the object name can be any string required. The DeviceID is entered in decimal (instance number or entire ObjectID).

PPS2 addressing

A PPS2 address is required when values are to be transmitted via the PPS2 interface. Addressing takes place via the input/output address [IOAddr] and always starts with the prefix "Q=".

Address syntax

Up to five room units can be connected to one Desigo PX automation station and addressed via the PPS2 interface. The addressing syntax is as follows:

Q=RoomUnitNumber.Object(Profile)

Example: Q=1.40 (1)

The functions available in the room unit are mapped directly to the I/O blocks. The following elements of the address are predefined:

Type (standard BACnet objects)	Room unit number	Object	Object description	Profile[1]	Example
Analog input	1…5	24	Setpoint correction	–	Q=1.24
Analog output	1…5	24	Setpoint correction	–	Q=2.24
Analog input	1…5	40	Room temperature	0, 1…6	Q=1.40[1]
Analog output	1…5	195	Room temperature display	–	Q=5.195
Multistate input	1…5	205	Mode	–	Q=4.205
Multistate output	1…5	205	Mode	–	Q=2.205
Multistate output	1…5	206	Heating/Cooling display	–	Q=3.206

Table 76: Predefined address elements

Key:

1 The Profile relates to the configuration number shown in the next table.

The room unit is configured with this configuration number and appended to the Room temperature object. Other objects are not assigned a configuration number.

Only the relevant operating and process values are mapped in the I/O blocks, rather than all objects of a room unit.

Six profiles have been defined to keep both the memory requirements and the demands placed upon the user in practice to a reasonable level. If no profile information is supplied, the predefined device-specific default value [DefVal] is used. As an exception in the case of the QAX units, Profile No. 5 is used.

Configuration	Profile					
	1	2	3	4	5	6
Enable operating mode						
StandBy	ON	ON	ON	ON	ON	ON
Auto	ON	ON	ON	ON	ON	ON
Fan1	ON	ON	ON	ON	ON	ON
Fan2	OFF	OFF	ON	ON	ON	ON
Fan3	OFF	OFF	OFF	OFF	ON	ON
KonfLCD						
Symbol Standby	ON	ON	ON	ON	ON	ON
Symbol Auto	ON	ON	ON	ON	ON	ON
Symbol Fan1	ON	ON	ON	ON	ON	ON
Symbol Fan2	OFF	OFF	ON	ON	ON	ON
Symbol Fan3	OFF	OFF	OFF	OFF	ON	ON
TempUnit	℃	℉	℃	℉	℃	℉

Table 77: Room unit profile

This profile (or configuration number) is always valid for one room unit only. It is used to configure the objects ConfigLCD and EnableOperatingMode and to define how the room unit is to operate (for example, ℃ or ℉).

In principle, the profile can be attached to any other object.

This configuration applies only to the QAX33.1 and QAX34.1 room units.

Configuration of the object ConfigLCD is only relevant in the case of the QAX34.1, as this is the only unit with a display in ℃ or ℉.

The configuration of the object EnableOperatingMode is only relevant in the case of the QAX33.1 or QAX34.1, as only these two room units have the option of selecting Fan1, Fan2 or Fan3.

Where QAX units without an address switch are still in use, only one room unit per automation station can be integrated. The room unit number in such cases is then "1".

LonWorks addressing

There are two ways to integrate data points from LonWorks devices:

- via Discipline I/O
- via standard inputs/outputs (the latter approach is only sensible with a small number of data points to be integrated, for example, from third-party devices)

Address syntax

The block registers the control variables and output variables of the RX devices (outside the CFC chart) in accordance with the information in the [IOAddr] property (Input/output address).

Addressing starts with the prefix "L=".

Addressing via discipline I/O

L=DeviceType DeviceNo. GroupIndex(MappingTableNo.)

- DeviceType: M (Master), S (Slave)
- DeviceNo: Field device identification number
- GroupIndex: Group identification: Up to 4 similar groups of an application unit may exist in the field device (for example, lighting or window-blind groups). The group index number is optional.
- MappingTableNo: Number of the mapping table which is valid for that Discipline I/O.

More than one device can be specified for each [IOAddr] string. The devices are separated with a semicolon. However, the maximum [IOAddr] string length of 60 characters must not be exceeded.

Desigo RXC	DeviceType	DeviceNo	GroupIndex	MappingTableNo	Example
RXC14 RXC27	M	1…255	–	1…99	L=M14;M27(4)
RXC5 RXC11 RXC22 RXC109	M	1…255	–	1…99	L=M5;M11;M22;M109(91)
RXC13 RXC17	M/S	1…255	1…4	1…99	L=M13.2;S17.2(9)

Table 78: Addressing via discipline I/O

Addressing via standard I/O

L= DeviceType DeviceNo.GroupIndex(3RD[NVIndex.FieldIndex])

- DeviceType: M (Master). There are no slaves (S) with third-party devices There is only ever one device.
- DeviceNo: Field device identification number
- GroupIndex: Group identification: Up to 4 similar groups of an application unit may exist in the field device (for example, lighting or window-blind groups). The group index number is optional.
- ObjectType: Constant for third-party devices: 3RD.
- NVIndex: Network variable referenced in the third-party device.
- FieldIndex: Element number, if the network variable is structured

Desigo RXC	DeviceType	DeviceNo	GroupIndex	ObjectType	NVIndex	FieldIndex	Example
e.g. RXC 26	M	1…255	1….4	3RD	1…255	1…32	L=M26(3RD[4.1])

Table 79: Addressing via standard I/O

KNX addressing

You can integrate data points from KNX devices as follows:

- See *PX KNX, RXB integration - S-Mode* (CM1Y9775)
- See *PX KNX, RXB/RXL integration - Individual addressing* (CM1Y9776)
- Address Info LED for PX KNX: D=1001

17.7 Discipline I/Os

Discipline I/Os are standardized combinations of inputs and outputs related to a specific application. They have a predefined number of parameters.

Three different input variable types can be interconnected to Discipline I/Os:

- Simple value
- Trigger value
- Commandable value

Simple value

The input value can be connected via the data flow. In the engineering tool, this is preceded by a function block or compound, for example, a Scheduler. However, if the input value is not connected, it can also be modified via BACnet client. The subsystem registers a change in the input value by comparing the value with the process image and transferring it to the field devices.

Trigger value

This input value is the logical image, or memory map, of an analog positioning command and describes its properties. Within the program, the Present Value is made available to the block as a program value. The block transfers the program value to the subsystem, from where it is transmitted to the field device.

Writing to this value acts as a trigger. This makes it possible, for example, to generate the output of the same value (for example, Lighting 100%, followed later by 100% again). In this case the subsystem registers the trigger value and transmits the value to the devices. This capability is required when the same variable can be modified from several sources (for example, when Desigo management station writes 100.0%, the local operator unit writes 0.0% and the user of Desigo management station wants to rewrite the value of 100.0%). The sources can be BACnet clients or system function blocks.

Only analog trigger values may be used.

Commandable value

The input value is the logical image, or memory map, of an analog positioning command and describes its properties. Within the program, the Present Value is made available to the block as a program value. The block transfers the program value to the subsystem, from where it is transmitted to the field device.

The commandable value is based on the BACnet priority-mechanism (which is the same as for the output blocks – refer to Section 0). A commandable value can be operated from various sources. Each source has its own priority. The sources are mutually exclusive (interlock). The source with the highest priority prevails. for example, Emergency = Priority 1, Façade control = Priority 6, Operator = Priority = 8). The sources can be BACnet operator units or system function blocks (grouping function).

Only analog commandable values can be used.

17.8 Reliability Table

Value (decimal)	Text
0	No error recognized.
1	No sensor.
2	Above the range.
3	Below the range.
4	Continuous loop.
5	Short circuit.
6	No output.
7	Unreliable other.
8	Process error
9	Multistate fault.
64	Subsystem not supported.
65	Subsystem feedback not supported.
66	Invalid address (syntax error).
67	Invalid feedback address (syntax error).
68	Invalid address value.

Value (decimal)	Text
69	Invalid feedback address value.
70	Invalid address parameter (syntax error).
71	Invalid feedback address parameter (syntax error).
72	Invalid address parameter value.
73	Invalid parameter value for feedback address.
74	Destination device unknown.
75	Feedback device unknown.
76	Destination object unknown.
77	Feedback object unknown.
78	Unsuitable destination type.
79	Unsuitable feedback type.
80	Unreliable destination object.
81	Unreliable feedback object.
82	Invalid subsystem (syntax error).
83	Invalid feedback subsystem (syntax error).
84	Memory full.
85	Unreliable target device.
86	Communication failure reported in subsystem.
87	Alarm in subsystem application.
88	Maximum BACnet references reached for device.
89	Reliable participant.
90	Feedback error reported in binary output.
91	Invalid reference: Address not valid.
92	Reference object cannot be commanded.
93	Actual operating mode not found in command list.
94	Invalid priority set for command (valid : 2,4,14,16).
95	Invalid object number configured in sequence table.
96	Invalid object type configured in sequence table.
97	Invalid step control configured in sequence table.
98	Neighboring object not reachable.
99	Command lists indicate different variables.
100	Invalid calendar reference.
101	Configured switch kind not supported by destination controller.
102	Multistate mapping error.

Table 80: Reliability table

Signal types in the automation station which are not supported also generate reliability error message 72.

17.9 Slope [Slpe] and Intercept [Icpt]

[Slpe] and [Icpt] value exist for:

- I/O modules (PX Modular and PX Compact)
  These values impact signal type (the I/O module).
- Siemens field devices
  These values affect the combination of Slpe and Icpt values for the signal type, the field device and its measurement and positioning range. XWP automatically enters these values, and they can be changed there, for example, to consider the line resistance of a sensor or to describe a third-party sensor.
- BACnet referencing
- PPS2 interface

The combined values [Slpe] and [Icpt] can be calculated as follows from individual values for signal type (I/O module) and characteristic curve (field device):

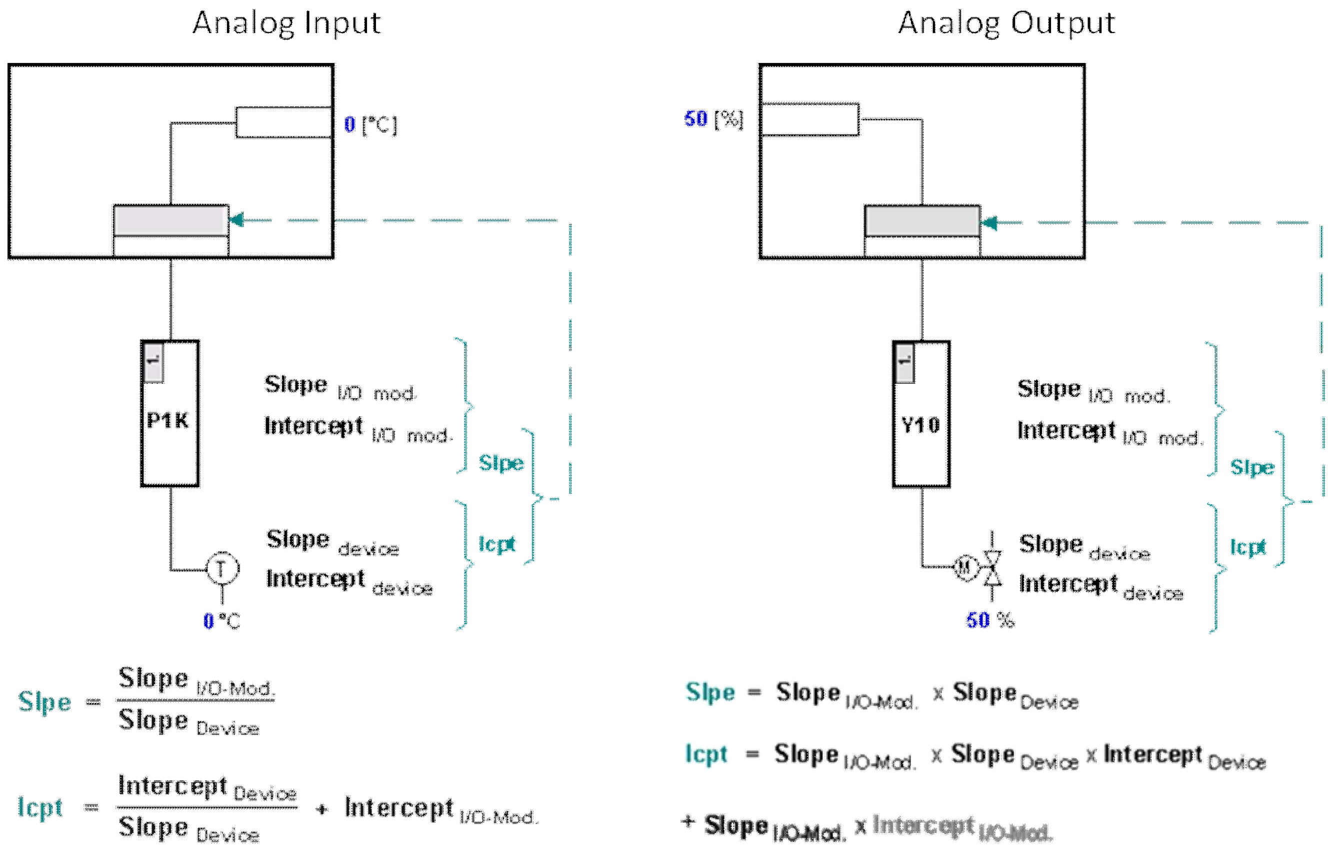


Figure 228: Slope and intercept

Siemens Building Technologies field devices: XWP automatically enters the combined values [Slpe] and [Icpt] (for the signal type, the field device and its measurement or positioning range) on the I/O block.

Third-party field devices: You can calculate the value [Slpe] and [Icpt] using the Intercept Calculator.

[Slpe] and [Icpt] Analog Input

TX- and PT-I/O modules PX modular

In the Desigo PX modular automation stations, the analog input block is used with the following TX-I/O and PT-I/O modules:

Signal type measurement	Description	Standard measuring range	Resolution on the bus	Value range on the bus	[Slpe]	[Icpt]
R1K	LG-Ni 1000	-50 … 150 °C	1/100 °C	-5000 ... 15000	0.01	0
P100	Pt100	0 … 250 Ohm	1/100 Ohm	0 ... 25000	0.01	0
R250	Resistance	0 … 250 Ohm	1/100 Ohm	0 ... 25000	0.01	0
Pt100_4	Pt100	-50 ... 600 °C	1/100 °C	-5000 ... 40000	0.01	0
P1K	Pt1000	0 … 2 500 Ohm	1/10 Ohm	0 ... 25000	0.1	0
R2K5	Resistance	0 … 2 500 Ohm	1/10 Ohm	0 ... 25000	0.1	0
T1	PTC sensor	-50 ... 150 °C	1/100 °C	-5000 ... 15000	0.01	0
Ni1K	LG-Ni 1000	-50 ... 180 °C	1/100 °C	-5000 ... 18000	0.01	0
Pt1K375	Pt1000 (NA)	-50 ... 180 °C	1/100 °C	-5000 ... 18000	0.01	0
Pt1K385	Pt1000 (EU)	-50 ... 600°C	1/100 °C	-5000 ... 60000	0.01	0
NTC10K	NTC sensor	-40 ... 115 °C	1/100 °C	-5000 ... 11500	0.01	0
NTC100K	NTC sensor	-40 ... 125 °C	1/100 °C	-5000 ... 12500	0.01	0
U10	DC 0 ... 10V	0 … 10 Volt	1/1000 V	0 10000	0.001	0
I420	DC 4 ... 20mA	4 … 20 mA	1/1000 mA	4000 ... 20000	0.001	0
I25/020 (Shunt 200 Ohm)	DC 0 ... 25mA	1 … 5 mA	1/1000 V	0 ... 5000	0.001	0
I25/020 (Shunt 100 Ohm)	DC 0 ... 25mA	0 … 10 mA	1/500 V	0 ... 5000	0.002	0
I25/020 (Shunt 50 Ohm)	DC 0 ... 25mA	0 … 20 mA	1/250 V	0 ... 5000	0.004	0
I25/020 (Shunt 40 Ohm)	DC 0 ... 25mA	0 … 25 mA	1/200 V	0 ... 5000	0.005	0
I25/020 TX-I/O*	DC 0 ... 20mA*)	0 ... 20 mA*	1/1000 mA	0 ... 20000	0.001*	0
U10 (Shunt 400 Ohm) TX-I/O*	DC 0 ... 25mA*)	0 ... 25 mA*	1/1000 V	0 ... 10000	0.0025*	0

Table 81: TX- and PT-I/O modules PX modular

Key:

* TX-I/O modules support only 0 ... 20 mA. For a range of 0 ... 25 mA, use the shunt for 400 Ohm (0.1%, 1 W) and measure the voltage with U10.

I/O configuration PX Compact

The analog input block is used in the Desigo PX Compact PXC10 TL to PXC52 automation station in cases where an LG Ni1000 sensor (signal type R1K) or DC 0…10 V (U10) is connected to device terminals X1…X16 of Module 001.

The following information results:

Signal type measurement	Description	Standard measuring range	[Slpe]	[Icpt]
R1K	LG-Ni 1000	-50…150 °C	0.01	0
U10	DC 0…10V	0…10 Volt	0.001	0

Table 82: I/O configuration PX Compact

BACnet referencing

Reference to a value in another BACnet object. As the referenced value is already available as a converted or resulting value, no conversion is required, that is, [Slpe] must be defined as 1 and [Icpt] as 0.

The measured value from a room unit connected via the PPS2 interface. In the analog input block, only Objects 24 (setpoint correction) and 40 (room temperature)

PPS2 interface

may be used. As the value is already available as a converted or referenced value, no conversion is required, that is, [Slpe] must be defined as 1 and [Icpt] as 0.

[Slpe] and [Icpt] Analog Output

I/O modules PX modular

In the PX modular automation stations, the analog output block is used with the following signal types:

Signal type positioning	Description	Standard measuring range	[Slpe]	[Icpt]
Y10S	DC 0…10 V	0 … 10 V	100	0
Y420	DC 4…20 mA	4 … 20 mA	160	4000
Y250T (P-bus)*	Three-point	AC 24…250 Volt	2.55*	0
Y250T (Island bus)*	Three-point	AC 24…250 Volt	100*	0

Table 83: I/O modules PX modular

Key:

* Value [Slpe] for Y250T is not a physical value, but rather a special code controlling output of the AO to two relay outputs. This code differs between P-bus and island bus.

I/O configuration PX Compact

The analog output block is used in the PX compact automation stations, when valves or actuators with DC 0…10 V control signals, signal type Y10S, are connected to device terminals Y1…Y8 of Module 004.

Signal type positioning	Description	Standard measuring range	[Slpe]	[Icpt]
Y10S	DC 0…10 V	0 … 10 V	1000	0

Table 84: I/O modules PX Compact

PPS2 interface

Transfer of an analog control command to a room unit connected via the PPS2 interface. Only Object 195 (= Room temperature display) can be used in the analog output block. As the value is already available as a converted or referenced value, no conversion is required, that is, [Slpe] must be defined as 1 and [Icpt] as 0.

Line resistance with [Icpt]

For analog inputs (measurement of temperatures or resistances), most signal types are calibrated at a line resistance of 1 Ohm. The [Icpt] can be changed at the AI block if the line resistance deviates strongly from 1 Ohm.

Line resistance	[Slpe]	[Icpt]	Delta slope	Delta intercept
P1K (Pt1000)				
0 Ohm	0.0259740	-259.480519	0	0.259740
Default = 1 Ohm	0.0259740	-259.740260	0	0
2 Ohm	0.0259740	-260.000000	0	-0.259740
3 Ohm	0.0259740	-260.259740	0	-0.519481
R2K5 P1K (0...2500 Ohm)				
0 Ohm	0.1	1	0	1
Default = 1 Ohm	0.1	0	0	0
2 Ohm	0.1	-1	0	-1
3 Ohm	0.1	-2	0	-2

Line resistance	[Slpe]	[Icpt]	Delta slope	Delta intercept
R250				
0 Ohm Default = 1 Ohm 2 Ohm 3 Ohm	0.01 0.01 0.01 0.01	1 0 -1 -2	0 0 0 0	1 0 -1 -2
R250 **P100 (0...250 Ohm)***				
0 Ohm Default = 1 Ohm 2 Ohm 3 Ohm	0.01 0.01 0.01 0.01	0 -1 -2 -3	0 0 0 0	0 -1 -2 -3

Table 85: Measuring resistances (internal resolution = 1/10 Ohm)

Key:

*	PT-I/O modules	P100 is a four-wire type	Default line resistance = 0 Ohm Line resistance not compensated
	TX-I/O modules with island bus integration	Pt100_4 is a four-wire type	Default line resistance = 0 Ohm Line resistance not compensated
		R250 is a two-wire type	Default line resistance = 1 Ohm
	TX-I/O modules with BIM integration	Pt100_4 is a four-wire type	Default line resistance = 0 Ohm Line resistance not compensated
		R250 is a two-wire type, but must be connected to four terminals using bridges	Default line resistance = 0 Ohm

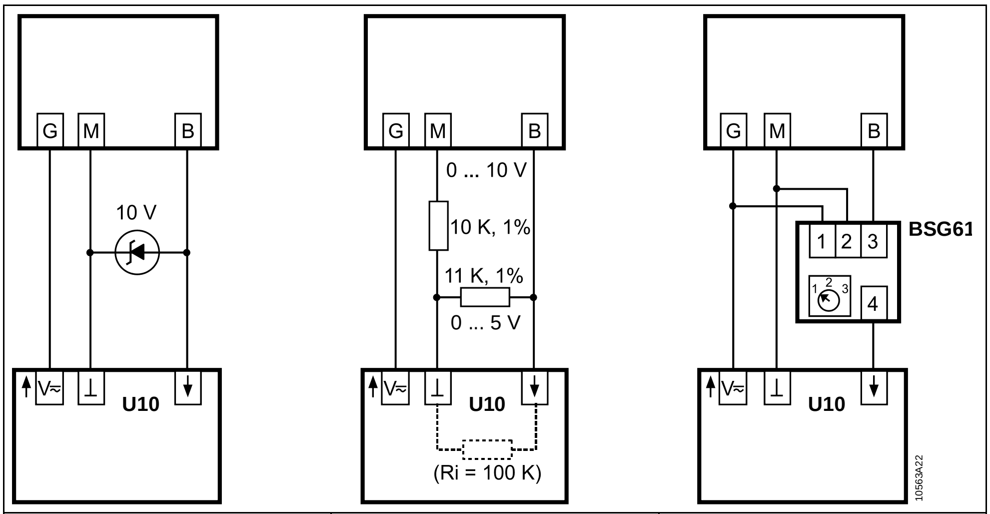
Line resistance	[Slpe]	[Icpt]	Degrees per Ohm	Degrees per Ohm
Pt 1K 385			3.85	0.259740
0 Ohm Default = 1 Ohm 2 Ohm 3 Ohm	0.01 0.01 0.01 0.01	0.259740 0 -0.259740 -0.519481		
Pt 1K 375			3.75	0.266667
0 Ohm Default = 1 Ohm 2 Ohm 3 Ohm	0.01 0.01 0.01 0.01	0.266667 0 -0.266667 -0.533333		
Ni1K			5	0.2
0 Ohm Default = 1 Ohm 2 Ohm 3 Ohm	0.01 0.01 0.01 0.01	0.2 0 -0.2 -0.4		

Line resistance	[Slpe]	[Icpt]	Degrees per Ohm	Degrees per Ohm
T1			9.57 10.39 11.31 12.36	0.104450 -50...0 ℃ 0.096246 0...50 ℃ 0.088417 50...100 ℃ 0.080893 100...150 ℃
0 Ohm Default = 1 Ohm 2 Ohm 3 Ohm	0.01 0.01 0.01 0.01	0.096246 0 -0.096246 -0.192493		
Pt100_4				
	Pt100 is a four-wire type, default line resistance = 0 Ohm -> Line resistance is not compensated			

Table 86: Measuring temperature (internal resolution = 1/100 ℃)

Power surges on U10 inputs

The U10 inputs are designed for DC 0 ... 10 V with a narrower high / low tolerance range. The input reports an error when a value is stored that outside this range. A transient voltage suppressor can prevent an error message. A faulty response from the analog signal supplied by the automation station can no longer be detected.



Zener diode	Voltage divider	Active setpoint adjuster BSG61 (Datasheet CE1N1992)
	Slope must be adapted to 0...5 V (0.01 -> 0.005) Precision resistance, for example, VISHAI MBB/SMA 0207	Switch position 1 (Setpoint limit control) Setpoint 100%

Table 87: Solution examples

[Icpt] and [Slpe] for BT devices

Note for all U10 inputs

The physical inputs are designed for 0 -10V with narrow high and low tolerance limits. If a value falls outside this range, the input transmits an error signal. However, provided it is established that the peripheral devices are in order, an error signal can be prevented by using a transient voltage suppressor (10 V Zener diode and two resistors). A faulty response from the analog input signal supplied cannot subsequently be detected in the automation station.

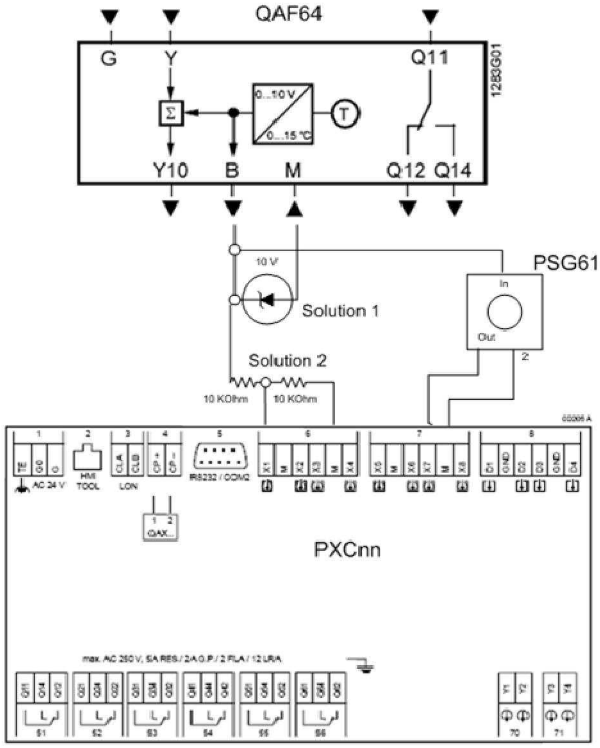


Figure 229: Example of a circuit including the QAF64 which transmits more than 10 volts

17.10 Addressing entries for PXC…-U, PTM and P-Bus

Addressing entries PX modular (PXC…-U)

For the PX modular series, the P bus I/O modules at the Input-Output address pin [IOAddr] start with the prefix: "P=".

Address syntax: P= Module.Channel (Signal type, parameter)

Example: P=2.1 (Y10S,15)

The exception is the Info LED which must have the prefix "C=" because the fixed address 8.1, which is used for the Info LED may also be used by an I/O module.

Info-LED for PX KNX: D=1001.

The following table shows the various address entries required when using the modular series automation station in conjunction with TX-I/O modules.

Type	Module addressing	I/O point or channels
Desigo TX-I/O	1...120	1...16
Desigo PT-I/O	1...255	1...8
PX Info LED	8	1

Table 88: Addressing entries

Module type	Signal type	Parameters	Example
Analog Input	R1K, P1K, U10, I25, I420 P100 T1 (only TX-I/O)	-	P=1.1 (R1K)
	AI, AIS, AIL, AISL	-	P=2.1 (AIS)
Analog Output	Y10S	NO, KEEP 0...30	P=2.1 (Y10S, KEEP) P=2.1 (Y10S,15)

Module type	Signal type	Parameters	Example
	Y250T	1...13, 1...13	P=3.1 (Y250T,8) P=3.1 (Y250T,8,10)
	Y420 *AO, AOS, AOSL, AOL*	-	P=34.1 (Y420) P=36.1 (AOS)
Binary Input	D20, D20S D42, D250 (only PT-I/O)	-	P=25.2 (D20)
	DI, DIS, DIL, DISL	-	P=26.3 (DIS)
Counter Input	C	-	P=38.1 (C)
Info LED	Q_LED PX KNX: D=1001	-	C=8.1(Q_LED)
Binary Output	Q250_P, Q250A_P	0, 1...600	P=12.1 (Q250_P)
	Q250 QD, Q250B, (only PT-I/O)	-	P=1.1 (QD) P=14.1 (Q250)
	DO, DOS, DOL, DOSL	-	P=15.2 (DOS)
Multistate Input	D20 D42, D250 (only PT-I/O)	Binary - Mapping	P=1.1;1.2 (D20)
		Updown - Mapping	
		1:n - Mapping	
Multistate Output	*DI, DIS, DIL, DISL* Q250 Q250B, QD (only PT-I/O)	Binary - Mapping	P=7.1 (DIS) P=1.1;1.2;1.3 (Q250)
		Updown - Mapping	
		1:n - Mapping	
	Q250_P3	0, 1...600	P=1.1 (Q250_P3,120)
	Q-M3 QD-M2 (only PT-I/O)	-	P=1.1 (Q-M2) P=1.1 (QD-M2)
	DO, DOS, DOL, DOSL	-	P=26.3 (DIS)

Table 89: Addressing entries PX modular (PXC...-U)

Signal types shown in *italics* are used to map virtual modules for use with I/O OPEN at module level. Signal types AIS, AOS, DIS and DOS deliver a 16 bit value with status information, while signal types AISL, AOSL, DISL and DOSL deliver a 32 bit value with status information. All other signal types deliver a 16/32 bit value without status information.

While all the module types listed may be connected to any P-bus addresses, not all module types have 16 channels.

Parameter values

Parameter values for the analog output, binary output and multistate output blocks:

Y10S

Failsafe function (emergency control function) if the transfer of data over the P-bus fails (for longer than 4 seconds) or in the event of a power failure. (an operating voltage of AC 24 V must be available).

NO -> Module output signal goes to 0 V.

KEEP -> Module output signal remains at previous value.

0...30 -> Module output signal 0 = 0 V, 1 = 0.33 V, etc. , … 30 = 10 V.

Y250T

1…13, 1…13 Runtime ranges for On/Off signals (the ranges do not need to be the same for On/Off). Values 1…13 correspond to the following runtimes:

1 = 8.5 ...13 seconds

2 = 13 ... 18 seconds

3 = 18 ...25 seconds

4 = 25 ...35 seconds
5 = 35 ... 48 seconds
6 = 48 ... 66 seconds
7 = 1.1 ... 1.6 minutes
8 = 1.6 ... 2.3 minutes
9 = 2.3 ... 3.2 minutes
10 = 3.2 ... 4.5 minutes
11 = 4.5 ... 6.3 minutes
12 = 6.3 ... 9.0 minutes
13 = 9.0 ... 11 minutes

The PTM1.2Y250T(-M) module can only implement one runtime. It therefore uses the opening-command runtime for closing commands.

Q250_P, Q250A_P, Q250_P3 ….

0, 1…600 -> Pulse times, where 0 = 0.5 seconds and then 1 = 1 second, 2 = 2 seconds etc. up to 600 (=600 seconds).

Pulse times for island bus applications:

Values in the I/O address editor: 0...255 (corresponds to 0...25.5 seconds)

Default = 5 (corresponds to 0.5 seconds).

Addressing entries PX Compact (PXC…)

The addressing procedure is almost identical for Desigo PX compact and for Desigo PX modular. However, the valid address ranges and signal types are not the same as those used for the addressing of individual P-bus I/O modules.

For PX compact, the on-board I/O modules at the [IOAddr] pin start with a "C" (prefix: "C=").

Address syntax: C=Module.Channel (Signal type, parameter)

Example:C=2.1 (Y10S, NO)

The table below shows the available address ranges and signal types, which vary according to the Desigo PX compact automation station (each with its own integrated, fixed configuration of I/Os) type.

Desigo PX compact	PXC10-TL[1]		PXC12 PXC12-T		PXC22 PXC22-T		PXC36 PXC36-T		PXC52		Signal type
	Module	Channel	Module	Channel	Module	Channel	Module	Channel	Module	Channel	
Uni-versal Inputs (UI: for AI, DI)	1	1…4	1	1…6 X1…X6	1	1…8 X1…X8	1	1…12 X1…X12	1	1…16 X1…X16	R1K, U10, D20 T1, P1K, N1K
Digital Inputs (DI) (Counter Input)	2	1…4	–	–	2	1…4 D1…D4	2	1…4 D1…D4	2	1…4 D1…D4	D20, C
Digital Inputs (DI)	3	1…4	–	–	–	–	3	1…8 D5…D12	3	1…12 D5…D16	D20
Analog Outputs (AO)	-	-	4	1…4 Y1…Y2	4	1…4 Y1…Y4	4	1…6 Y1…Y6	4	1…8 Y1…Y8	Y10S
Digital Outputs (DO)	5	1…2	5	1…2 51…54	5	1…6 51…56	5	1…8 51…58	5	1…12 51…62	Q250

Desigo PX compact	PXC10-TL[1]		PXC12 PXC12-T		PXC22 PXC22-T		PXC36 PXC36-T		PXC52		Signal type
	Module	Channel	Module	Channel	Module	Channel	Module	Channel	Module	Channel	
Manual switch[2] (only PXC36-S)	–	–	–	–	–	–	7	1…4	–	–	D_M3
LEDs	8	2…5	–	–	–	–	8	2…7	–	–	Q_LED
Info LED	8	1	8	1	8	1	8	1	8	1	Q_LED
PPS-2 signal[3]	[3]	1..5	[3]	1..5	[3]	1..5	[3]	1..5	[3]	1..5	R1K, U10, D20
PXC52 from Desigo V5[4]: Universal Inputs / Outputs									1 4	1…16 X1…X16 1…8 Y1…Y8	D20, C R1K, U10, D20 T1, P1K, N1K, Y10S

Table 90: Addressing entries PX compact (PXC...)

Key:

[1] For PXC10-TL the two Alarm1/2 buttons and the DIL switches1/2 are mapped to the modules with the Address 3.

[2] The manual switch can only be loaded into the application if the DIL switches (in the cover of the PXC36-S) are set correctly.

[3] Syntax for PPS-2 signal: Q=Romm device number.Object number (profile number). Up to five devices can be connected.

[4] The current UI and AO can all be configured as AI, DI, CI, or AO.

Signal type if no application is loaded (wiring test): X1...X16 = Y10S, Y1...Y8 = R1K.

Module 4

For Module 4, the universal outputs (UO for AO and DO) not only control proportional actuators (AO), but can also be used as binary switch commands (DO).

Analog Output = 0…10 V

Binary Output = DC 0 or 24 V, max. 22 mA with the use of an additional external relay.

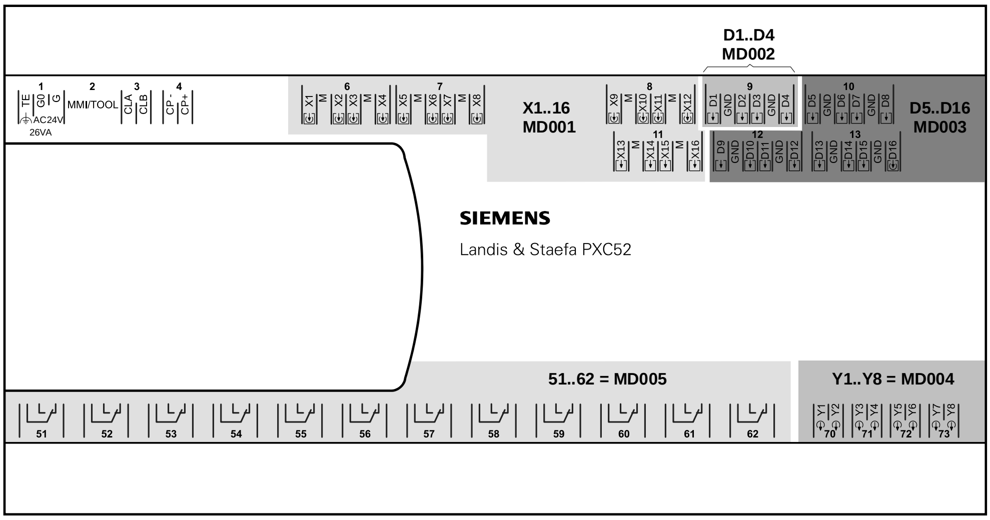


Figure 230: Layout of PXC52 housing with address ranges

Addressing multistate I/Os with PTM

Multistate input

The multistate value is made up of several separate binary measured values.

Addressing is via the input/output address [IOAddr]. In both the modular and the compact series, the logical and physical I/O must be located in the same automation station, but they do not need to be contiguous. The addressing cannot extend across automation stations. The addresses must be on the same module for TX-I/O.

Simple mapping

Syntax: P=Module.Channel;Module.Channel;Module.Channel;Module.Channel (Signal type)

Examples:

- P=1.1 (D20)
- P=1.1;1.2 (D20)
- P=1.1;1.2;1.3 (D20)
- P=1.1;1.2;1.3;1.4 (D20)
- P=10.3 (DIS)

Up to four binary status values (for example, Off/St1/St2/St3/St4) can be registered. The signals to be registered, which are addressed via Module.Channel, must always be of the same hardware signal type. With the simple mapping procedure, to enable the multistate input to interpret the current binary signals correctly, only one binary signal may be present at any one time. If several binary signals are present at once, this is displayed as an error at the [Rlb] pin.

The examples below show a possible application for multistate input blocks in conjunction with the physical I/O modules. The example on the left of the diagram is a multiple I/O module, while the one on the right shows the mapping of several individual I/O modules in one multistate input block.

Multistate output

The multistate value from the program is converted in the Multistate Output block into a switching command. Addressing is via [IOAddr]. For PX modular, the syntax is as follows:

Syntax: P=Module.Channel;Module.Channel;Module.Channel;Module.Channel (signal type, parameter)

Examples:

- P=1.1 (Q250)
- P=1.1;1.2 (Q250)
- P=1.1;1.2;1.3 (Q250)
- P=1.1;1.2;1.3;1.4 (Q250)
- P=10.1 (Q250-P3,120)
- P=24.7 (DOS)

Values with up to four stages can be processed. The signals to be registered, which are addressed via Module.Channel, must always be of the same hardware signal type. In the case of a multistate output on the hardware side, there is one address only (this is only possible with PXC modular automation stations).

Error handling

If an automation station does not support a given address (for example, incorrect syntax) or a given I/O system, this will lead to a reliability error, which will be displayed at the [Rlb] pin.

Advanced mapping (Multistate Input)

The manual switch can be encoded on the PX compact in various ways, for example:

- (Auto/Off/On) or (Off/Auto/On)
- (Auto/Off/S1/S2) or (Off/Auto/S1/S2)

To avoid having to keep adapting the data types and text groups in the system, the manual switch must always be represented in the same way within the system:

- (Auto/Off/On)
- (Auto/Off/S1/S2)

A prerequisite for this approach is that it must be possible in the multistate input block to configure the hardware coding and mapping to the standardized manual switch. This is made possible with parameters in the address.

1_n-Mapping (Multistate Input and Output)

Syntax: P=Module.channel;Module.channel;Module.channel;Module.channel (signal type, a,b,c,d,e)

a represents [PrVal] for HW-I/O (0,0,0,0)

b represents [PrVal] for HW-I/O (1,0,0,0)

c represents [PrVal] for HW-I/O (0,1,0,0)

d represents [PrVal] for HW-I/O (0,0,1,0)

e represents [PrVal] for HW-I/O (0,0,0,1)

Example: P=1.1;1.2;1.3;1.4 (D20, **1**, **3**, **2**, **4**, **5**)

[PrVal]	Addr1	Addr2	Addr3	Addr4	Comment / Text group
1	0	0	0	0	Auto
3	**1**	0	0	0	Stage 1
2	0	**1**	0	0	Off
4	0	0	**1**	0	Stage 2
5	0	0	0	**1**	Stage 3

Table 91: 1_n-Mapping (Multistate Input and Output)

UpDown mapping (Multistate Input and Output)

Application: Connecting/disconnecting further stages.

Example: Electric heating registers, multi-stage burners.

Syntax: P=Module.channel;Module.channel;Module.channel;module.channel (signal type, UPDOWN)

With "Up/Down" mapping, more than one hardware input or output may be active.

Binary mapping (Multistate Input and Output)

Application: Output of an integer in binary form.

Example: Binary electric heating coil.

Syntax: P=Module.channel;Module.channel;Module.channel;Module.channel (signal type, BINARY)

With binary mapping, more than one hardware input or output may be active.

18 Room Automation

Desigo Room Automation

Desigo Room Automation offers solutions with greater functionality and flexibility allowing for energy-optimized plant operation without loss of comfort (efficiency class A).

The DXR2 room automation stations are perfectly suited to exclusively automate heating, ventilation, and air conditioning in a room. In addition, the DXR2 can be extended with lighting and shading functions by adding devices with KNX PL- Link.

The PXC3 modular room automation stations are used in buildings with multiple disciplines for room automation (HVAC, lighting, blinds) all combined in one system.

Desigo RX

Desigo RX is a proven room automation product range featuring comprehensive communications and application functions for individual rooms. The product range consists of three series of communicating room controllers (RXC…, RXB…, RXL…) with operator units and predefined applications for HVAC, lighting, and blinds. Desigo RX room automation is capable of autonomous operation. Integration of LonWorks or KNX network via the system controllers provides for additional functionality.

18.1 Desigo Room Automation

New guidelines to save energy and lower operating costs and greater requirements for comfort and design require a more sophisticated interaction between a building's various technical installations. The modular and compact room automation stations combine lighting, shading, and HVAC in one total solution and provide a direct connection to the automation stations via BACnet.

Overview of room automation stations

Product range	Configurable		Programmable	
Applications and tool	Configurable with ABT Site		Programmable with library in ABT Pro	
Communication (Backbone)	BACnet ethernet	BACnet MS/TP	BACnet ethernet	BACnet MS/TP
Communication with sensors and actuators in room (integration)	KNX PL-Link	KNX PL-Link	KNX PL-Link KNX (with ETS) DALI	KNX PL-Link
System integration/functions	PXC..-E.D	PXG3.L PXC..-E.D	PXC..-E.D	PXG3.L PXC..-E.D
Modular controller I/Os			PXC3.E.. TXM	
Compact controller	DXR2.E..	DXR2.M..	DXR2.E..	DXR2.M..
DALI extension			PXC3.E16A PXC3.E..A	
Communication with room units	KNX PL-Link	KNX PL-Link	KNX PL-Link	KNX PL-Link
Room units	QMX3..	QMX3..	QMX3..	QMX3..
Touch screen			QMX7..	

Table 92: Overview of room automation stations

KNX PL-Link

KNX PL-Link (PeripheraL Link) connects communicating room and field devices (room devices, sensors, actors) with the PXC3 room automation station.

DALI

DALI (Digital Addressable Lighting Interface) helps control lighting.

18.1.1 Configurable

With DXR2.. up to two rooms can be automated for heating, ventilation, air conditioning, shading, and lighting.

The stations communicate with each other and other system components, depending on the type, via BACnet/IP (DXR2.E…) or BACnet MS/TP (DXR2.M...). The room automation stations have a set number of I/O data points and an onboard interface to KNX to connect field devices. The automation stations are delivered with preloaded applications and only need to be configured.

A comprehensive library of proven, standardized applications is also available and can be used instead of the preloaded applications. Buttons, sensors, and actuators for lighting and shading are connected to the room automation stations via the KNX PL-Link.

The preloaded and proven standardized applications in the library are configured using ABT Site and offer a great deal of flexibility since the inputs and outputs of the DXR2… can also be configured in addition to the functions.

See Range Description *Desigo Room Automation (BACnet), Configurable Room Automation* (A6V10640595).

Topologies

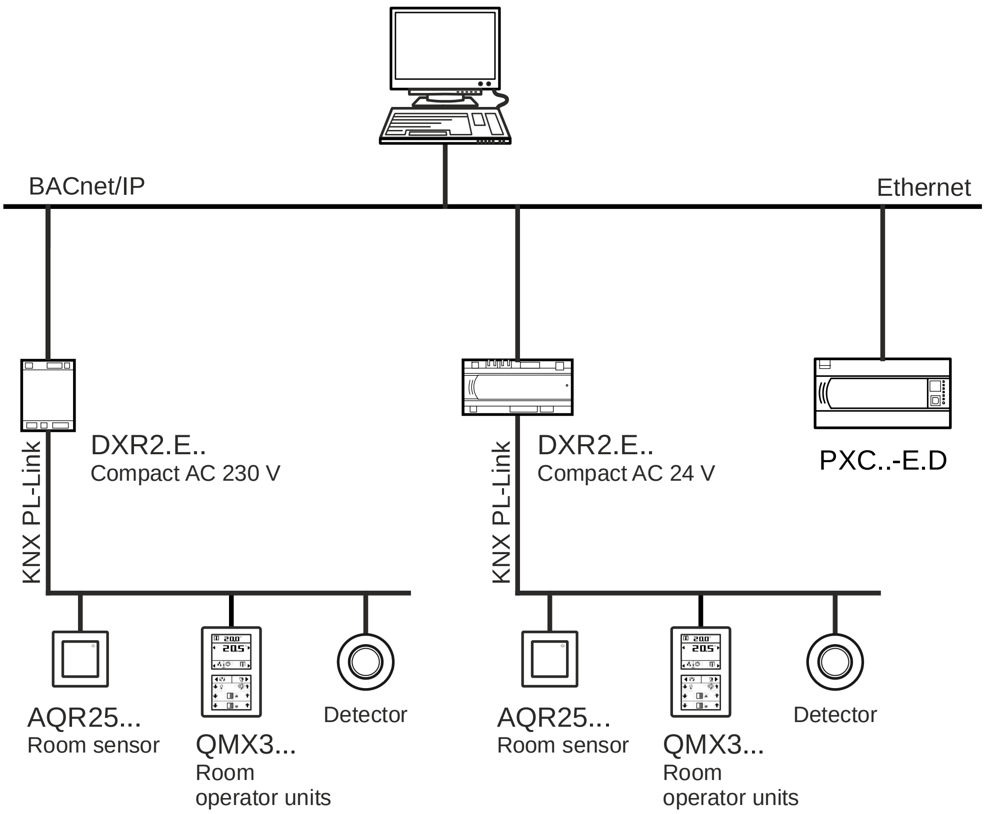


Figure 231: Compact DXR2 room automation stations for BACnet/IP

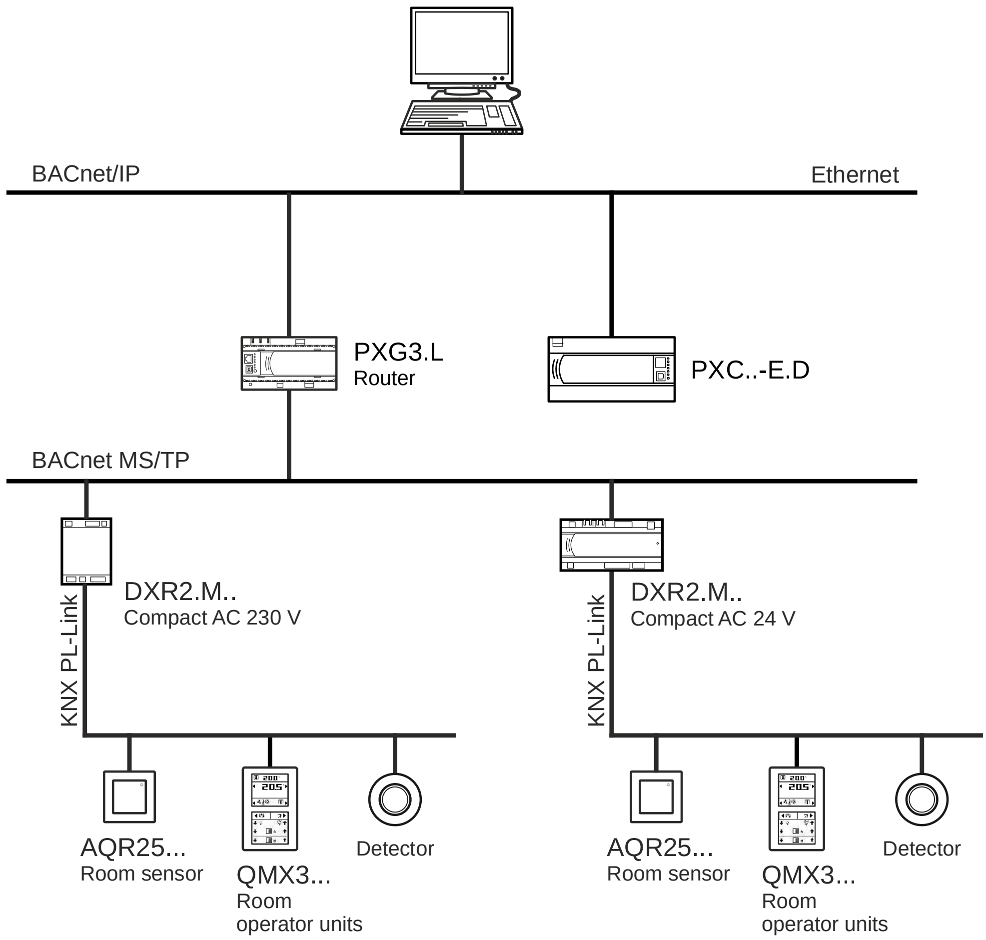


Figure 232: Compact DXR2 room automation stations for BACnet MS/TP

Applications

The following tables show the functions of the different applications of the DXR2 room automation stations.

Application	Functions
Fan coil unit	• Outside Air Damper • Single Speed Fan , Multi Speed Fan or Variable Speed Fan • Chilled water cooling coil • Direct expansion evaporator cooling coil • Heating/Cooling coil • Hot water heating coil • Electric heating coil modulating, single stage or two stage • Room temperature control by two-pipe system with change-over • Room temperature control by four-pipe system • Supply air temperature cascade control • Room dehumidification control • Air volume flow control • Rapid ventilation • Green leaf
Variable air volume	• Supply and extract air control • External flow control for VAV with integrated flow controller and differential pressure sensor • Internal flow controller and differential pressure sensor for damper actuator control • Internal flow controller and velocity sensor for damper actuator control • Chilled water cooling coil • Heating/Cooling coil • Hot water heating coil • Electric heating coil modulating, single stage or two stage • Room temperature control by two-pipe system with change-over • Room temperature control by four-pipe system • Supply air temperature cascade control • Air flow tracking for under/overpressure • Room dehumidification control • Room air quality control • Rapid ventilation • Green leaf
Radiator and chilled ceiling	• Chilled ceiling with chilled water • Heated/Chilled ceiling by two-pipe system with change-over • Heated/chilled ceiling by four-pipe system with 6 way valves • Heating ceiling with hot water • Hot water radiator • Electric radiator modulating or staged • Downdraft compensation for radiators • Condensation monitor • Room temperature control • Green leaf

Application	Functions
Fan powered box	• Supply air control • External flow control for VAV with integrated flow controller and differential pressure sensor • Internal flow controller and differential pressure sensor for damper actuator control • Internal flow controller and velocity sensor for damper actuator control • Single Speed Fan , Multi Speed Fan or Variable Speed Fan • Chilled water cooling coil • Heating/Cooling coil • Hot water heating coil • Electric heating coil modulating, single stage or two stage • Room temperature control by two-pipe system with change-over • Room temperature control by four-pipe system • Supply air temperature cascade control • Room air quality control • Rapid ventilation • Green leaf
Four light groups	• Manual switched control • Manual dimmed control • Automatic presence control • Automatic brightness control • Constant light control • Multi group constant light control • LED support on push buttons • Green Leaf - RoomOptiControl • Burn-in & operating hours function
Two blinds	• Manual control • Automatic control with anti glare function and energy efficiency function • Green Leaf - RoomOptiControl • Collision detection

Table 93: Preloaded applications

Application	Functions
Central functions	• 4x Control room operating mode groups with: – Room mode and room setpoint distribution to rooms – Start optimization switches the heating on at the appropriate time – Three delayed distribution groups of room operating mode for big buildings • 1x Seasonal compensation of room temperature setpoints • 2x Demand controlled hot water supply group • 2x Demand controlled chilled water supply group with: – Condensation prevention shifts the base chilled water setpoint to avoid condensation at chilled ceiling radiant devices – Two pipe changeover control handles the heating / cooling changeover for a two-pipe system – Free cooling manages the delivery of chilled water in situations where this can be done with almost a zero expenditure of energy. For example, chiller plants with the possibility to cool the water with the recoolers when outside conditions are favorable. • 1x Demand temperature control group with: – Relief function opens additional VAV without demand to ensure stable working of the primary plant – Changeover evaluation decide if the central air should be used for heating or for cooling – Dew point evaluation is used to dehumidify at the primary air handling unit to avoid condensation in the rooms – Humidity demand evaluates room humidity to help the primary plant determine when to humidify or dehumidify – Override function allows a technician or balancer to override the VAV applications for balancing and commissioning • 1x Demand controlled pressure control by either: – Supply VAV position evaluation helps to optimize fan speed by averaging the 10 highest supply damper positions and providing this information to the central plant – Extract VAV position evaluation helps to optimize fan speed by averaging the 10 highest extract damper positions and providing this information to the central plant. – Supply VAV flow deviation helps to optimize the fan speed by calculating the airflow deviation through the supply VAV dampers – Extract VAV flow deviation helps to optimize the fan speed by calculating the airflow deviation through the extract VAV dampers – Supply VAV flow saturation evaluation (air flow control loop cannot get enough air to reach setpoint) evaluates the supply VAV saturation signals from the rooms to optimize the fan speed – Extract VAV flow saturation evaluation (air flow control loop cannot get enough air to reach setpoint) evaluates the extract VAV saturation signals from the rooms to optimize the fan speed – Supply VAV setpoint evaluation with the summed setpoints of the supply VAV the fan's speed can be set for an optimized fan speed when VAV positions and VAV flow rates are not known – Extract VAV setpoint evaluation with the summed setpoints of the extract VAV the fan's speed can be set for an optimized fan speed when VAV positions and VAV flow rates are not known

Table 94: Loadable central functions

Central functions	• 2x VAV supply fire emergency group with off, extract, pressurization or purge • 1x Central weather station with: – Outside temperature – Outside brightness – Outside solar radiation – Outside wind speed – Outside precipitation • 2x Light manual central operation group • 1x Light central control group for emergency situations • 4x Shading central facade functions with: – Central weather station brightness calculation supports facade automatic function – Glare protection function calculates the glare protection state by central weather station for all facade – Annual shading calculates the glare protection state for all facade by in-formation from annual shading computer – Thermal protection for unoccupied rooms by central global radiation sensor on weather station – Three delayed distribution groups for central blind commands for big buildings • 2x Shading manual central operation with 3 delayed distribution groups for big buildings • 1x Shading service ensures central commanding of blind group with high priority • 1x Shading central protection for all blinds with: – Wind protection – Precipitation protection – Frost protection – Three delayed distribution groups for big buildings

Table 95: Loadable central functions (continued)

See *Application Catalog*.

Compact room automation stations

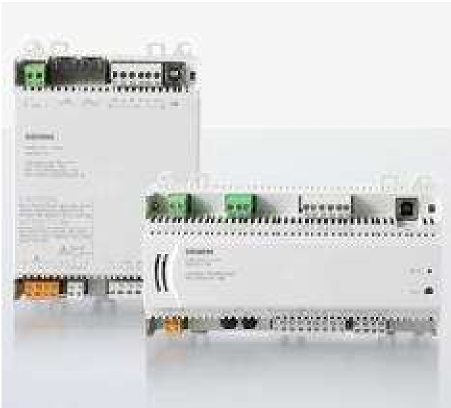


Figure 233: DXR2 automation stations

Communication								
BACnet ethernet	DXR2.E09 -101A	DXR2.E09 T-101A	DXR2.E10 -101A		DXR2.E12 P-102A	DXR2.E12 PX-102A/B	DXR2.E18 -101A	DXR2.E18 -102A
BACnet MS/TP[1]	DXR2.M09 -101A	DXR2.M09 T-101A	DXR2.M10 -101A	DXR2.M11 -101A	DXR2.M12 P-102A	DXR2.M12 PX-102A/B	DXR2.M18 -101A	DXR2.M18 -102A
Applications								
Room operating	•	•	•	•	•	•	•	•
Heated / Chilled ceiling radiator	•	•	•	•	•	•	•	•
Fan coil unit	•	•	•	•			•	

VAV system					•	•		•
Lighting	•	•	•	•	•	•	•	•
Shading	•	•	•	•	•	•	•	•
Central functions[1]							•	•
Housing								
DIN				•	•	•	•	•
Flat	•	•	•					
Operating voltage								
230V	•	•	•					
24V				•	•	•	•	•
Inputs and outputs onboard								
Digital inputs	1	1	1	1	1	1	2	2
Universal inputs	2	2	2	2	2	2	4	4
Relay outputs	3	1	3					
Triac outputs		4	4	6	6	6	8	8
Analog outputs (DC 0...10 V)[2]	3	1		2	2	2	4	4
Pressure sensor					1	1		
Maximum configuration								
Number of I/O data points[3]	30	30	30	30	30	60	60	60
Integrated power supply for KNX (mA)	50	50	50	50	50	50	50	50

Table 96: Compact room automation stations

Key:

[1] Cannot be combined with other applications.

[2] Cannot be extended by KNX PL-Link inputs and outputs.

[3] Total number of data point used by TX-I/O, KNX PL-Link and DALI. For details, see chapter *System Configuration*.

See *Compact room automation stations, BACnet/IP, 230 V DXR2.E10.., DXR2.E09.., DXR2.E09T..* (N9204).

See *Compact room automation stations, BACnet/IP, 24 V DXR2.E18.., DXR2.E12P..* (N9205).

See *Compact room automation stations, BACnet MS/TP, 230 V DXR2.M10.., DXR2.M09.., DXR2.M09T..* (N9206).

See *Compact room automation stations, BACnet MS/TP, 24 V DXR2.M11.., DXR2.M12P.., DXR2.M18..* (N9207).

18.1.2 Programmable

The DXR2.. and PXC3.. room automation stations are programmable, based on proven application blocks. Thus, solutions can be tailored to specific needs and can achieve maximum efficiency and comfort.

See Range Description *Desigo Room Automation (BACnet), Programmable Room Automation - Emergency Lighting* (A6V10640596), *Programmable Room Automation - Room Operation* (A6V10640597), *Programmable Room Automation - Distributed Functions and Scenes* (A6V10640598) and *Programmable Room Automation - Lighting Controls and DALI* (A6V10640599).

Topology

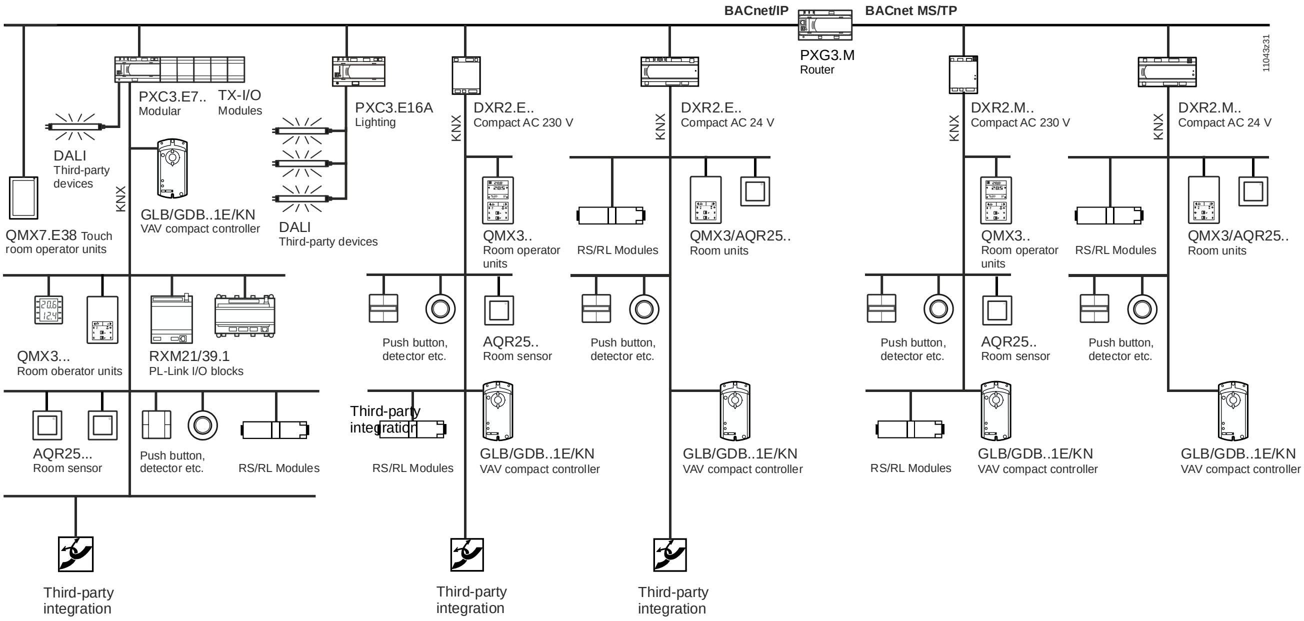


Figure 234: Desigo Room Automation topology

Applications

A comprehensive block library for room automation is provided as part the scope of delivery. The library contains predefined application functions for room climate, lighting, shading, and superimposed room functions. The applications can be combined with operating and display functions as required. The individual application functions can be adapted to customer needs and are programmable. The application functions do not depend on the selected field devices.

See *Application Catalog*.

Configuration of application functions

Many application functions are preconfigured and available in the library. Retroactive configuration during engineering or commissioning is possible. Your own configured application functions and entire rooms can be stored in a project library.

Configuration of field devices

The application architecture does not depend on the field device interface. Field devices can be connected directly to the PXC3 room automation station (via TX-I/O modules) or via bus (KNX or DALI) or IP communication.

Many field devices are preconfigured and available in the library. Retroactive configuration during engineering or commissioning is possible. Project-specific field devices configured accordingly can be saved in a project library.

Modular room automation stations

PXC3 room automation stations with control functions for one or multiple rooms:

- Assume control functions for one or multiple rooms.
- Communicate with each other or other system components via BACnet/IP. Scope and functionality of supported BACnet objects are matched to the requirements of room automation.
- Provide a 2-port Ethernet interface for cost-effective cabling via daisy chaining.
- Contain bus supplies for island bus, KNX PL-Link, and DALI. Internal bus supplies can be extended for island bus and KNX PL-Link as needed.
- Have an integrated web server for IP communication with QMX7.E38 touch room operator units.

See *Room automation station PXC3.E7..* (CM1N9203) and *Touch room operator unit QMX7.E38* (CM1N9295).

Figure 235: PXC3 automation station

	PXC3.E72	PXC3.E72A	PXC3.E75	PXC3.E75A	PXC3.E16A
Typical number of rooms / room segments	4/8	4/8	8/16	8/16	N/A
System communication	BACnet/IP	BACnet/IP	BACnet/IP	BACnet/IP	BACnet/IP
HMI automation level					
QMX3	•	•	•	•	
QMX7	•	•	•	•	•
Web based test and setup tool	•	•	•	•	•
System functions (BACnet)					
BACnet profiles	B-ASC	B-ASC	B-ASC	B-ASC	B-ASC
Programming	•	•	•	•	•
Peripheral bus					
Bus for I/O module	•	•	•	•	
KNX PL-Link[1] / KNX S-Mode	•	•	•	•	
DALI		•		•	•
Maximum configuration					
Number of I/O data points[2]	140	140	280	280	64
Inputs/Outputs for TX I/O modules	72	72	200	200	0
Devices on KNX PL-Link	64	64	64	64	0
DALI ballasts		64		64	64
Integrated power supply for KNX (mA)	160	160	160	160	N/A

Table 97: Modular room automation stations

Key:

1 Dedicated devices with KNX PL-Link.

2 Total number of data points used by TX-I/O, KNX PL-Link and DALI. For details, see chapter *System Configuration*.

TX-I/O modules

TX-I/O modules (TXM1) help connect field devices to the PXC3 room automation station. Bus supply and interface modules (TXS1, TXA1) are available as an accessory.

Figure 236: TX-I/O module

The following TX-I/O modules can be used with the PXC3 room automation station:

- TXM1.8T: Triac module with 8 outputs (AC 24 V) to control thermal and motorized valve actuators (AC 24 V) for up to 4 actuators (3-point output) or 8 actuators (permanent contact or pulse width modulation).
- TXM1.6RL: Bistable relay module to switch lighting for up to 6 data points.
- TXM1.8RB: Relay module to control blind motors for up to 2 motors (3 end switches) or 4 motors (2 end switches).
- TXM1.16D: Digital input modules for up to 16 data points.
- TXM1.8D: Digital input modules for up to 8 data points.
- TXM1.6R: Relay module for up to 6 data points.
- TXM1.8U: Universal module for up to 8 data points.

See *TX-I/O Assortment overview* (CM2N8170).

Compact room automation stations

Communication						
BACnet ethernet	DXR2.E09-101A	DXR2.E09T-101A	DXR2.E10-101A		DXR2.E12P	DXR2.E18-1..A
BACnet MS/TP	DXR2.M09-101A	DXR2.M09T-101A	DXR2.M10-101A	DXR2.M11-101A	DXR2.M12P	DXR2.M18-1..A
Housing						
DIN				•	•	•
Flat	•	•	•			
Operating voltage						
230V	•	•	•			
24V				•	•	•
Inputs and outputs onboard						
Digital inputs	1	1	1	1	1	2
Universal inputs	2	2	2	2	2	4
Relay outputs	3	1	3			
Triac outputs		4	4	6	6	8
Analog outputs (DC 0...10 V)*	3	1		2	2	4
Pressure sensor					1	
Maximum configuration						
Number of I/O data points	30	30	30	30	30	60
Integrated power supply for KNX (mA)	50	50	50	50	50	50

Table 98: Compact room automation stations

Key:

[1] Total number of data points used by TX-I/O, KNX PL-Link and DALI. For details, see chapter *System Configuration*.

PXC3.E16A room automation station for lighting

The PXC3.E16A room automation station is tailored for challenging lighting applications. All lighting applications that also run on the PXC3.E7.. are available. The PXC3.E16A communicates via BACnet/IP with the DXR2.E.. and PXC3.E.. room automation stations. Using the on-board DALI interface, up to 64 ECGs (electronic control gear) can be integrated in 16 groups. The PXC3.E16A can be used for centralized lighting automations or, as applicable, as a supplement to a decentralized HVAC installation.

Example: Centralized lighting installation with decentralized HVAC installation

- DXR2.E.. to automate HVAC in the room
- Centralized installation with PXC3.E..A for lighting

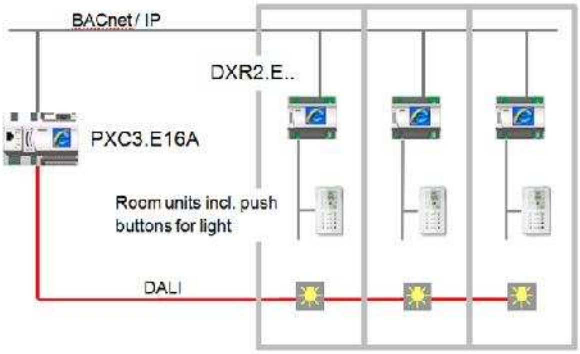


Figure 237: Centralized lighting installation with decentralized HVAC installation

Example: Centralized lighting installation without HVAC installation

- One PXC3.E16A is centrally installed per DALI line
- Optional PXC3.E7..A
  - To integrate buttons via KNX PL-Link
  - To use TXM1 modules
  - Three-phase power installation possible

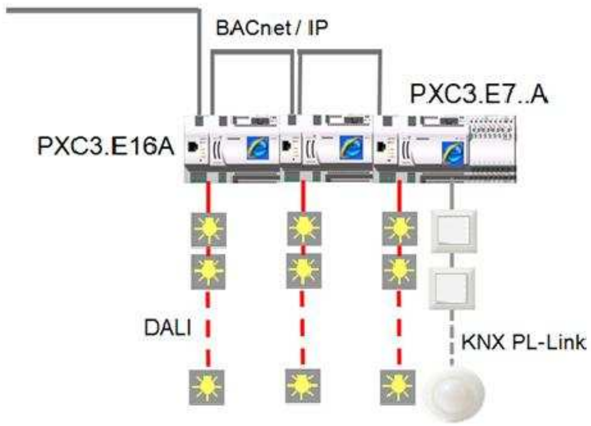


Figure 238: Centralized lighting installation without HVAC installation

18.1.3 Rooms and Room Segments

There are two methods to structure a building:

- Rooms (with fixed walls)
- Room segments (typically based on movable walls)

One of the two methods or a mixture thereof is possible depending on the building structure or required flexibility (for example, during the usage phase).

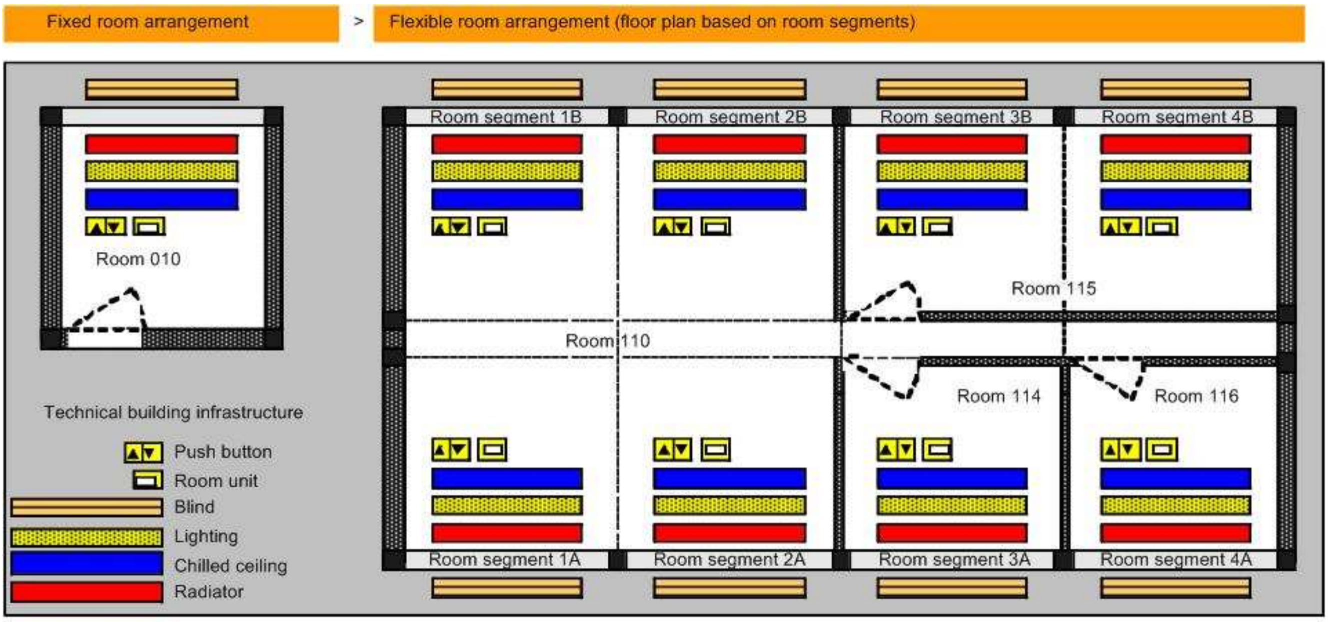


Figure 239: Rooms and room segments

A room segment is the smallest indivisible element. A room comprises at least one or several adjacent room segments. A room segment is defined and created only once. Room segments are typically combined several times to rooms over the course of a building's lifecycle.

18.1.4 Central Control Functions and Grouping

Grouping is used to implement central control functions and to coordinate demand and forced signals from the various rooms in an entire building, building wing, floor, etc.

Hidden behind the central control functions are system functions, such as operator interventions (via BACnet clients, for example, a management station or via local operator units), schedulers, automatic reactions, and data from a weather station.

Central functions influence:

- Room operating mode (occupancy and use in room)
- HVAC control via various setpoint requirements depending on the room operating mode
- HVAC setpoints via a weather-dependent adjustment
- Lighting control
- Shading control (blinds)

Grouping can be used to coordinate demand, operating, and forced signals, that is:

- Request signals for hot water distribution (heating circuit)
- Request signals for chilled water distribution (cooling circuit)
- Record demand, operating, and forced signals for the primary air handling unit

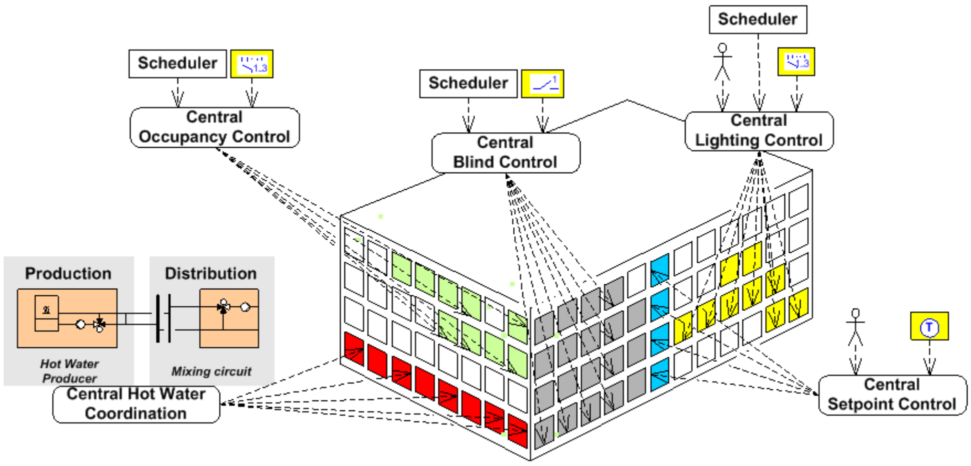


Figure 240: Grouping

Various sources are available for forming these central superposed functions:

- External system or third-party device
- System user via BACnet client
- Building user via BACnet client or local operator unit
- Scheduler or reaction program
- Superposed office based on grouping function

They are distributing after evaluating signals and commands via a Grouping function.

One group master exists for each of the various categories which then forwards the resulting information to all assigned group member (rooms). A group master can for its part be a group member of a superposed group master.

18.1.5 Desigo Room Automation and the Management Level

See chapter *Desigo Room Automation Integration*.

18.1.6 Desigo Room Automation and the Automation Level

Alarming is triggered directly on the PXC3.E.. and DXR2.. room automation stations. A primary automation station (typically PXC00.E-D) is only used for calendars , schedulers and time setting. This simplifies engineering and reduces the number of required system components.

18.2 Desigo RXC

The Desigo RXC room automation system controls and monitors comfort conditions in individual rooms. It provides predefined solutions for HVAC, lighting and blinds.

See *Desigo RXC Room automation system, System description* (CA110333).

The range consists of several controllers, operator units and predefined applications. The applications are configured and downloaded into the controllers with the RXT10 commissioning and service tool or a standard LNS tool.

See *RXT10.3 commissioning and service tool User's Guide* (CM110669) and *RXT10.5 commissioning and service tool User's Guide* (CM110658).

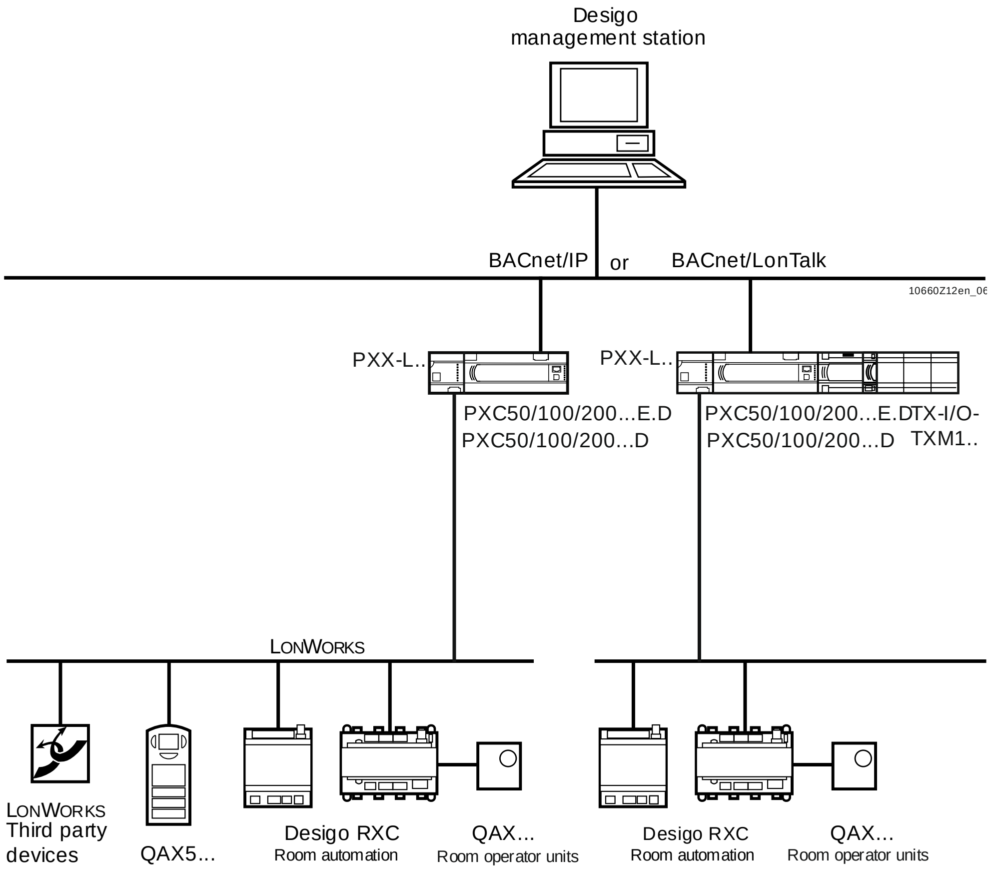


Figure 241: RXC topology

Binding

When a LonWorks network is designed, bindings are created with a LonWorks tool (RXT10 commissioning and service tool or a standard LNS tool). A binding is the connection of network variables of the same type between different nodes.

Network variables connected in this way communicate implicitly, that is, if a value changes, the new value is transmitted automatically. Transmit and receive times are also monitored, making it possible to react to communications errors.

Discipline I/Os

Discipline I/Os are function block in the LonWorks system controller that gather data from the RXC controller and make it available on the BACnet network. Discipline I/Os are available for HVAC, lighting and blinds.

Floor Level Network (FLN)

A Floor Level Network (FLN) is a communications network for room automation.

LonMark Interoperability Association

The LonMark Interoperability Association is an association founded by the manufacturers of LonWorks products, to define independent, interoperability guidelines for LonWorks systems. The association is responsible for checking compliance and for the certification of LonMark products.

LonWorks nodes

LonWorks nodes are devices that are connected to the LonWorks bus and communicate with other LonWorks nodes.

Network variables (NV)

Network variables (NV) allow the exchange of data between different LonWorks nodes. This type of communication is also called implicit, because transmission and reception are automatic. Network variables may be input or output variables.

Room-based groups

The discipline I/Os representing the RXC controllers in a room are combined in the LonWorks system controller into a room-based group. The result is a room view.

Cross-room groupings

A cross-room grouping contains all the control variables common to a given user grouping (for example, North facade, Tenant A, West zone, etc.) and distributes these control variables to the associated room or group members.

Standard Network Variable Type (SNVT)

A Standard Network Variable Type (SNVT) is a standard type of network variable, which simplifies the communication between LonWorks nodes. Only network variables of the same type can be connected. The SNVTs are defined in the SNVT Master List provided by LonMark.

Supergenies

Supergenies are predefined graphics in the graphics library of the management station. For each RXC application there is a supergenie that contains the main data points. The information in the supergenies is the same as the information in the binding templates in the RXT10 tool.

18.2.1 Product Range Overview

Desigo RXC is an innovative product range comprising controllers, extension modules, and room units. Data communication is based on LonWorks.

Desigo RXC hardware

The range comprises compact and modular controllers, easy-to-operate room units and room controllers.

The input and output configurations of the controllers, and the housing style are fully optimized to suit their field of application. The modular controllers include basic modules for HVAC control, which can be combined with extension modules for control of lighting and blinds.

The HVAC functions are operated with standard room units or the compact controller RXC10.5. The QAX50 and QAX51 configurable flexible room units are available for combined operation (HVAC, lighting, blinds).

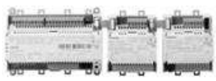
<table>
<tr><td></td><td colspan="5">Communicating (RXB, RXC)</td></tr>
<tr><td></td><td>KNX</td><td colspan="4">LonWorks</td></tr>
<tr><td>Lighting and blinds</td><td></td><td></td><td></td><td colspan="2" rowspan="2"></td></tr>
<tr><td>VAV</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="2"></td></tr>
<tr><td>Radiators and chilled ceilings</td><td></td><td></td></tr>
<tr><td>Fan coil units</td><td></td><td></td><td></td></tr>
<tr><td>Device name</td><td>RXB21
RXB22
RXB24
RXB39</td><td>RXC20
RXC21
RXC22
RXC39</td><td>RXC10</td><td>RXC30
RXC31
RXC32</td><td>RXC40
RXC41</td></tr>
</table>

Table 99: Desigo RX hardware

	PPS2 (RXC, RXB, PX)			enocean	LonWorks
	Standard		Flush mounting	Wireless	Flexible
Lighting and blinds					
HVAC					
Device name	QAX30 QAX31 QAX32	QAX33 QAX34.3 QAX39	QAX84	QAX95 QAX96 QAX97 QAX98 Only for RXC & RXB	QAX50 QAX51

Table 100: Desigo RX room units

Desigo RXC applications

The controllers and the QAX5.. flexible room units are loaded with application software which contains the control program for the associated room or area. Siemens Building Automation maintains a comprehensive library of applications covering a wide range of HVAC and electrical applications.

See *RXC application library Version 2* (CA110300).

Example: Fan coil system

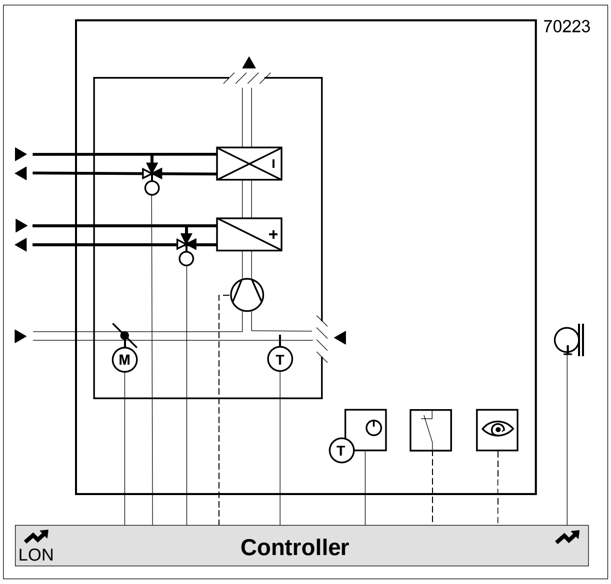


Figure 242: Example: Fan coil system

Application	Name	Controller
FNC02	Two-pipe system with changeover	RXC20.5 RXC21.5 RXC39.5
FNC03	Two-pipe system with changeover and electric re-heater	RXC20.5 RXC21.5 RXC22.5 RXC39.5
FNC04	Four-pipe system	RXC20.5 RXC21.5 RXC39.5
FNC08	Four-pipe system with room supply air cascade control	RXC21.5 RXC39.5
FNC10	Two-pipe system with changeover and outside air damper	RXC21.5
FNC12	Four-pipe system with outside air damper	RXC21.5

Table 101: Applications for RXC controllers

Common functions:

- Window contact, occupancy sensor, four operating modes
- Manual fan control with room unit
- Automatic fan control
- RXC20.5 single-speed, RXC21.5, RXC22.5 three-speed, RXC39.5 constant 0-10V
- Options with two-pipe systems: Heating only, cooling or changeover via bus using LonWorks technology

18.2.2 RXC Applications

Desigo RXC applications are standard applications developed at HQ. They cannot be modified for a specific project by the user. These applications are loaded to the controller using the RXT10 commissioning and servicing tool or a standard LNS tool (commissioning).

Applications of the same type are grouped into application groups. The complete range of RXC applications is held in a library which is continuously expanded.

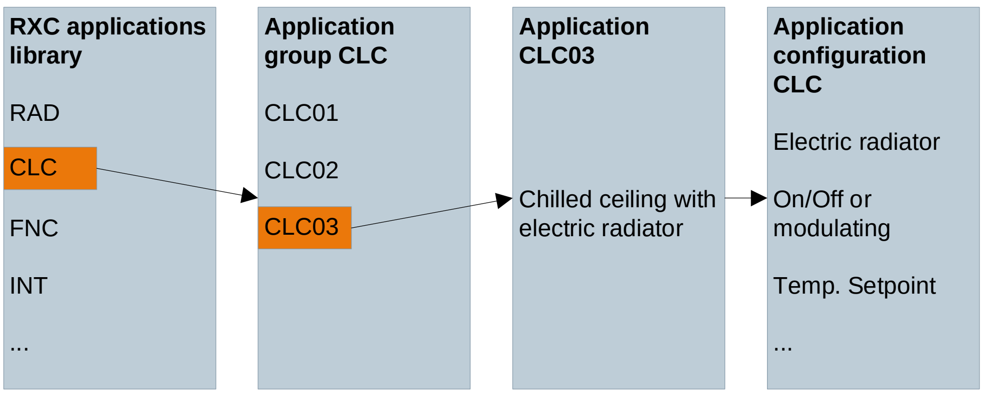


Figure 243: Hierarchical structure of the application library

RXC application library

The RXC application library contains application groups, each of which contains applications of the same type. The RXC application library has a version number which is defined in the RXC Valid Version Set. The Valid Version Set also defines the version of each individual RXC application.

The structure described above can be seen in the documentation and in the implementation of the RXT10 commissioning and service tool.

Application groups

Similar application types are grouped into application groups. These differ from each other in terms of how the functions are implemented. Thus, chilled ceiling with radiator (CLC02) and chilled ceiling and electric radiator (CLC03) are two different applications within the CLC group. The first of these two applications uses water for heating, while the second uses electrical energy. The difference between applications in the other groups follows a similar pattern.

The following application groups are available:

- 000: Basic applications (allow the RXC controllers to be used as I/O modules)
- RAD: Radiator applications
- CLC: Chilled ceiling applications
- FNC: Fan coil applications
- VAV: Variable air volume applications
- FPB: Fan-powered box applications (fan-assisted VAV)
- INT: Integrated applications (combined applications including lighting and/or blinds)
- IRO: Integrated room operation applications (applications for the QAX50/51 flexible room units)

Individual applications

The individual application is designed for typical HVAC systems as commonly used in practice in individual rooms, for example:

- FNC10: Two-pipe system with changeover and outside air damper
- VAV06: Single duct supply and extract air system with electric re-heater

Applications are modular in structure, and cover a specific combination of functions which are always implemented in the same way, for example, operating modes and setpoint derivation are identical in all applications (including those in different application groups). Similarly, fan speed control is identical in all FNC applications.

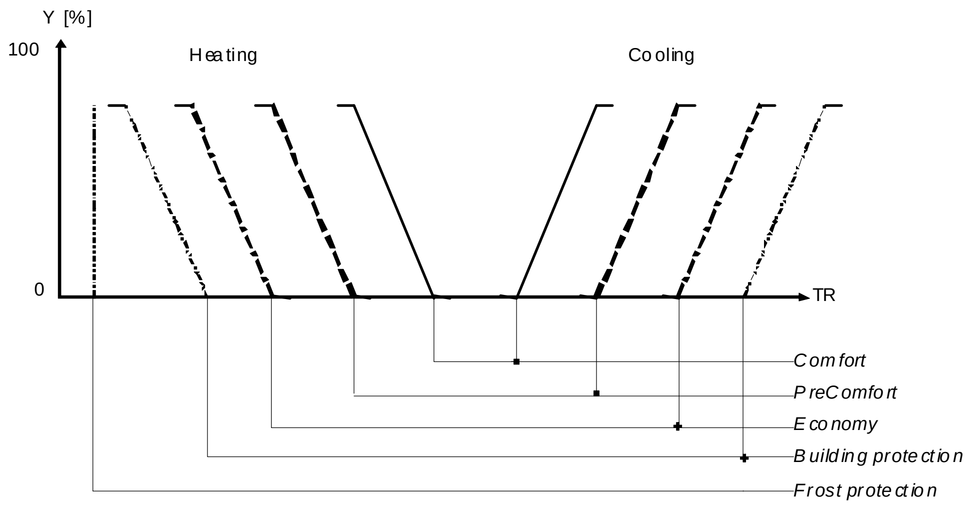


Figure 244: Example: Operating modes

Key:

Y	Output signal
TR	Room temperature

Each application has a defined number of configuration parameters with which the application can be programmed for a specific project. These parameters consist both of general values, for example, temperature setpoints, etc., and of specific

Configuring applications

values for the respective application, for example, changeover configuration, electric reheater, etc.

18.2.3 RXC and the Management Level

Generic and engineered operation is available at the management level. The operation is explained below based on Desigo Insight.

Generic operation

For operation in the Object Viewer, no additional engineering is required in Desigo Insight. Operation may be either via groups and rooms or directly via the discipline I/Os.

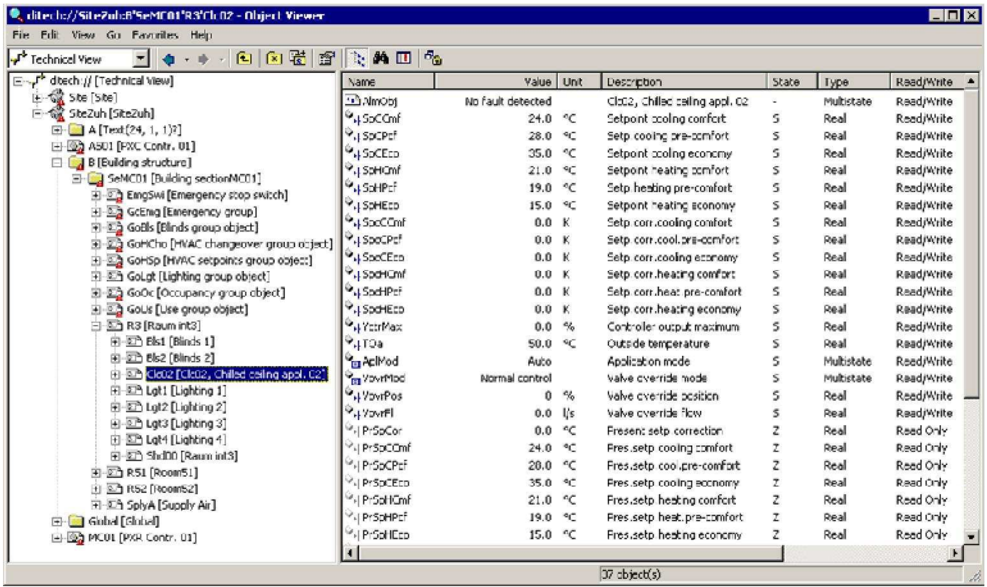


Figure 245: Object Viewer with RXC integration

Engineered operation – Plant Viewer

A typical requirement in the case of room integration is a graphical representation of the building, showing the different floors and rooms. Desigo Insight supports the generation of graphics and the integration of RXC.

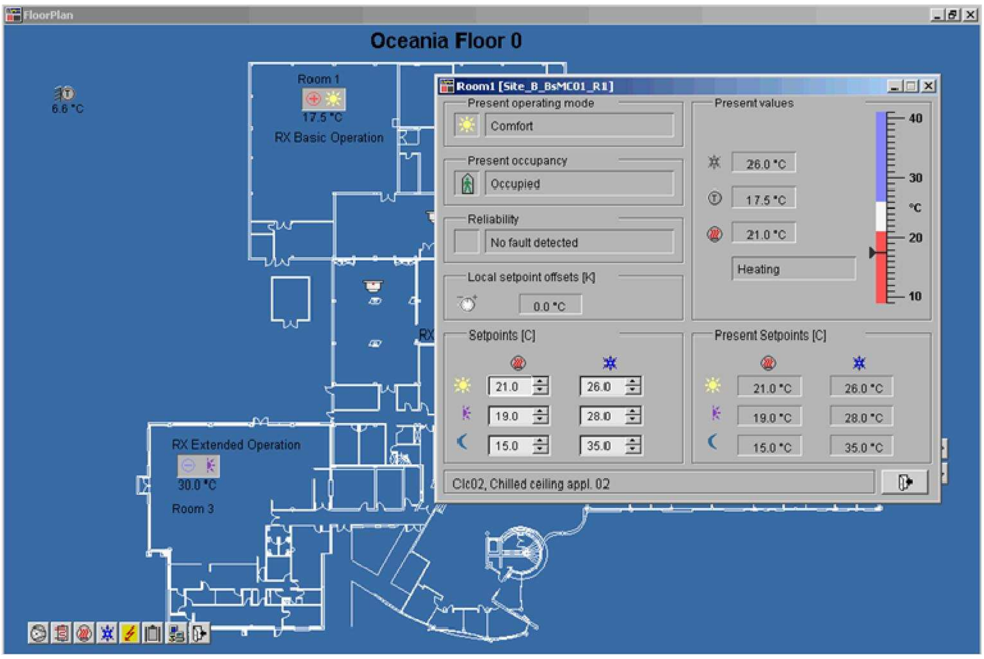


Figure 246: RXC supergenie with a floor plan as the background

For each RXC application, there is a predefined graphic (supergenie) in the Desigo Insight graphics library, containing the main data points. The information contained in the supergenies is the same as the information in the binding templates in the RXT10 tool.

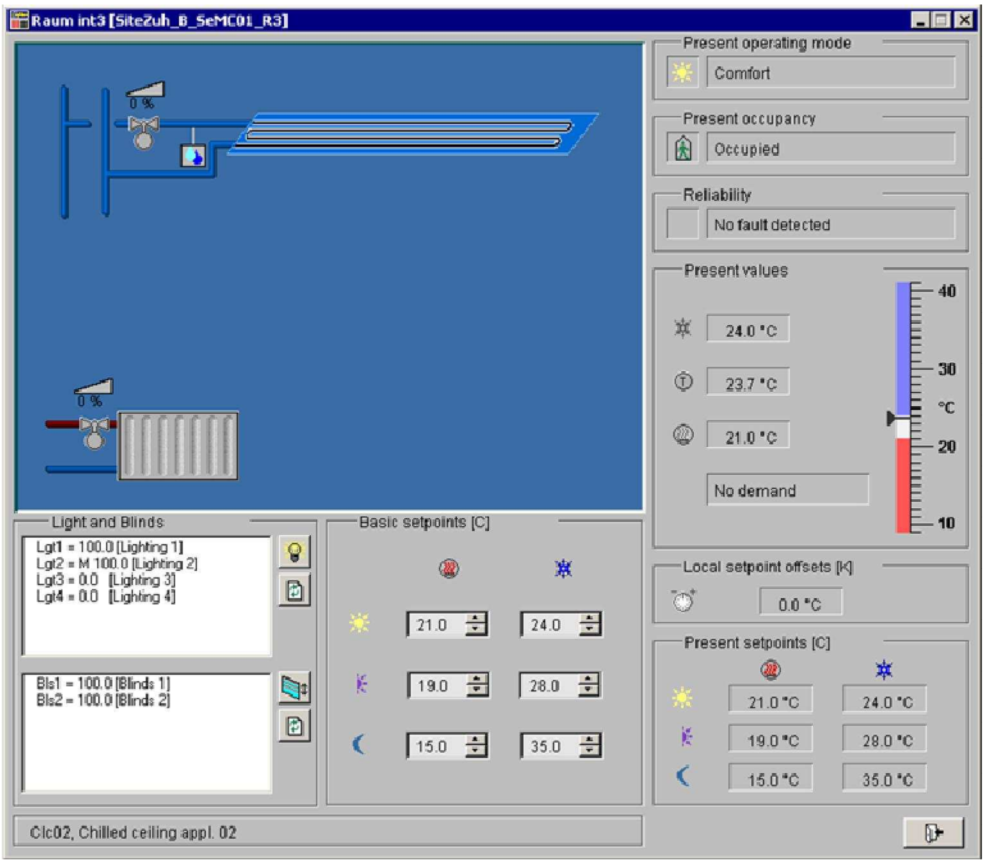


Figure 247: RXC supergenie

18.2.4 RXC and the Automation Level

Desigo RXC is integrated into the automation level with the LonWorks system controller.

The main tasks of the system controller are:

- Mapping RXC data to BACnet objects
- Implementing higher-level functions (grouping, time schedules, etc.)

On the BACnet side of the LonWorks system controller, the RXC controllers can be operated and monitored from a client (PXM20/40/50, management station). Data can also be exchanged with the primary plant.

18.2.5 Mapping LonWorks in the LonWorks System Controller

RXC data in the LonWorks system controller is mapped by objects that assemble the main functions of the RXC applications. The LonWorks system controller thus operates as a data concentrator (the data points are not mapped individually).

These objects are referred to as discipline I/Os and are components of the block library.

The following types of discipline I/Os exist:

- HVAC: Comprises all the HVAC information
- Light: Comprises all the information relating to a lighting group
- Sunblind: Comprises all the information relating to a blinds group
- Shared: Contains shared data points (for example, time schedules, occupancy status, etc.)

The discipline I/Os are defined according to the maximum principle, that is, one HVAC discipline I/O contains all the information found in the HVAC part of the RXC application. When mapping an application, however, only the specific data points for that particular application are mapped to BACnet.

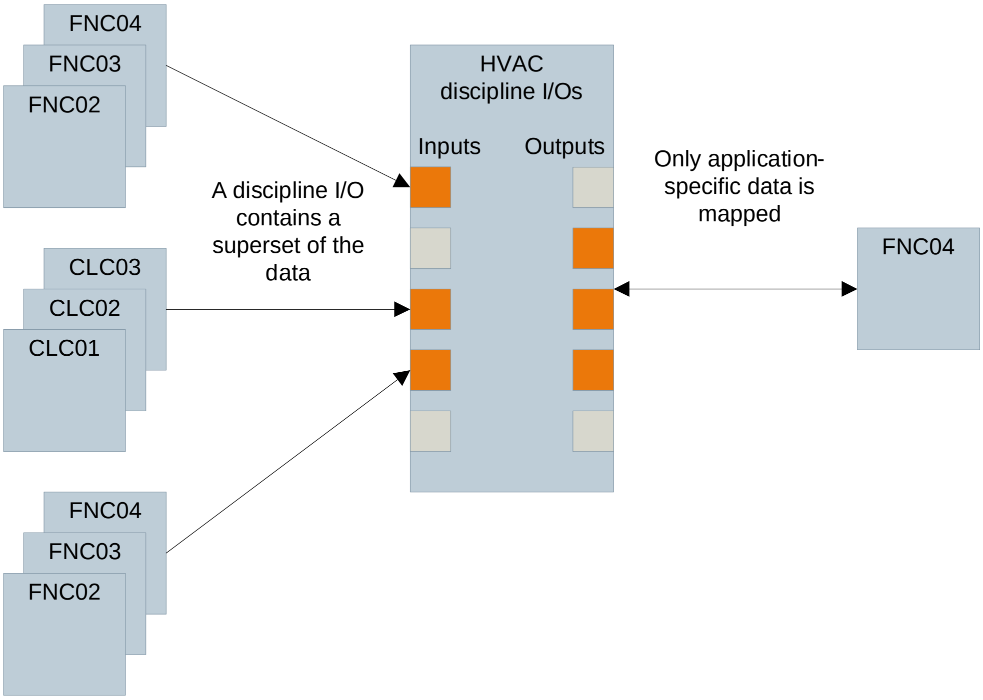


Figure 248: Data points in the application

18.2.6 Groups in the LonWorks System Controller

The RXC controller data is grouped in the LonWorks system controller. The discipline I/O is a preliminary form of grouping. It groups the data for the different sections (HVAC, lighting and blinds) of the RXC applications into the associated objects.

The LonWorks system controller has the following groups:

- Room-based groups (grouping of discipline I/Os into a room) > Compounds
- Multi-room groupings (groups of rooms) > Firmware

Room-based groups

A room-based group is a structuring element. If more than one RXC controller is installed in a room, only the discipline I/Os of the master controller is integrated. In such cases, master and slave are connected at the field level. A room-based group accommodates all the discipline I/Os of one physical room. This leads to a room-based view.

The second function of the room-based group is the mapping of application-specific data to BACnet, that is, the selection of those points of the discipline I/Os which are needed for the RXC application concerned. Room-based groups are compounds. There is a room compound for every RXC application.

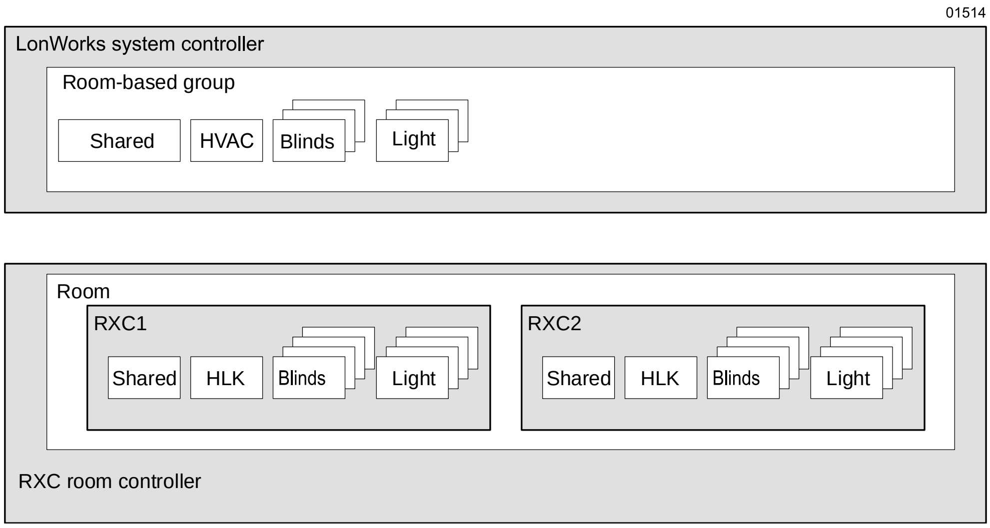


Figure 249: Room-based view

Grouping across rooms

A multi-room group contains all the control variables common to a given group of users (for example, North facade, Tenant A, West zone etc.), and distributes these control variables to the associated room or group members. For this reason, a multi-room group contains two member lists, one for the referenced room and one for the referenced group.

Multi-room groups take the form of blocks and are contained in the block library.

Referenced rooms

Referenced rooms are referenced via the discipline I/O of the room-based groups. Only rooms connected to the same LonWorks system controller can be referenced. The addressed rooms cannot be modified online.

Referenced groups

A multi-room group can also transmit values to another group, which may be connected to the same or different LonWorks system controller. Up to five more groups can be addressed. These references can be modified online.

A group can only distribute information. It cannot gather data.

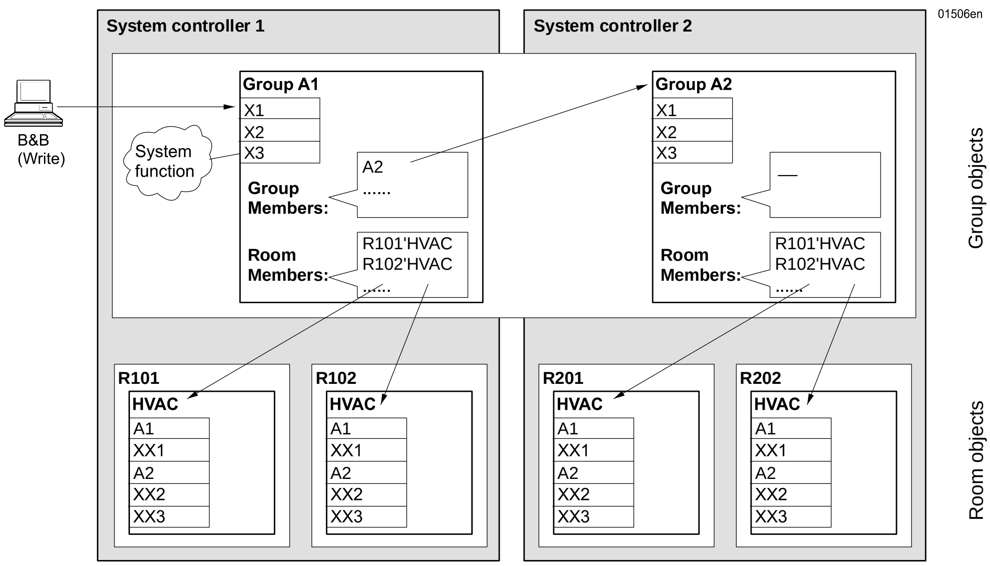


Figure 250: Multi-room groups

Group types

The following group types are available:

HVAC functions:

- Changeover: Transmission of the changeover signal (LTHW or CHW in pipe work)
- Setpoints: Basic setpoint correction and setpoint adjustments
- Emergency: Override of supply/extract air dampers in the event of fire/smoke
- Outdoor temperature: Distribution of outside air temperature

Electrical functions:

- Lighting: Transfer of lighting control and forced control of lighting
- Blind: Transfer of blind control and forced control of blinds

Time schedules:

- Building use: Transfer of values for the building use time schedule
- Room occupancy: Transmission of values for the room occupancy time schedule

18.2.7 System Functions

System functions are higher-level functions which are typically applied to groups. They are thus stored upstream of the groups and connected to them as part of the data flow. System functions are implemented in the form of compounds and are part of the compound library.

"Program" = System function

Example:
Building in use schedule for a floor

Example:
Emergency control for a fire sector

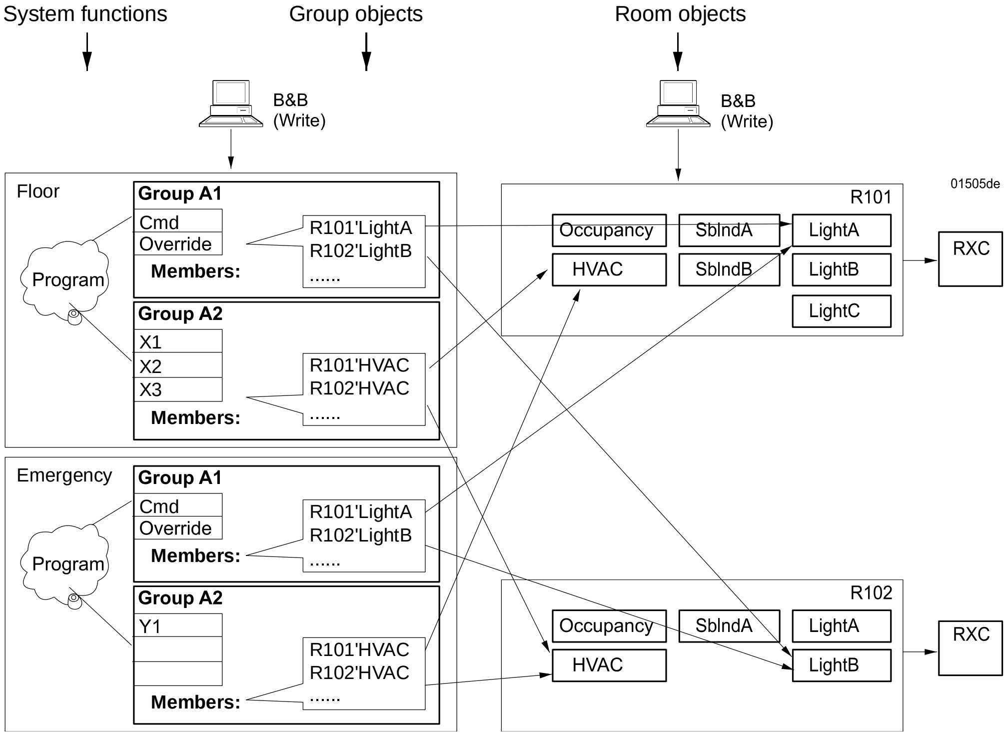


Figure 251: System functions

The following system functions are available:

- Summer/winter compensation: Adjusts the setpoints as a function of the outdoor temperature. For example, the heating setpoint is raised in winter as the outdoor temperature falls.
- Changeover: Is used when both heating and cooling are required in a room, but only one water pipe is installed. The changeover information is mapped in the LonWorks system controller and transmitted to the RXC controllers via the groups. These switch between heating and cooling accordingly.
- Emergency override: Is used in emergencies (for example, fire) to force a specific and immediate reaction from the ventilation system in the individual room. Possible reactions are: Close damper, generate positive or negative pressure, etc.

18.3 Desigo RXB

The Desigo RXB room automation system controls and monitors comfort conditions in individual rooms. It supplies predefined solutions for HVAC.

See *RXB Room automation system - system overview* (CM110380).

The range consists of controllers, operator units and predefined applications. The applications are configured and downloaded with the ETS Professional commissioning and service tool.

See *Working with ETS* (CM1Y9779).

RXB topology

The Desigo RXB room automation system is based on KNX/EIB technology. To integrate Desigo RXB into the automation level, the RXB data is mapped to BACnet.

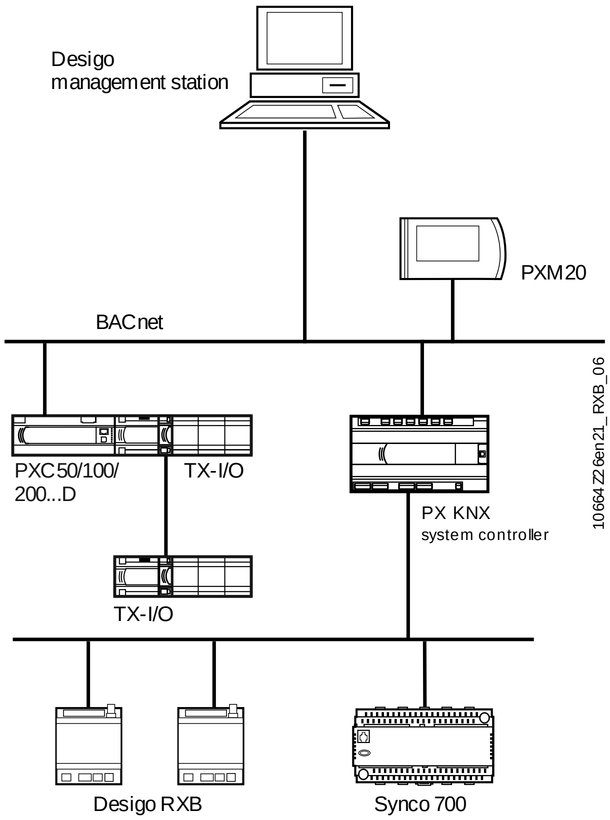


Figure 252: RXB topology

Group address / Binding

A group address / binding is a connection of network variables of the same type between different nodes. The group addresses / bindings are generated using ETS (EIB tool software) when designing the KNX/EIB network. The bound network variables communicate when changing the value and using a heartbeat. Transmission and reception times are also monitored, allowing you to react to communications errors.

Discipline I/Os

Discipline I/Os are function blocks in the PX KNX system controller, which gather data from the RXB controller and make it available on the BACnet network. Discipline I/Os are available for HVAC functions.

Konnex Association

The Konnex Association is an association founded by the manufacturers of KNX/EIB products, to define interoperability guidelines for KNX/EIB systems. The association is responsible for checking compliance and for the certification of KNX/EIB products.

KNX/EIB nodes

A KNX/EIB node is a device which is connected to the KNX/EIB bus and communicates with other KNX/EIB nodes.

Network variables (NV)

Network variables (NV) allow the exchange of data between different KNX/EIB nodes. Network variables may be input or output variables.

Room-based groups

The discipline I/Os representing the RXB controllers in a room are combined in the PX KNX system controller into a room-based group. The result is a room view.

Cross-room groupings

Cross-room groupings contain all the control variables common to a given user grouping (for example, north facade, tenant A, west zone, etc.) and distribute these control variables to the associated room or group members.

Supergenies

Supergenies are predefined graphics from the graphics library in the Desigo Insight management station. For each RXB application there is a supergenie containing the main data points.

PX KNX system controller

The PX KNX system controller comprises a PXC001(-E).D controller and loaded PX KNX firmware. Communication takes place via BACnet/LonTalk (PXC001.D) or BACnet/IP (PXC001-E.D). With the system controller, you can integrate the Synco RMU710, RMU720, RMU730 and RMH760 controllers into Desigo.

PX KNX Tool

The PX KNX tool is used to configure the PX KNX system controller on the KNX side.

18.3.1 Product Range Overview

Desigo RXB is an innovative range of controllers and room units. Data communication is based on KNX/EIB technology.

Desigo RXB hardware

The range comprises compact controllers, easy-to-operate room units and controllers in room-style housings. The input and output configurations of the controllers, and the housing style are fully optimized to suit their field of application. The HVAC functions are operated with standard room units or controllers in a room-style housing.

Desigo RXB software

Each controller is loaded with a selection of application software which contains the control program for the associated room or area within a room.

The ETS commissioning and service tool is used for the engineering and commissioning of a network incorporating the Desigo RXB range. This tool also supports the creation of communication bindings between KNX/EIB-compatible devices (Desigo RXB or third-party devices).

Example: Fan coil system

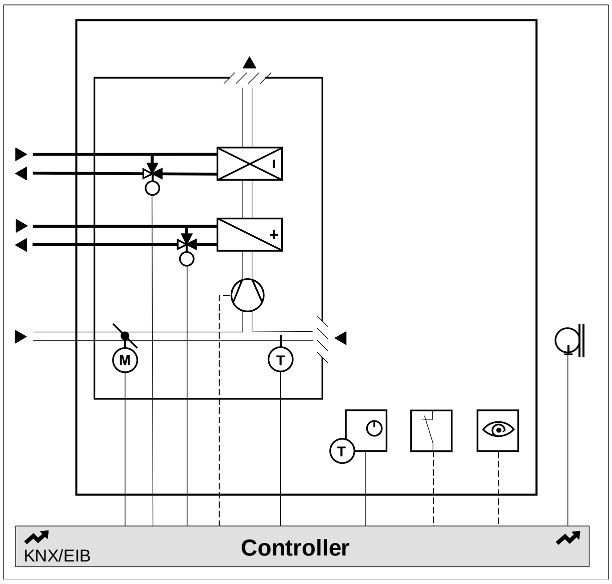


Figure 253: Example: Fan coil system

Application	Name	Controller
FNC02 FNC04 FNC08 FNC20	Two-pipe system with changeover Four-pipe system Four-pipe system with room supply air cascade control Four-pipe system with damper control	RXB21.1/FC-10 RXB39.1/FC-13
FNC03 FNC05	Two-pipe system with changeover and electric reheater Four-pipe system with electric reheater	RXB22.1/FC-12 RXB39.1/FC13
FNC10 FNC12 FNC18	Two-pipe system with changeover and outside air Four-pipe system with outside air Two-pipe system with changeover and radiator	RXB21.1/FC-11

Table 102: Applications for RXB controllers

Common functions:

- Window contact, occupancy sensor, four operating modes
- Manual fan control with room unit
- Automatic fan control (three speeds)
- Options with two-pipe systems: Heating only, cooling or changeover via KNX/EIB bus

18.3.2 RXB and the Management Level

The integration of Desigo RXB into the management level is analogous to the integration of Desigo RXC into the management level.

18.3.3 RXB and the Automation Level

Desigo RXB is integrated into the automation level with the PX KNX system controller, which carries out the same tasks as the LonWorks system controller for Desigo RXC.

18.3.4 RXB Applications

The existing Desigo RXB applications are identical to the RXC applications of the same name. They cannot, however, be modified for a specific project by the user. These applications are preprogrammed by groups in the controller and are selected and parameterized using the ETS Professional commissioning and service tool.

Applications of the same type are grouped into application groups. The technical manual contains the complete range of RXB applications.

See *RXB (KNX) Technical manual* (CM110389).

RXB application library

The RXB application library contains application groups, each of which contains applications of the same type. The RXB application library has a version number which is defined in the RXB Valid Version Set. This Valid Version Set also defines the version of each individual RXB application.

Application groups

Similar application types are grouped into application groups. These differ from each other in terms of how the functions are implemented. Thus chilled ceiling with radiator (CLC02) and chilled ceiling and electric radiator (CLC03) are two different applications within the CLC group. The first of these two applications uses water for heating, while the second uses electrical energy. The difference between applications in the other groups follows a similar pattern.

The following application groups are available for RXB:

- CLC Chilled ceiling applications (not for Synco)
- FNC Fancoil applications
- VAV Variable air volume applications (not for Synco)

Individual applications

The individual application is designed analogous to RXC for typical HVAC systems as commonly used in practice in individual rooms.

Configuring applications

Each application has a defined number of configuration parameters with which the application can be programmed for a specific project. These parameters consist both of general values (for example, temperature setpoints, etc.) and of specific values for the application concerned (for example, changeover configuration, electric reheater, etc.).

18.3.5 Mapping RXB in the PX KNX System Controller

The RXB system is mapped to the PX KNX system controller with objects analogous to RXC. These objects are called discipline I/Os and are components of the block library.

See *PX KNX, RXB integration – S-Mode* (CM1Y9775).

The following types are available for RXB:

- HVAC: Comprises all the HVAC information
- Shared: Contains shared data points (for example, time schedules, occupancy status, etc.)

18.4 Desigo RXL

The Desigo RXL room automation system controls and monitors comfort conditions in individual rooms. It supplies predefined solutions for HVAC.

The range consists of controllers, operator units and predefined applications, which are configured with the HandyTool QAX34.3 or the ACS.

See *RXL Room automation system – system overview* (CM110780).

RXL topology

The Desigo RXL room automation system is based on proprietary technology. To integrate Desigo RXL into the automation level, the RXL data is mapped to BACnet.

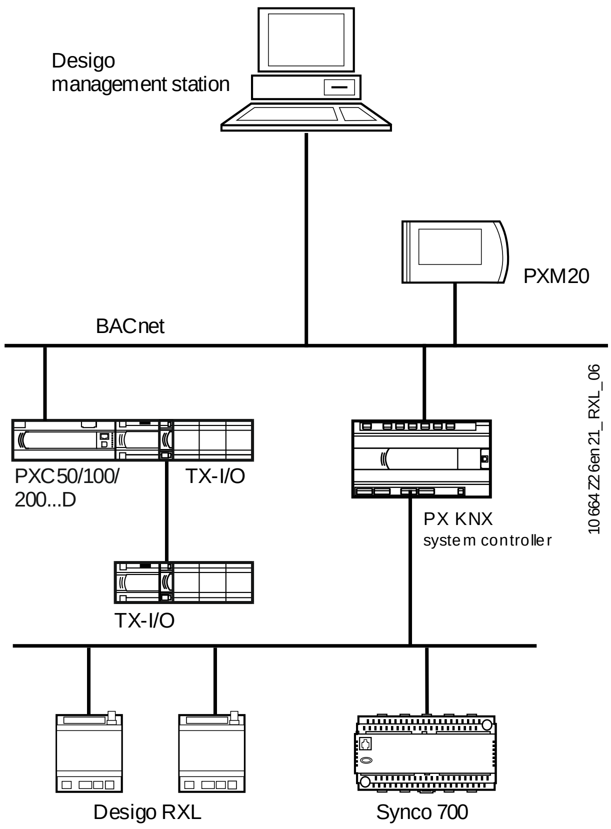


Figure 254: RXL topology

Individual addressing

Individual Addressing is engineering the field level using the HandyTool (QAX34.3) or ACS.

Discipline I/Os

Discipline I/Os are function blocks in the PX KNX system controller that gather data from the RXL controller and make it available on the BACnet network. Discipline I/Os are available for HVAC functions.

Room-based groups

The discipline I/Os representing the RXL controllers in a room are combined in the PX KNX system controller into a room-based group. The result is a room view.

Cross-room groupings

Cross-room groupings contain all the control variables common to a given user grouping (for example, North facade, Tenant A, West zone, etc.) and distribute these control variables to the associated room or group members.

RXB/RXL addressing tool

The RXB/RXL Addressing Tool is a Microsoft Excel workbook with macros for defining the addresses and parameters for the controllers.

See *PX KNX, RXB/RXL integration - individual addressing* (CM1Y9776).

Supergenies

Supergenies are predefined graphics from the graphics library in the Desigo Insight management station. For each RXL application there is a supergenie containing the main data points.

PX KNX system controller

Desigo RXL uses the PX KNX system controller for integration into Desigo. The hardware for this system controller consists of the PXC001(-E).D controller and the loaded PX KNX firmware. Communication takes place via BACnet/LonTalk (PXC001.D) or BACnet/IP (PXC001-E.D). With the system controller you can also integrate the Synco RMU710, RMU720, RMU730 and RMH760 controllers into Desigo.

HandyTool

The QAX34.3 room unit incorporates the HandyTool feature for setting the RXL controller parameters.

ACS Service

ACS is the ACS tool for Synco.

18.4.1 Product Range Overview

Desigo RXL is an innovative and inexpensive range of controllers and room units.

Desigo RXL hardware

The range comprises compact controllers, easy-to-operate room units and controllers in room-style housings. The input and output configurations of the controllers, and the housing style are fully optimized to suit their field of application. The HVAC functions are operated with standard room units or controllers in a room-style housing.

Desigo RXL software

Each controller is loaded with a selection of application software which contains the control program for the associated room or area within a room. The RXL controllers are commissioned with the QAX34.3 commissioning and service tool or with ACS.

Example: Fan coil system

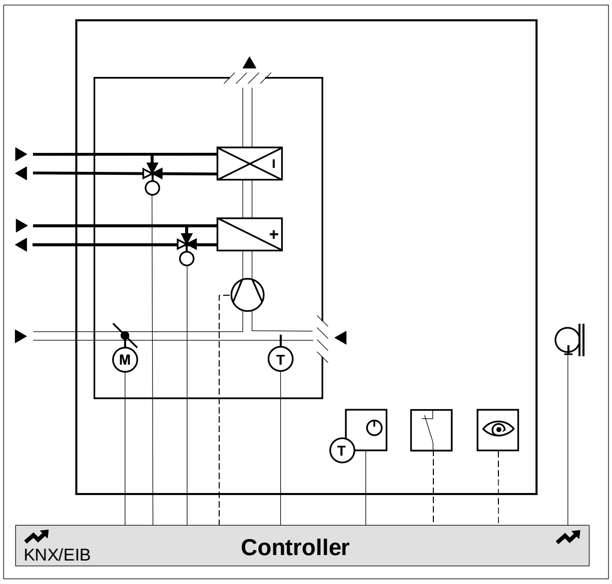


Figure 255: Example: Fan coil system

Application	Name	Controller
FNC02 FNC04 FNC08 FNC20	Two-pipe system with changeover Four-pipe system Four-pipe system with room supply air cascade control Four-pipe system with damper control	RXL21.1/FC-10 RXL39.1/FC-13
FNC03 FNC05	Two-pipe system with changeover and electric reheater Four-pipe system with electric reheater	RXL22.1/FC-12 RXL39.1/FC13
FNC10 FNC12 FNC18	Two-pipe system with changeover and outside air Four-pipe system with outside air Two-pipe system with changeover and radiator	RXL21.1/FC-11

Table 103: Applications for RXL controllers

Common functions:

- Window contact, occupancy sensor, four operating modes
- Manual fan control with room unit
- Automatic fan control (three speeds)
- Options with two-pipe systems: Heating only, cooling or changeover via KNX/EIB bus

18.4.2 RXL and the Management Level

The integration of Desigo RXL into the management level is analogous to the integration of Desigo RXC into the management level.

18.4.3 RXL and the Automation Level

Desigo RXL is integrated into the automation level with the PX KNX system controller, which carries out the same tasks as the LonWorks system controller for Desigo RXC.

18.4.4 RXL Applications

The existing Desigo RXL applications are identical to the RXC applications of the same name. They cannot, however, be modified for a specific project by the user. These applications are preprogrammed by groups in the controller and are selected and parameterized using the QAX34.3 or ACS commissioning and service tool.

Applications of the same type are grouped into application groups. The technical manual contains the complete range of RXL applications.

See *RXL Technical manual* (CM110789).

RXL application library

The RXL application library contains application groups, each of which contains applications of the same type. The RXL application library has a version number which is defined in the RXL Valid Version Set. This Valid Version Set also defines the version of each individual RXL application.

Application groups

Similar application types are grouped into application groups. These differ from each other in terms of how the functions are implemented. Thus, chilled ceiling with radiator (CLC02) and chilled ceiling and electric radiator (CLC03) are two different applications within the CLC group. The first of these two applications uses water for heating, while the second uses electrical energy. The difference between applications in the other groups follows a similar pattern.

The following application groups are available for RXL:

- CLC: Chilled ceiling applications
- FNC: Fan coil applications
- VAV: Variable air volume applications

Individual applications

The individual application is designed analogous to RXC for typical HVAC systems as commonly used in practice in individual rooms.

Configuring applications

Each application has a defined number of configuration parameters with which the application can be programmed for a specific project. These parameters consist both of general values (for example, temperature setpoints, etc.) and of specific values for the application concerned (for example, changeover configuration, electric reheater, etc.).

18.4.5 Mapping RXL in the PX KNX System Controller

The RXL system is mapped to the PX KNX system controller with objects analogous to RXC. These objects are called discipline I/Os and are components of the block library.

See *Desigo TRA: QMX3... Engineering and commissioning guide* (CM111044).

The following types are available for RXL:

- HVAC: Comprises all the HVAC information
- Shared: Contains shared data points (for example, time schedules, occupancy status, etc.)

19 Desigo Open

Desigo Open lets you integrate devices and systems from different manufacturers into the Desigo system. Integration with Desigo Open offers:

- Standardized automated functions, operating and monitoring of the entire building
- Single-station operation, common view and display. Simplified multidisciplinary operation, common reporting and common alarm management.
- Peer-to-peer interaction, communication on the automation level, automated interactions and data exchange
- Comfort combined with lower energy consumption. New opportunities to save energy with systems that communicate among themselves. Improved performance, efficiency evaluation, flexibility and ability to modify system operation and configuration without re-cabling or new hardware.
- Engineering of integrated solutions in Xworks Plus (XWP)
- Reduced risk thanks to standard solutions. Clear functions that cover the most important standard protocols.

Topology

Third-party devices and systems can be integrated with Desigo on all levels.

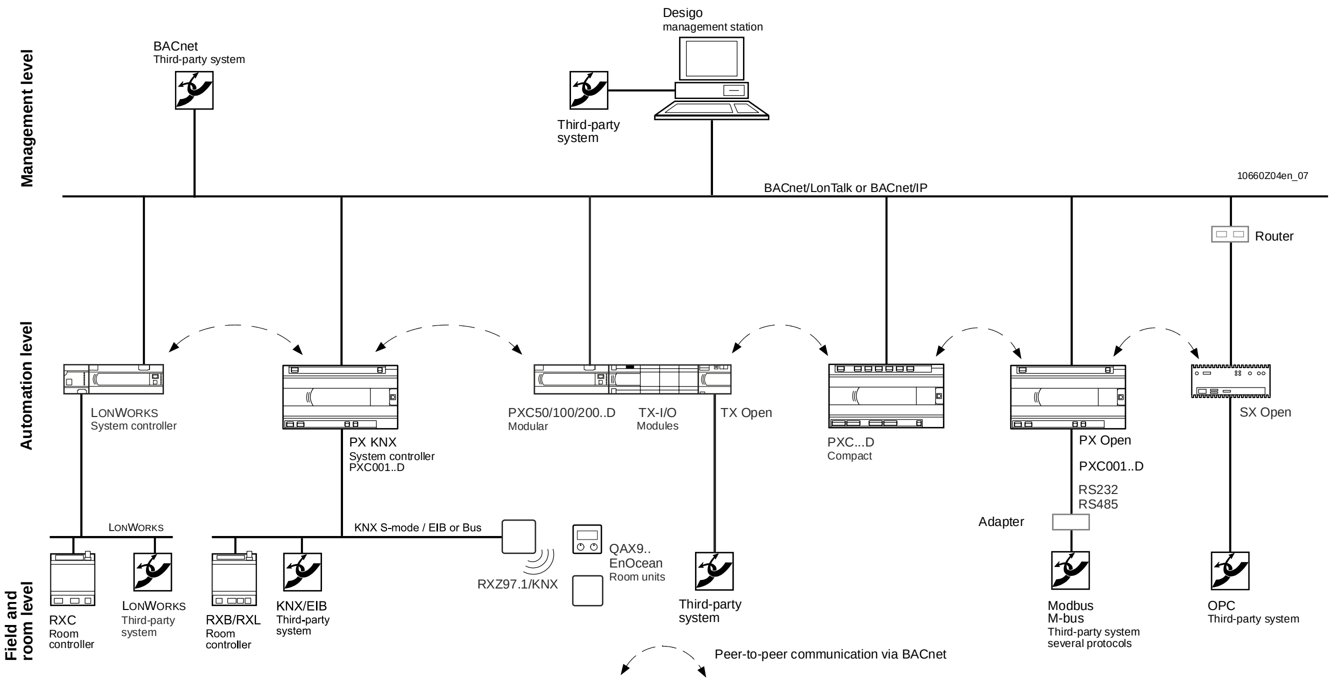


Figure 256: Topology

Which protocols does Desigo support?

Desigo Open System	Protocol
Management station	SCADA, etc.
SX Open	OPC to BACnet
PX Open	Modbus, KNX/EIB, LonWorks, M-Bus, SCL, etc.
TX Open	Modbus, M-Bus, GENIbus, etc.
Room level (Desigo Room Automation and RX)	DALI, KNX, EnOcean, LonWorks

Table 104: Supported protocols

Which plant sections can be integrated into Desigo on which level?

Desigo Open system	Desigo Open application	Data points
Desigo management station	CC, Insight Open, SX Open Energy monitoring, fire security, access control and security	1,000 - 10,000
Desigo PX	SX Open, PX Open Power distribution, refrigeration machines	50 - 2,000
Desigo TX-I/0	TX Open Pumps, variable speed drives, meters, etc.	Max. 160
Desigo Desigo Room Automation / RX	PXC3 Lighting and blinds	16 DALI groups

Table 105: Integration of plant sections

Desigo Insight is the current management station, Desigo CC is the new management station.

SDKs

If a solution is not supported by HQ and RCs need a specific solution, HQ offers Software Development Kits (SDKs) for experts. The regional companies can develop their own solutions using Software Development Kits (SDKs).

The following SDKs are available:

- PX Open platform SDK
- TX Open platform SDK

19.1 Integration on Management Level

The integration of third-party devices and systems on the management level is appropriate:

- For monitoring and operating plants that are not time-critical
- When process communication with other automation stations is not needed

19.1.1 Desigo Insight

The Desigo Insight Open OPC platform allows the exchange of information between the Desigo management level and third-party systems and devices. OPC is a standard way of connecting software using Microsoft DCOM (Distributed Component Object Model) technology.

The Desigo Insight Open OPC platform supports the Data Access Custom Interface V1.0a and V2.03 OPC service.

See *OPC Platform* data sheet (CA1N9751).

Citect drivers

The third party integration into Desigo Insight is based on Citect drivers.

Networking with OPC

There are two ways of networking using OPC:

- For systems with several management stations: One management station can have both the OPC server and the OPC client. The other management stations receive the data via the Desigo Insight I/O server.
- For systems with one management station: If the OPC server and OPC client cannot be on the same management station, you can use one PC with the OPC server and another PC with Desigo Insight and the OPC client. They will communicate via Ethernet using Microsoft DCOM.

OPC Import Tool

The OPC import tool:

- Facilitates the import of OPC data into Desigo Insight
- Allows the visualization of third-party automation systems by using the OPC technology
- Automates the process of creating Citect databases and setting-up the Citect communication forms

The Citect data is then imported into the Desigo Insight database to allow seamless integration with the third party automation system.

See *OPC Import Tool User's Guide* (CA1Y9751).

EIB client

The Insight Open EIB client is a standard integration solution for the communication and exchange of information between Desigo Insight and an EIB network, based on the OPC standard.

See *EIB client* data sheet (CA1N9752).

BACnet client

The Insight Open BACnet client is a standard integration solution for the communication and exchange of information between Desigo Insight and a BACnet network. OPC forms the basis of the solution.

See *BACnet client* data sheet (CA1N9753).

LON client

The Insight Open LON client is a standard integration solution for the communication and exchange of information between Desigo Insight and a LonWorks network. OPC forms the basis of the solution.

See *LON client* data sheet (CA1N9754).

Simatic S7

The Insight Open Simatic S7 solution is a standard integration solution for the communication and exchange of information between the Simatic S7 PLC and Desigo Insight. OPC forms the basis of the solution.

See *Simatic S7* data sheet (CA1N9756).

19.1.2 Desigo CC

BACnet

BACnet is a widely used communication protocol for building automation and control networks. It defines a number of objects, services and data link layers. It is an essential part of Desigo CC's openness for integrating any third-party devices, using the BACnet/IP protocol. An online auto-discovery and alternatively an offline EDE import are available for integrating third-party devices.

See *BACnet 3rd party Integration Guide* (A6V10446271).

BTL

Desigo CC is compliant with BACnet revision V1.13 of the latest BACnet Standard 135-2012. The compliance and interoperability has been tested. For more information, see (http://www.bacnetinternational.net/btl).

Modbus-TCP

A native Modbus-TCP driver lets you integrate a Modbus TCP server and subsequent Modbus RTU devices via a protocol converter. An offline importer supports the engineering workflow for integrating Modbus data points.

See *Modbus Integration Guide* (A6V10438039).

OPC

OLE for Process Control (OPC) is a communication standard for exchanging data between windows based software applications and process control hardware without any proprietary restrictions. It is a client/server technology, where one application acts as the server providing data, and another acts as a client using data. The most common specification *Data Access* (DA) defines a set of objects, interfaces and method to facilitate the interoperability. OPC has been extended to become a cross-platform communication standard, named OPC Unified Architecture (OPC UA).

For more information about OPC, see the documentation by the OPC Foundation (www.opcfoundation.org) and the OPC Training Institute (www.opcti.com).

OPC DA client

An OPC client interface lets you integrate any OPC server, using the Data Access specification. An offline Importer supports the engineering workflow to integrate OPC items.

See *OPC Server Integration Guide* (A6V10415483).

OPC DA server

An OPC server option provides a freely configurable set of data points for integration in any enterprise system, using the OPC DA standard. Each data point (object) is represented by several OPC items, providing the relevant readable and writable object property information.

See *OPC DA Server Manual* (A6V10415485).

The Desigo CC OPC server is officially tested and certified by the OPC foundation (https://opcfoundation.org/products/view/251).

OPC UA server

OPC Unified Architecture (OPC UA) clients can connect to the Desigo CC OPC DA server using the OPC DA/UA wrapper, provided with the Desigo CC setup. The UA wrapper meets the security model of mutual authentication for a trusted connection between the OPC UA server and the OPC UA client.

See *OPC DA Server Manual* (A6V10415485).

Simatic S7

A native S7 Ethernet driver lets you integrate S7-300 and S7-400 or S7-400H PLC. You can use the CP for Ethernet or the built-in PNIO interface on the S7 hardware. An offline importer supports the engineering workflow for integrating S7 data points.

See *Simatic S7 Integration Guide* (A6V1042787).

SNMP

Simple Network Management Protocol (SNMP) is a data communication protocol for monitoring devices and applications on a network. It is an Ethernet based protocol for retrieving management data from networked devices, and exposing this data as properties.

SNMP gives you the capability to monitor a device, for example, a printer or UPS, which is not directly configured on a computer, but can be reached through a network link.

Device monitoring capabilities are provided by device manufacturers via a Management Information Base (MIB) text file, which describes the structure of the device management data. MIB files use a hierarchical namespace containing object identifiers (OID). Each OID identifies a property that can be read or written via SNMP.

Desigo CC has an SNMP Manager feature for reading and writing information from SNMP agents.

See *SNMP Application Guide* (A6V10455382).

Web services

Using RESTful technology, Desigo CC provides alarm, object and time series data via web based services for supervising management stations or other third-party external applications.

19.1.3 SX Open

SX Open is a configurable third-party system - BACnet/IP gateway. It allows the data exchange between third-party systems and the Desigo system in an IP network. That means, Desigo automation stations (peer-to-peer communication) or a BACnet management station. Multiple BACnet servers can be defined in the gateway and third-party data points can be mapped to standard BACnet objects. The mapping supports functional and signal mapping. Alarms, trends and schedules can be defined in the BACnet server. With SX Open you can integrate any number of data points. There are two application types.

SX API

SX API is the basic software with an Application Programming Interface (API). With the API you can independently develop other applications using Microsoft® Visual Studio, if necessary. This lets you integrate other third-party systems, protocols, and drivers.

SX OPC

The predefined SX OPC application contains an OPC DA client that can connect to respective OPC servers of the third-party system and map their domain to the respective BACnet objects and properties.

Engineering

Engineering is carried out with the SX Configurator (a predefined Excel sheet) in which the allocation of OPC objects and BACnet objects can be configured line by line. You can also enable additional functions, such as alarm, scheduler, trend and individual mapping functions.

See *SX OPC SX Configurator User's Guide* (CM110702) and *SX Open Engineering Guideline* (CM110700).

Licensing

SX Open is available for both application types in four different license models, graded according to the number of BACnet I/O and value objects.

- Tiny for up to 200 BACnet objects
- Light for up to 2,000 BACnet objects
- Regular for up to 5,000 BACnet objects
- Full for up to 20,000 BACnet objects

The license is linked with the hardware in use (the physical MAC address). A registry key is generated with the license. The licenses can be ordered and downloaded via CGU Web.

All third-party software is available directly from the appropriate producer as described in the application guide. The number of configured BACnet objects are relevant for licensing.

Installation

SX OPC operates under Microsoft Windows. The SX OPC setup file including the function block library and the SX OPC documentation can be downloaded from the intranet.

See *SX Open* data sheet (CM1N9745).

19.2 Integration on Automation Level

The integration of third-party devices and systems on the automation level is appropriate when:

- Cross-communication to other PX or BACnet devices is needed
- System functions (for example, alarms, trends, schedulers) are needed

The PX Open Platform comprises:

- PXC001.D system controller for the integration of KNX, Modbus, M-Bus and SCL via BACnet/LonTalk
- PXC001-E.D system controller for the integration of KNX, Modbus, M-Bus and SCL via BACnet/IP
- PXA40-RS1 and PXA40-RS2 option modules for additional data points

The automation stations have interfaces to RS232, RS485 and KNX.

Xworks Plus (XWP) is used to engineer all solutions. Various compounds and blocks are available.

PXC001..D supports the firmware versions V4.1, V5.0, V5.1 and V6.0.

The following solutions on the PX Open platform are available:

- PX KNX
- PX Modbus
- PX M-Bus
- PX SCL
- PX RS-Bus
- PX Pronto
- PX Open Plattform (SDK)

Data points

	PXC001.D	PXC001-E.D	PXA40-RS1	PXA40-RS2
PX KNX	2,000	2,000	N/A	N/A
PX Modbus	250	250	800	2,000
PX M-Bus	250	250	800	2,000
PX SCL	250	250	800	1,000
PX RS-Bus	2,000	2,000	N/A	N/A
PX Pronto	2,000	2,000	N/A	N/A

Table 106: Data points

The platform for integrating LonWorks compatible third-party devices consists of:

- System controller PXC00.D and automation station PXC50.D, PXC100.D or PXC200.D for integrating LonWorks devices via BACnet/LonTalk
- System controller PXC00-E.D and automation station PXC50-E.D, PXC100-E.D or PXC200-E.D for integrating LonWorks devices via BACnet/IP
- PXX-L11 and PXX-L12 expansion modules for 60 and 120 LonWorks devices

PXC00..D with PXX-L11/L12 supports the firmware versions V4.1, V5.0, V5.1 and V6.0.

PXC50..D, PXC100..D and PXC200..D with PXX-L11/L12 support the firmware versions V5.0, V5.1 and V6.0. For information about the system limits, see chapter *System Configuration*.

PX KNX

PX KNX connects KNX networks with Desigo and maps the group addresses to BACnet datapoints. PX KNX can handle the following main tasks:

- Data compression on the automation level (group functions)
- Time control
- Alarming, device monitoring
- Trend storage
- Mapping the Desigo RXB and RXL applications to BACnet for operating and monitoring

PX KNX supports the integration of:

- KNX S mode third-party devices
- RDF, RDG and RDU room thermostats
- RXB and RXL room automation stations

The PXC001.D system controller can integrate KNX via BACnet/LonTalk. The PXC001-E.D system controller can integrate KNX via BACnet/IP. PX KNX is preinstalled on PXC001..D controllers.

PX Modbus

PX Modbus connects Modbus devices or networks supporting the Modbus protocol to the Desigo system and maps their data points to BACnet data points. PX Modbus is particularly suitable for integrating industrial controls or chillers and linking them to the automation process.

The PXC001.D system controller can integrate Modbus via BACnet/LonTalk. The PXC001-E.D system controller can integrate Modbus via BACnet/IP. The PXA40-RS1 and PXA40-RS2 option modules support additional data points.

See *PX Modbus* (CA2N9772).

PX M-Bus

PX M-Bus connects the M-Bus consumption meters to the Desigo system and maps meter readings and device-related meter information to BACnet data points. PX M-Bus handles the following main activities:

- Measurement of consumption data and remote monitoring of max. 250 consumption and heat meters
- Compression of data from consumption and heat meters at the automation level

- Alarm handling, device monitoring
- Trend storage to record meter readings

The PXC001.D system controller can integrate M-Bus via BACnet/LonTalk. The PXC001-E.D system controller can integrate M-Bus via BACnet/IP. The PXA40-RS1 and PXA40-RS2 option modules support additional data points.

See *PX M-Bus* (CM2N9774).

PX SCL

PX SCL lets you quickly develop simple protocol solutions. The script control language from XWP is used with an interpretable environment and lets engineers create a solution. The solution cannot be used for complex protocols and solutions. It is used to develop other applications, such as local serial printer driver and pager applications.

The PXC001.D system controller can integrate SCL via BACnet/LonTalk. The PXC001-E.D system controller can integrate SCL via BACnet/IP. The PXA40-RS1 and PXA40-RS2 option modules support additional data points.

The regional companies develop the necessary protocols themselves.

The hotel management system Fidelio can be integrated into Desigo via PX SCL.

See *PX SCL* (CA2N9773).

PX LON

PX LON connects LonWorks networks to Desigo and maps Standard Network Variables (SNVT) to BACnet data points. The main functions of PX LON are:

- Compression of Desigo RXC room automation stations and third-party data
- Mapping Desigo RXC applications to BACnet for operation and monitoring (grouped as HVAC, lighting and blind control functions)
- Higher-level control and optimization functions, such as room and zone-based groups, time control, and system functions, such as changeover, summer/winter compensation, etc.
- Alarm handling, device monitoring
- Trend storage

PX LON maps RXC applications in such a way as to produce a room view. This enables the rooms to be grouped together, for example, for shared occupancy programs, or for shared commands for the control of lighting or blinds.

The PXC00.D system controller and the PXC50.D, PXC100.D and PXC200D automation stations can integrate LonWorks devices via BACnet/LonTalk. The PXC00-E.D system controller and the PXC50-E.D, PXC100-E.D and PXC200-E.D automation stations can integrate LonWorks devices via BACnet/IP. With the PXX-L11 and PXX-L12 expansion modules you can connect 60 and 120 devices.

PX Open Platform SDK

HQ provides the PX Open Platform Software Development Kit (SDK) for experts in the regional companies.

19.3 Integration on Field Level

The integration of third-party devices and systems on the field level is appropriate:

- For communicative pumps, meters, etc.
- For small numbers of data points (10 to 100/160 data points)

TX Open is suitable for the integration of a few data points (from 10 to 160 data points). These data points can be processed further in the automation system or used for visualization in the management station.

- The current TX Open module TXI1.OPEN supports up to 100 data points and has an RS232/RS485 interface.
- The new TX Open module TXI2.OPEN supports up to 160 data points and has in addition an ethernet connection for remote access, diagnosis and remote engineering.

The TXI1.OPEN or TXI2.OPEN module is loaded with the protocol applications for Modbus/M-Bus/GENIbus/G120P and then works as the Modbus/M-

Bus/USS/GENIbus master. The values of the Modbus/M-Bus/GENIbus/G120P data points and the status of the existing data connection with the data points are transmitted to the automation station via the island bus and mapped to BACnet objects in the automation station. This way, the Modbus/M-Bus/GENIbus/G120P data points can be made available to all the devices and applications in the Desigo system.

The PXC50..D, PXC100..D and PXC200..D automation stations support TX Open. You can attach up to five TX Open modules to one PXC automation station.

Xworks Plus (XWP) is used to engineer all solutions. Various compounds are available, for example, for pumps, variable speed drives and heat meters.

Predefined solutions allow for simple commissioning. Solutions for Grundfos, Wilo, Danfoss and G120P are delivered as part of the HQ CAS Library. For M-bus and Modbus, sample solutions serving as device description templates are provided (TX Open templates).

The following solutions on the TX Open platform are available:

- TX Modbus
- TX M-Bus
- TX G120P/SED2
- TX Grundfos via GENIbus
- TX Open platform (SDK)

TX Modbus

TX Modbus supports Modbus RTU, Wilo pumps and variable speed drives. TXI2.OPEN supports 160 data points. They may be distributed in any fashion to the devices for the Modbus system. The number of devices is only limited by the 160 data points.

See *TX Modbus Engineering Guide* (CM110571).

TX M-Bus

TX M-Bus supports templates for meters. The regional companies can create templates. You need a level converter for TX M-Bus. TXI2.OPEN supports 160 data points. They may be distributed in any fashion to the devices for the M-bus system. The number of devices is only limited by the 160 data points.

See *TX M-Bus Engineering Guide* (CM110572).

TX G120P

TX G120P supports the integration via the Modbus and USS protocol. You can integrate up to eight G120P variable speed drives per TX Open module into the Desigo system.

See *TX G120P Engineering Guide* (CM110576).

TX SED2

TX SED2 supports the integration via the USS protocol. You can integrate up to eight SED2 variable speed drives per TX Open module into the Desigo system.

You can add new G120P variable speed drives to an existing TX Open (USS) with already installed SED2 drives, for example, when:

- A defective SED2 needs to be replaced with a G120P in an existing project
- An existing project with installed SED2 drives needs to be extended with a new G120P

See *TX SED2 Engineering Guide* (CM110573).

TX Grundfos via GENIbus

TX Grundfos supports the integration of Grundfos via GENIbus. You can integrate up to eight Grundfos pumps into the Desigo system.

See *TX Grundfos / GENIbus Engineering Guide* (CM110574).

TX Open Platform (SDK)

HQ provides the TX Open Platform Software Development Kit (SDK), including training, for experts in the regional companies. The training course provides the necessary tools and knowledge to create new protocol applications.

19.4 Integration on Room Level

See chapter *Network Architecture*.

20 Solutions for Critical Environments

Desigo Insight Pharma solution (DIPS) is a key component of the Siemens Compliance Solution and provides support for secure lifecycle management of the most important electronic data sets. Together with the InfoCenter Suite, DIPS provides a comprehensive solution for managing electronic data sets while simultaneously maintaining the highest level of compliance requirements.

DIPS offers additional functionality for data security and tracing required of Desigo Insight to meet FDA regulation 21 CFR Part 11.

InfoCenter Suite is an instrument to archive, administer and log business-critical data for compliance reports. InfoCenter Suite was specially developed for critical installations with high amounts of data, offline storage requirements and special client access requirements. The functions are primarily designed for the security and management of valuable information and compliance with compliance regulations.

20.1 Desigo Insight Pharma Solution (DIPS)

The Desigo Insight Pharma Solution (DIPS) is an integral part of Desigo Insight.

Database audit trail for GxP critical data

The audit trail functionality monitors and logs any insertion, update or deletion of GxP critical data in Desigo Insight as well as data, stored in the audit trail, trend or system activity log databases.

See *Desigo Insight - Audit trail for critical environments* (CM110796).

Actions triggered by Desigo Insight applications are logged in a system activity log and do not impair audit trail performance. Attempts to manipulate data of actions triggered by external clients are logged by the audit trail.

See *Desigo Insight - Operating the management station* (CM110588).

Database Audit Viewer

The database audit view allows user to display, search and filter the online audit trail. The application is used to generate audit reports that can be printed as well. Layout and report contents encompass the same data and structures as the viewer's operator interface.

The user can use the view to display database audit trail information from the online database as well as archived audit trail data (for example, XML archive file produced by a previously existed Pharma solution). The results of the MD5 checksum verification are issued and integrated in the report when displaying the archived data.

Standard report templates are available allowing the user to created ad hoc of planned reports - based on the audit trail of system activity (log) data in PDF format, for example. Reports may also be generated from the archived data.

Expanded data backup of all databases

Desigo Insight supports the system's ability to be restored. Hourly backups of all database transaction logs and complete, daily database backups that significantly reduce any potential data loses during a system failure.

The backup files are used to restore a system after a system failure. The procedure for restoring is documented per industry requirements. So that the system can be fully restored to the state prior to the system failure.

The expanded data backup functionality requires a Windows server operating system. The function can be used for all Desigo Insight project types that meet these requirements – no dependent on other DIPS functions.

Data archiving in XML

The aforementioned audit trail is archived automatically per customized settings for archiving time and data storage period. The archived data is available as an option in a readable from (XML). This open data format ensures that electronic data sets is available during the entirety of the data storage period – often decades – by the industry. The validity of the data can be verified via a MD5 checksum.

For trending and system activities in Desigo Insight, the XML archiving methods can be used as an option for open long-term alternative to the archiving as part of Desigo Insight.

Mandatory comments for user acts

The option Mandatory Comments is supported exclusively together with Desigo PX (PXC...D).

For projects in a critical environment, the user must enter a comment (reason) for each change made on the management station, before the change is executed. Multiple comments are possible for the same actions (or log entry), and comments can no longer be changed once they are entered.

Mandatory comments can be switched on or off via the System Configurator. The function can be used for all Desigo Insight project types – not dependent on other DIPS functions.

Technical principles

DIPS Insight protects the GxP-relevant data from unauthorized access at database level. This ensures that GxP-relevant data cannot be altered after the fact. However, should someone be able, for whatever reason, to access the data, any changes made by that person are recorded in a separate audit trail.

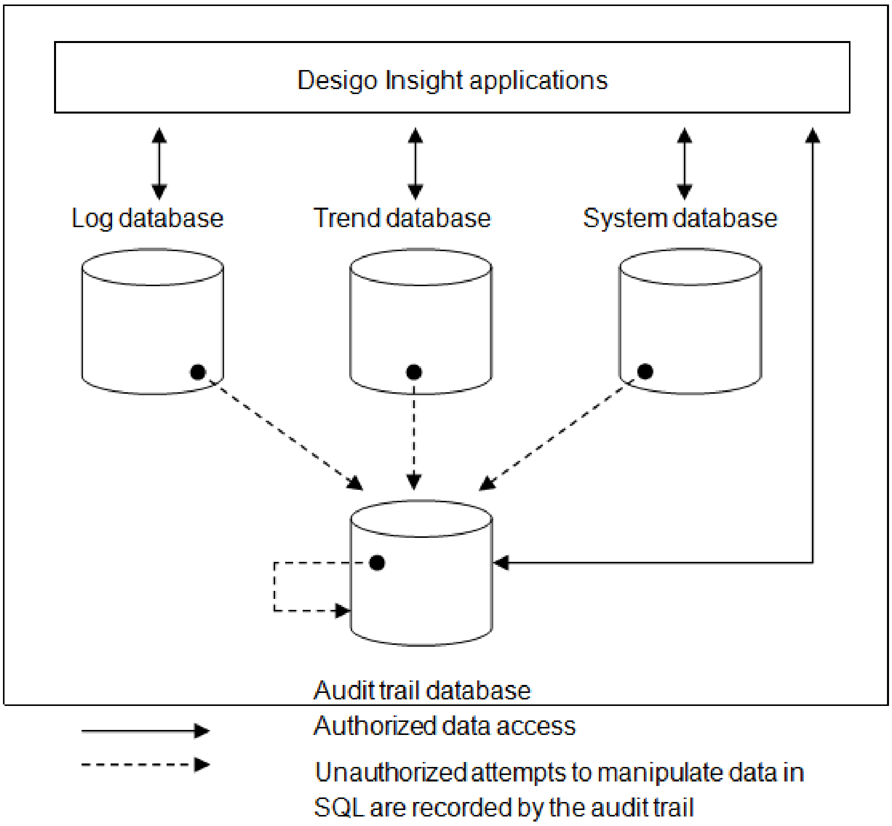


Figure 257: Desigo Insight Pharma Solution (DIPS)

Each attempt to breakthrough database security, is registered and all changes made are annotated in the audit trail database per FDA requirements.

Desigo Insight can always access the Audit, Log, Trend and System databases.

The audit trail database is an integral part of the Desigo Insight project and is thus installed with the other databases on the same server.

If Desigo Insight is installed on the same server as InfoCenter, you need a second SQL license, even if InfoCenter has its own SQL license.

The InfoCenter SQL license applies only for InfoCenter and cannot be used for other software which also requires an SQL server.

User access to Database Audit Viewer

All information via the audit trail can be viewed using the database audit viewer. Users authorized to start the view are set in the System Configurator as all other Desigo Insight applications.

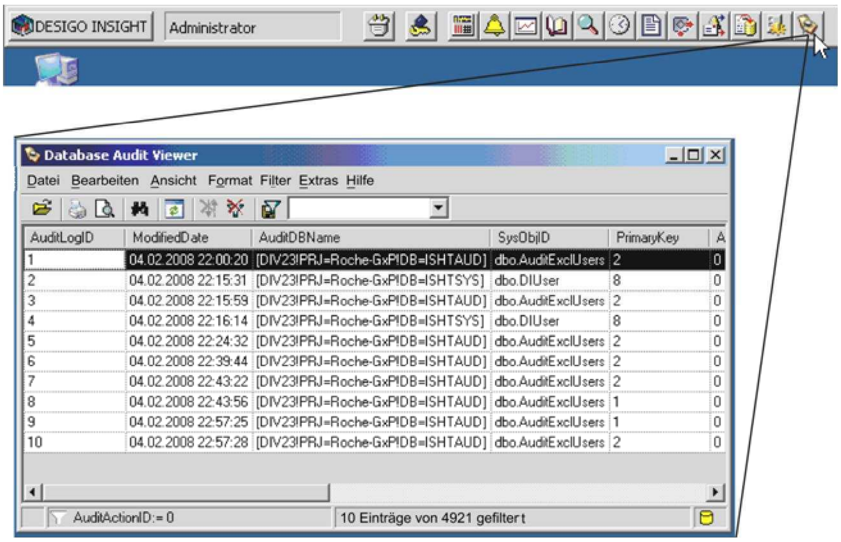


Figure 258: Database Audit Viewer

You can use the viewer to create report on individual events.

20.2 InfoCenter Suite

The main functions of InfoCenter Suite are:

- Secure GxP data logging
- Management, archiving and queries
- Report generation and exception reports
- Supports digital signatures

InfoCenter can log and administer the following data from Desigo Insight:

- Trend data (offline trend)
- Alarm data
- System activities in the log database including user actions

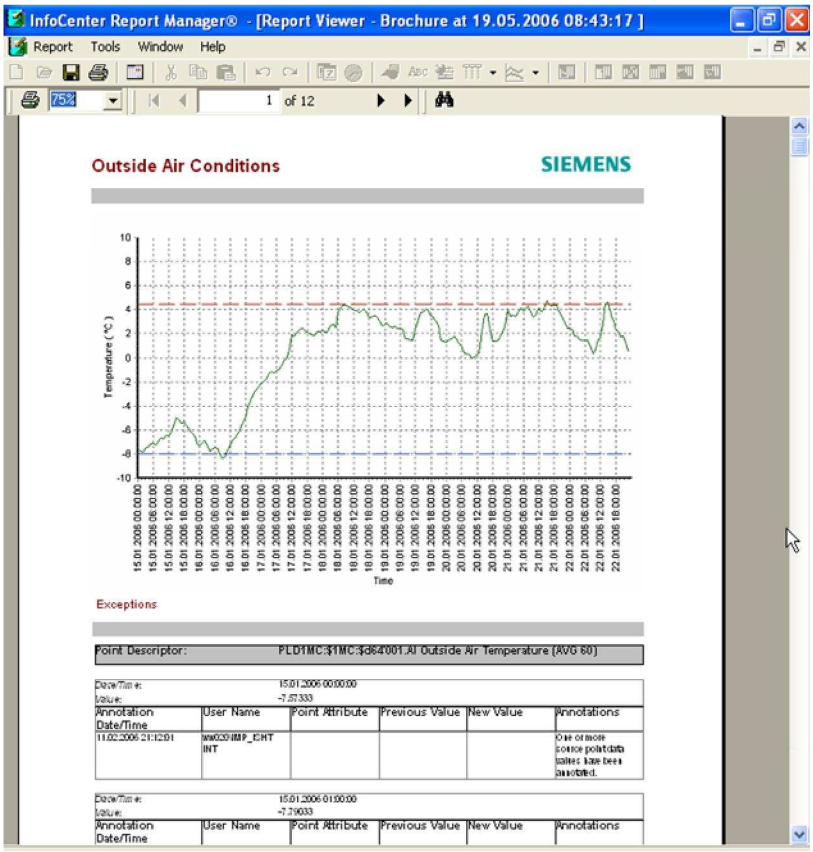


Figure 259: InfoCenter Report Manager

Software components

The InfoCenter Suite consists of the following software components:

- InfoCenter Server
- InfoCenter Administrator
- InfoCenter Report Manager
- InfoCenter web and spreadsheet clients

Server

The server serves as an interface between client applications and the Microsoft SQL server database where the information is stored. The SQL server database engine offers an open, flexible platform for all data storage requirements. Close integration with the SQL server enables an integrated and trouble-free installation procedure where five client software licenses for end users are available with InfoCenter.

Administrator

InfoCenter Administrator is a client application for the management and administration of information in the InfoCenter Server. Activities:

- Administer access to data in the InfoCenter
- Define data logging and program the time period
- Create derived points, including MKT and formula calculations
- Comment on and change data and management of the audit trail
- Administer archiving
- Administer and review audit trail and comments

Report Manager

The InfoCenter Report Manager represents the interface for queries to the InfoCenter Server and generates reports based on configurable templates. Report objects may include bars, columns, scatter and Venn diagrams and min/max lines, fonts and sizes, colors and definitions for the axes. Reports with precise data/time information and text fields can be created together with table objects. The statistic table object calculates and derives critical data to quickly recognize performance problems.

Alarm analysis report generation serves to recognize problems for alarms and to compile critical alarm data and statistics. Each point include the number of alarms, their length each and the highest alarm stage. Statistics for each point include the average alarm time, the longest alarm time and highest achieved alarm stage.

Reporting based on exception offers users only relevant information without displaying all the data. Such exceptions can be encoded in red to immediately see when a point exceeds or drops below the defined range. Altered or commented data, or data with an unusual quality attribute are also recorded in report.

Access and security

The InfoCenter Server acts as the interface between the client applications and the SQL server database. The InfoCenter Server administers all application-specific Windows Services and the communication between the client applications and Microsoft SQL server.

Integrated security protocols in the Windows Server combined with the functions ensures the integrity of the information controlled by the InfoCenter Suite. Integrated security means that the data in the InfoCenter database meets the audit standards FDA 21 CFR Part 11 for electronic data sets and signatures.

A hierarchical tree of all data points allow users to search data based it user requirements rather than being forced to work with a fixed technical system structure. Access rights to point information via InfoCenter Report Manager, web and spreadsheet clients are set in the InfoCenter Administrator. This ensures that users see on the data required for their work.

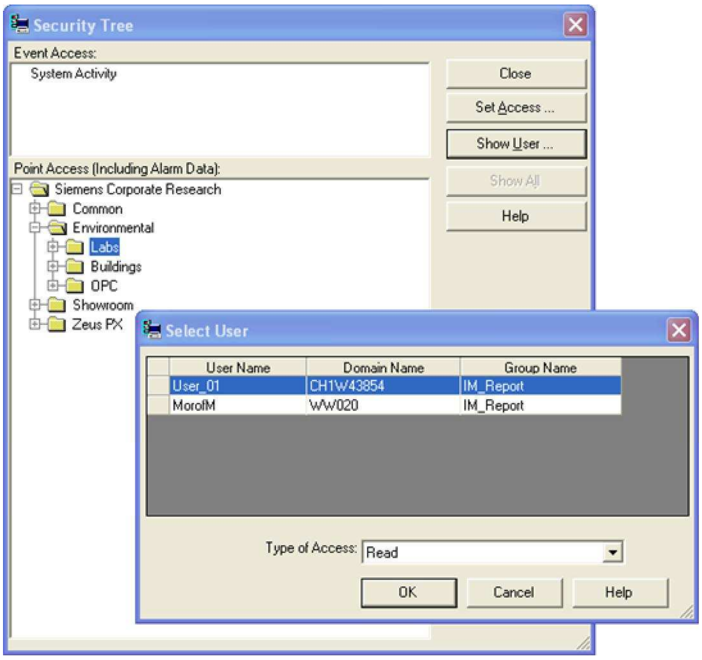


Figure 260: InfoCenter Security Tree

Report templates and the generated reports can be released for joint use or access can be limited by assigning them to certain users.

Digital signatures

Reports in the InfoCenter Suite can be generated in PDF format and stored electronically. The Report Manager opens the appropriate program (for example, Adobe Acrobat) when an electronic report is displayed as a PDF.

Add-ins in Adobe Acrobat support a digital signature of these reports, while InfoCenter Suite takes care of report security and corresponding management. The main signature functions in the Adobe Acrobat interface includes verification of signature, tracing changes to reports and comparing report versions.

Audit trail

Expanded functions in the InfoCenter Administrator ensure detailed and secure tracing of changes in data for audits.

All previous changes are saved in the system so that auditors and end users can view the revision history for a specific point at any time. Each entry or change includes Windows account users, date, time and reason for the change.

Spreadsheet

Microsoft Excel and InfoCenter Server together provide effective data analysis and report options for the InfoCenter Suite. The InfoCenter spreadsheet is an add-on to Microsoft Excel to dynamically query data in the InfoCenter directly from the Excel interface.

See *Infocenter Spreadsheet* (149-198P25eu).

21 Data Evaluation and Reporting (ADP/CC)

Energy management in the building is becoming more important. Furthermore, a high degree of availability and optimum use of operational and process data takes on an increasingly greater roll.

Advanced Data Processing (ADP) guarantees the complete processing and display of all data stored long term in the PDM database and generates powerful reports in any number of combinations and over adjustable time periods. The reports can be displayed and printed in various forms.

Consumption Control (CC) lets you respond quickly to changes in prices or in building use. In this process, CC takes account of seasonal or environmental influences and creates meaningful reports, which can be used as a basis for energy-saving measures.

21.1 Advanced Data Processing (ADP)

Advanced Data Processing (ADP) guarantees the complete processing and display of all operational data.

See *Advanced Data Processing* (CM2B8705).

ADP can be used to analyze the optimization potential of a property. It supports efficient and economic building operation. High availability and optimum use of data for the building automation and control systems are of particular importance.

ADP generates powerful reports based on the data stored in the PDM database in any combination over a selectable time period. The reports can then be displayed and printed in various forms.

See *Process Data Manager* (CM2B8736).

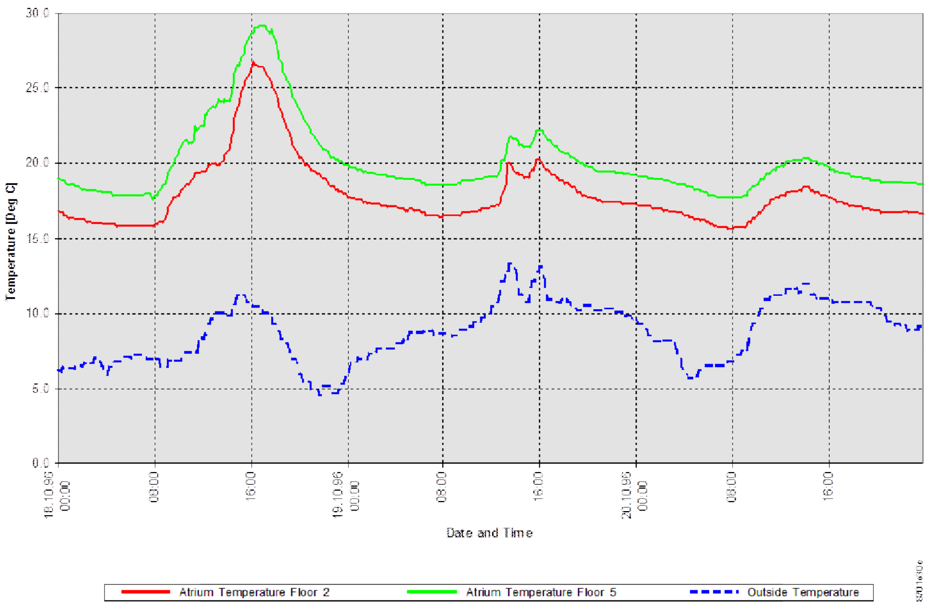


Figure 261: A comparison of temperature characteristic curves

With the aforementioned properties, ADP has significantly expanded possibilities vis-à-vis the report function in the Report Viewer, which is provided as a standard feature with Desigo Insight.

Strengths of ADP

The ADP program displays process data:

- ADP analyzes operational weaknesses and monitors and evaluates the appropriate optimization measures. It allows energy efficient and transparent building operation.
- Visualization of process data using graphic images or tables or combination of both forms. ADP offers an integrated worksheet program. You can export data to Microsoft Excel.
- The program offers documentation on compliance with required operating states, emission laws and production conditions.
- Long-term data evaluation: As part of documentation required under ISO9000, you can query long-term archived operational data at any time and process it as ADP reports.
- The program offers report templates to efficiently generate ADP reports.
- Simple calculation of consumption and costs.
- Strong integration and high degree of consistency with Desigo Insight:
  - Uniform database and licensing
  - Consistent operation and display of ADP trend reports and in the Desigo Insight Trend Viewer
  - ADP reports can be queried by Desigo Insight Plant Viewer with a simple click of the mouse.

Main functions

As shown in the figure below, all building data required by ADP is available in the PDM database. ADP lets you visualize the data individually or in any combination.

ADP has six main functions:

- Report definition:
  - Comprehensive calculations for trend data
  - Define data series where the data is compiled and displayed in reports for comparison purposes.
  - Define report display formats (lists, tables, Excel and trend).
  - Define time trigger for a report.
- Report display:
  - Reports can be displayed or printed manually or automatically at predefined times.
  - The time period, that is, the time and date range to be covered by a report and the report start time can be freely selected.
- Simple and fast access:
  - The reports can be run and printed using Internet Explorer in a Web display format (Trend + Table).
  - Simply click a desktop link to run the reports.
- Access via Web
- Support of contractibility (Scopes)
- Quickly restores archive data thanks to a data-series oriented archive

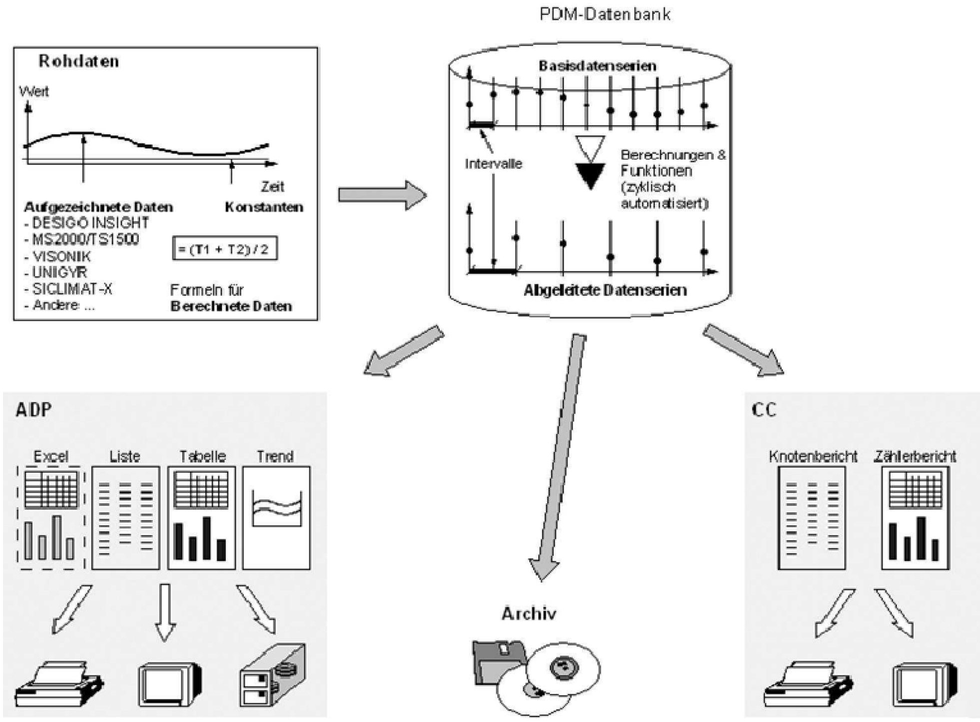


Figure 262: All building data required by ADP is available in the PDM database

21.2 Budget Monitoring

Consumption Control (CC) supports building managers in monitoring the budget and helps the manager reduce energy costs.

See *Consumption Control* (CM2B8716).

CC processes manually entered consumption data or data recorded by the building automation and control system. CC quickly reacts to changes in prices or building usage. CC takes into account seasonal or environmental influences and creates powerful reports, which can be used as a basis for energy-saving measures.

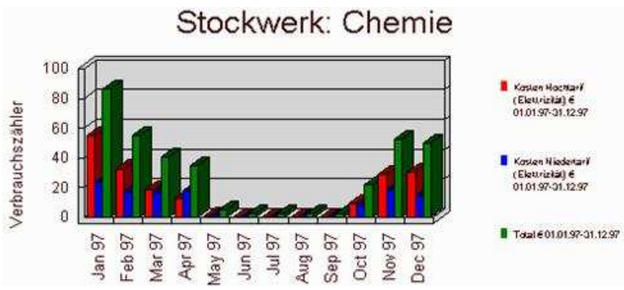


Figure 263: CC shows consumption data

CC is an independent component of a fully integrated software package and meets the requirements of modern facility managers. The entire service pack is called Computer-Aided Facility Management Services (CAFMS).

An integrated facility management system includes the following components:

- Building operation, control and maintenance management
- Consumption monitoring

21.3 Linking with Desigo Insight

We assume that the subsystems were engineered and the data points imported to Desigo Insight. Afterward, each subsystem regularly sends the trend log values to

Desigo Insight. Each subsystem has its own mechanism that triggers or waits for the transmission of data, until Desigo Insight requests the data.

In a next stage, the trend log profile (name of the trend logs) is imported to PDM. The name of the ADP/CC data series is formed from it.

Finally, PDM must be set up to periodically read trend log values, for example, PDM requests newly incoming trend log data on a daily basis. In this case, PDM reads only data that is one-day old.

If ADP/CC is installed on a Desigo system later, there may already be archived trend log values. The first time trend-log data is uploaded, PDM can read the Desigo Insight archive even when it is located on separate files that are outside the trend database.

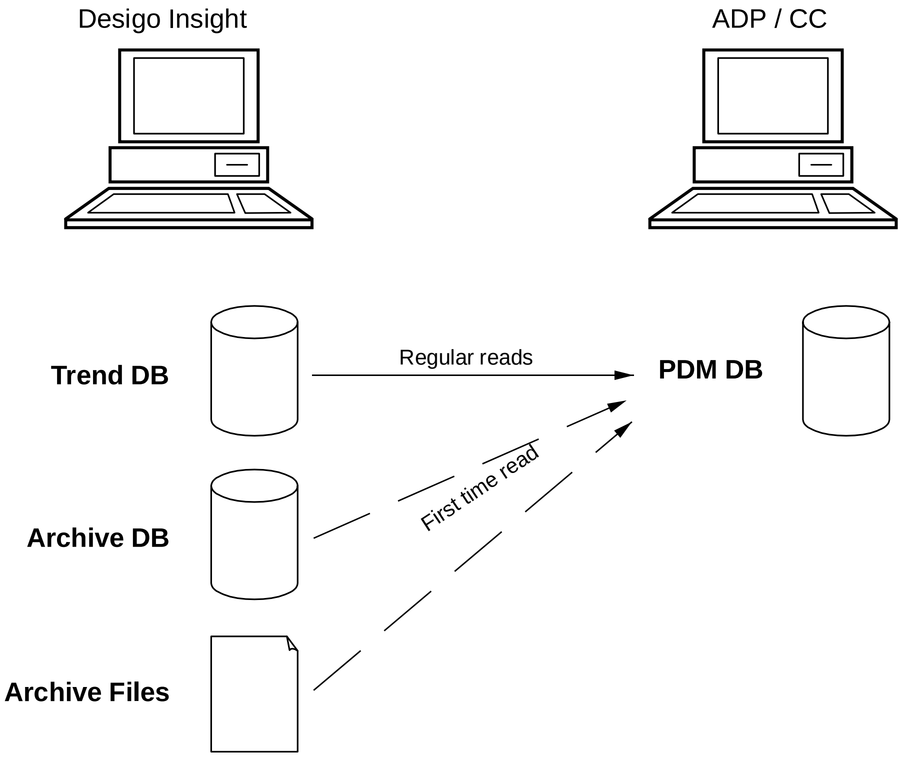


Figure 264: Linking with Desigo Insight

22 Desigo S7 Automation Stations

Desigo S7 offers an expansion of the Desigo product portfolio with Simatic S7 for applications requiring programmable logic controllers (PLC) at the automation level.

Desigo S7 uses the components spectrum for the Simatic S7-300, supplemented by the BACnet communications processor CP 343-1 BACnet.

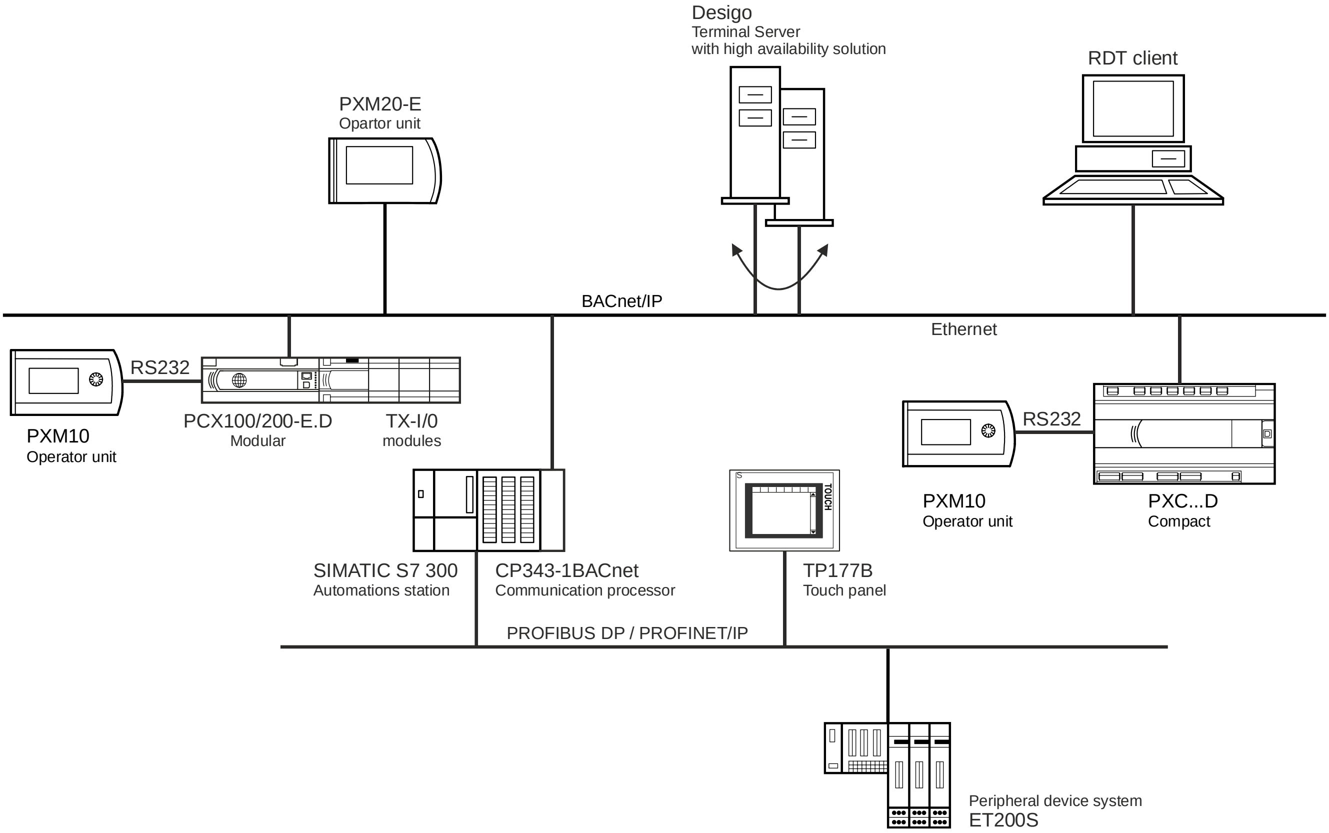


Figure 265: Desigo S7 topology

The most important features are:

- Usage of Simatic S7 components and tools (input and output components, network adapters, Step7 Manager, CFC Tool) in one integrated Desigo System
- HVAC library with standardized and test blocks and applications
- Use of standard communication BACnet, Ethernet TCP/IP, PROFINET, PROFIBUS DP, KNX, ASI, Modbus
- Decentralized periphery ET 200S for distributed plants, larger distances, use of integrated motor starts and a high degree of accuracy

Desigo S7 is designed for S7-300 automation stations.

H/F systems from the Simatic family are not supported.

Desigo S7 supports BACnet/IP at 10/100 bps for connecting Desigo Insight or other BACnet clients and for peer-to-peer data exchange with Desigo PX or other BACnet servers. On the field level, PROFIBUS/IP and PROFINET are supported directly. Other Simatic S7 stations are connected via Ethernet/IP or the PROFIBUS S7 Protocol.

PXM20-E cannot be used for Desigo S7.

Market performance packages

Desigo S7 includes the market performance packages:

- Desigo S7 Building Solution
- Desigo S7 Building Integration

Desigo S7 Building Solution

The market performance package Desigo S7 Building Solution lets you expand a Desigo system using Simatic S7. Desigo S7 Building Solution is a complete solution for industrial building automation and control. It expands the Desigo system using Simatic S7 components and tools. The package uses the Desigo S7 HVAC library which is modeled on the Desigo application library.

It includes the following expansions, in addition to the communications processor CP 343-1 BACnet:

- Desigo S7 Library
- Desigo S7 Basis Tool

Desigo S7 Library

The Desigo S7 Library consists of an HVAC block library based on the proven Desigo applications concept and functionality of the Desigo PX firmware library and the HVAC compound library. The compound library includes preconfigured, documented and tested applications as the basis for project-specific applications.

Desigo S7 Basis Tool

The Desigo Basis Tool is an engineering tool based on the CFC Standard Tool. It provides consistent data and efficient engineering thanks to a common data basis for automation software and BACnet configuration. The Desigo Basis Tool is fully integrated into the Simatic tool environment. Software changes are possible during operation (delta download).

Desigo S7 Building Integration

The market performance package Desigo S7 Building Integration allows for seamless integration of existing Simatic S7 automation stations into the Desigo system via BACnet communication.

In addition to using existing Simatic S7 and tools together with the CP 343-1 BACnet communication processor, the market performance package also includes the Desigo S7 Mapping Tool.

Desigo S7 Mapping Tool

The Desigo S7 Mapping Tool maps process data to BACnet objects and has conversion functions for adapting the format.

Runtime protection

The licensing model from SICLIMAT is used for Desigo S7. Licensing costs depend on the number of BACnet objects used for the building solution market performance package. The license key must be entered on the corresponding pin for block AS_BASIC.

The license key is part of the project data in the mapping tool for the market performance package.

22.1 Product Range Overview

Simatic S7 automation station

The modular automation station Simatic S7 for all industrial plants and for HVAC applications for industry and infrastructure. The modular, fan-free design, simple implementation of distributed structures, and user-friendliness of Simatic S7 make it the convenient and cost-effective solution for a wide range of functions.

Several CPUs with different levels of performance, plus an extensive range of modules with numerous convenient functions enable the user to select only the modules actually required for the application concerned. If the required function is later extended, the automation station can simply be upgraded as required, by adding further modules.

A Simatic S7 system comprises:

- A central processing unit (CPU): Different CPUs are available for various performance ranges, to some extent, CPUs with integrated PROFINET or PROFIBUS DP interfaces.
- Signal modules (SM) for digital and analog inputs and outputs

- Communication modules (CP) for bus coupling and point-to-point connections
- Power supply modules (PS) for connection of the Simatic S7 to a supply voltage of AC 120/230 V or DC 24 V

Usage scenarios:

- Connected to BACnet/IP, Ethernet TCP/IP system bus
- Stand-alone, with local TP177B touch panel

Communications processor CP 343-1

The communications processor CP 343-1 BACnet for the Simatic 300 automation station allow for cross-electrical and mechanical installation building automation and control and process automation. For example, you can use Simatic S7 automation stations and Desigo PX automation stations at the same time in plants and buildings.

The communications processor communicates via with Desigo Insight via BACnet/IP. It can also directly exchange data peer-to-peer between Desigo PX and Simatic S7.

The CP 343-1 BACnet communications process for Simatic S7-300 automation stations exchanges data between a S7 automation station and Desigo automation stations including as third-party providers of BACnet clients.

Simatic ET 200 S

In conjunction with Simatic S7, digital and analog inputs and outputs can be linked to the central control system via the PROFINET or PROFIBUS DP field bus system.

The peripheral devices can perform central control sub-functions independently. Sections of the plant can be tested and commissioned in advance. In the event of an error, stand-alone elements can continue to operate autonomously.

TX-I/O for Simatic

The PROFINET BIM allows you to use TX-I/O modules in plants with Simatic S7 via PROFINET communications.

This allows you to take advantage of the TX-I/O module benefits featuring, for example, integrated local manual operation, cheaper integration of analog signals, and support of typical HVAC field devices in plants with Simatic S7.

Engineering occurs via the standard PROFINET engineering workflow (Simatic Manager). TX-I/O properties are available in the product range-specific device root file (GSDML file) of the Profinet BIM. The GSDML file serves as engineering basis.

SBT TP177B touch panel

The SBT TP177B touch panel serves to locally operate and monitor the Simatic S7 automation station. It provides access to all data points and the associated parameters (for example, messages and switch commands) in all plant. Normally the unit is built into the control panel door.

The SBT TP177B enables the user to locate faults, operate and optimize the operation of plant and equipment such as heating coils and fans, and modify switch times.

Ordering

All Simatic components are ordered via the standard horizontal path at SIEMENS for the relevant region.

The CP341-1 BACnet is ordered directly by SBT at the Distribution Center Nuremburg.

The touch panel TP177B is ordered via the configuration center at SBT Zug.

Desigo S7 tools and library are downloaded via the SBT Standard Download Server.

22.2 System Limits

The following table shows the system limits for Desigo S7:

Item			Limits
Configured alarm recipient (number of entries on the NC recipient list)			30
Number of peer to peer objects by BACnet (as client)			approx. 50
COV subscriptions as server (If > 400 decrease of updating performance)			approx. 400
BACnet object in the CP for building integration			approx. 1000
Number of BACnet I/O objects including typical HVAC application* for building solution:			
	CPU 314	..314-1AG13 / 96 KB	approx. 20
	CPU 314	..314-1AG14 / 128 KB	approx. 40
	CPU 315-2DP	..315-2AG10 / 128 KB	approx. 40
	CPU 315-PN/DP	..315-2AH14 / 256 KB	approx. 150
	CPU 315-PN/DP	..315-2EG10 / 128 KB	approx. 40
	CPU 315-PN/DP	..315-2EH13 / 256 KB	approx. 50
	CPU 317-2DP	..317-2AJ10 / 512 KB	approx. 200
	CPU 317-PN/DP	..315-2EJ13 / 512 KB	approx. 200
	CPU 317-PN/DP	..315-2EK13 / 1000 KB	approx. 200
	CPU 317-PN/DP	..317-2EK14 / 1000 KB	approx. 800
	CPU 319-PN/DP	..318-3EL00 / 1400 KB	approx. 800
Number of function block instances in the CFC chart			32767
Trend Log – limited only by available RAM in the CPU			Depends on RAM*
Scheduler – limited only by available RAM in the CPU			Depends on RAM*
Calendar – limited only by available RAM in the CPU			Depends on RAM*
Max. number of TP177 on a CPU			3
Max. number of CPUs on a TP177			4
Communication between S7-Station (send – receive)			Max. 3 partner Max. 200 Bytes Min. clock pulse 5 sec. for send

Table 107: Desigo S7 system limits

Key:

* A calculation table is available for a more precise calculation.

22.3 Alarm Management

Alarm Management in Desigo S7 is almost identical to alarm management in Desigo PX. The BACnet objects displayed in the following figure are equipped with intrinsic reporting. The objects report alarms to the assigned notification class objects. The notification class objects forward the alarms to the assigned BACnet clients.

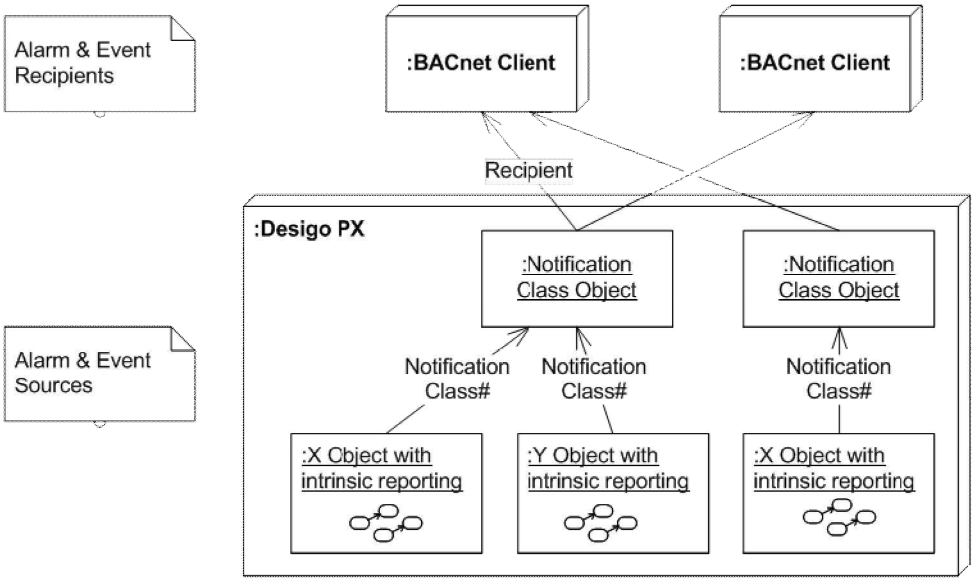


Figure 266: Alarming and Eventing

	Desigo S7	Desigo PX
Principle	The Notification Class (NOTIFCL) is local and applies per automation station only.	Notification Class is a server function that applies globally for the entire site.
Number of Notification Class objects	One NOTIFCL required per automation station in the Global chart. All entries are made in this block.	48 NOTIFCL blocks per automation station in the Global chart.
Number of alarm classes	32 alarm classes (only 6 are used in the library).	16 alarm classes (only 6 are used in the library).

Table 108: Notification Class Object [NOTIFCL]

See *Desigo S7 Building Integration* (CM110890).

Detailed differences in the implementation

The following figure shows a typical application of blocks associated with the alarm strategy.

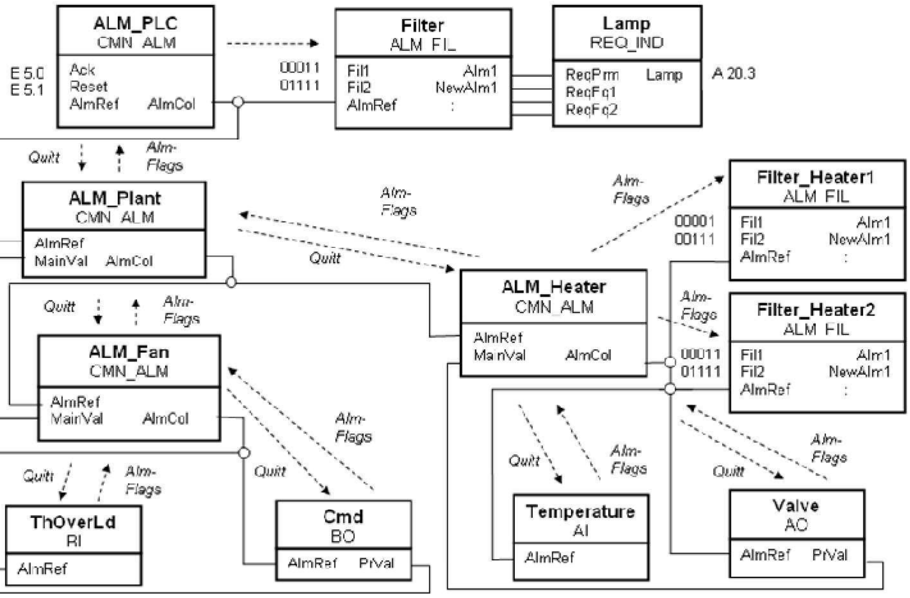


Figure 267: Alarm blocks

	Desigo S7	Desigo PX
Number of objects	One CMN_ALM per BACnet hierarchy	A CMN_ALM block per plant
Function	Gather alarms Map to BACnet hierarchy	Gather and filter alarms
Mechanism	Interconnect: All alarmable blocks must be interconnected to the CNM_ALM. Unwired object must be individually acknowledged via a BACnet client.	Referencing – automatic

Table 109: Common alarm [CMN_ALM]

Alarms can be acknowledged via the TP177B, which is wired on the CMN_ALM - Acknowledge a BACnet hierarchy level.

Alarmable blocks not interconnect on the CMN_ALM may only be operated via a BACnet client, for example, Desigo Insight.

	Desigo S7	Desigo PX
Principle	Interconnected with CMN_ALM (optional functionality)	Integrated in CMN_ALM
Number of objects	One block per BACnet hierarchy	A CMN_ALM block per plant
Number of filters	Four filters per block – multiple blocks may be used	Five filters

Table 110: Alarmfilter [ALM_FIL]

	Desigo S7	Desigo PX
Function	Light control Flash speed depends on the alarm input	Compound solution using the same functional scope

Table 111: Request indicator [REQ_IND]

22.4 Control Concept

Open-loop control strategy

The control strategy of the Desigo S7 building solution market performance package is identical to the control concept for Desigo PX. Desigo S7 cannot, however, reference BACnet to interfaces for other blocks for technical reasons. As a result, all bindings between the blocks are wired.

Control blocks cannot use the PX look-ahead mechanism.

Interconnection in CFC and not BACnet referencing is used for superposed control blocks to communicate with the commanding aggregates.

In contrast to Desigo PX, the scheduler cannot switch the objects to be controlled via BACnet communication, but rather via wiring.

Control strategy

The control strategy for Desigo S7 is similar to the control strategy for PX.

The strategy comprises the following function blocks:

- PID_CTR: As individual controlled or wired (FmHigher/ToLower). It can be used as a sequence controller. The block is mapped on a standard BACnet loop object. This expands the interface for Desigo S7.
- CAS_CTR: A cascade controller like in PX.
- SEQLINK: The block binds multiple PID_CTR blocks to a sequence controller. The block offers benefits primarily during engineering (PX).

22.5 Desigo S7 Block Library

Block concept

The block concept for the building solution market performance package is the same as for Desigo, that is, interfaces and function distribution are the same. Deviations to these concepts are explicitly described in this document.

The block interfaces correspond to BACnet version 1.5.

Changes to data types

The building solution market performance package is used to engineer the standard CFC editor. To this end, some data types, which are specially supported in Desigo, were changed at the block interfaces. The data types can still be operated. The changes primarily effect time data types Long Duration and Short Duration and date formats using jokers.

Storage for an optimized concept was selected. There are short and long runtimes or monitoring times.

Command Control CMD_CTL

The block ensures that individual plant aggregates (optimized for ventilation plants) are switched on or off in a certain order.

The differences to Desigo PX are:

- The normal signal flow between the blocks (interconnection) is used to exchange data with the aggregates. The Standard CFC Editor does not contain a Plant Control Editor. CMD_CTL cannot be used to reference aggregates via BACnet.
- CMD_CTL has only two priorities for commanding: High priority (for example, safety) and low priority (for example, program). The interconnection determine the priority on the aggregate.
- The LookAhead function is not available on CMD_CTL.
- The CMD_CTL does not have switch-on and off delays. They must be implemented on the aggregates. The OpSta feedback is used to consider delays for switching.
- The CMD_CTL does not have a BACnet alarm function.

The control strategy itself is, however, identical to Desigo PX.

Power Control PWR_CTL

The block ensures that individual plant aggregates (optimized for ventilation plants) are switched on or off in a certain order and at certain output.

The differences to Desigo PX are:

- The normal signal flow between the blocks (interconnection) is used to exchange data with the aggregates. The Standard CFC Editor does not contain a Plant Control Editor. PWR_CTL cannot be used to reference aggregates via BACnet.
- PWR_CTL has two priorities for commanding: High priority (for example, safety) and low priority (for example, program). The interconnection determine the priority on the aggregate.
- The LookAhead function is not available on PWR_CTL.
- PWR_CTL does not have a BACnet alarm function.

I/O blocks

Emergency operation (local override)

Manual operation can be recorded directly on the I/O Module using Desigo. For Desigo S7, local manual override is logged on the module level via its own feedback signal. The blocks BO, AO and MO have the pin [Ovrr] for this purpose. In contrast to Desigo, the value of manual operation is not issued on PrVal.

Peer-to-peer blocks

Blocks AO_PTP, BO_PTP and MO_PTP (FB327) write a value to the BACnet object (command via BACnet). The block is used to write a process value via BACnet to another automation station (commanding).

Memory optimized block pins

The pin sequence on Desigo S7 blocks differ from the sequence for Desigo, since they are memory optimized (application-oriented in the case of Desigo).

Dynamic memory ranges

The block TRNDLOG stores the BACnet values on the CPU.

Alarm blocks (CMN_ALM, ALM_FIL)

The differences to Desigo PX are:

- In Desigo S7, all notification classes are compiled in block NOTIFCL.
- The Common Alarm block in the CFC is nested with the block generating the alarm.

Device object

Each automation station contains a device object, which in turn contains the device and system information for that automation station. The device object is a standard BACnet object, representing the entire Desigo S7 automation station and, among other, includes a list of all processed BACnet objects.

22.6 Operating States

The following table shows the operating states in Desigo S7:

S7-CPU RUN	Normal operation - application software is processing
S7-CPU STOP	Digital outputs are reset. Application software and BACnet communication are not processed. The STOP state is achieved: - After a fatal error in the S7 CPU - During initial configuration - During a full download - When the operator uses the STOP switch - When operated with the S7 – Manager
BACnet – IP RUN	BACnet/IP allows Ethernet communication including BACnet/IP and S7 communication. BACnet communication can also be interrupted in RUN mode. Reasons: - No BACnet configured (S7 – hardware configuration) - Reconfiguration is running - Fatal error BACnet – CP
BACnet – IP STOP	BACnet/IP allows PG functions via Ethernet, for example, restart or diagnostics. The STOP state is achieved due to: - Fatal error BACnet - CP - User operation

Table 112: Desigo S7 operating states

22.7 Error Sources and Monitoring Functions

The following table shows some examples of errors and their effects:

Error	Effect
1) Fatal error in S7-CPU, for example, memory command code.	S7 goes to STOP. All binary outputs are reset.
2) Potentially dangerous process state in S7-CPU, for example, faulty I/O periphery.	The application is no longer processed. An alarm is sent via BACnet. BACnet communication is stopped. S7 must be restarted locally or via remote following troubleshooting.
3) Non-critical error in S7-CPU	An alarm is sent via BACnet.
4) Critical error BACnet-CP, for example, memory.	BACnet communication is stopped. BACnet communication must be restarted locally or via remote following troubleshooting.
5) Non-critical error BACnet-CP, for example, buffer overloaded.	An alarm is sent via BACnet.

Table 113: Errors and effects

23 System Configuration

System overview

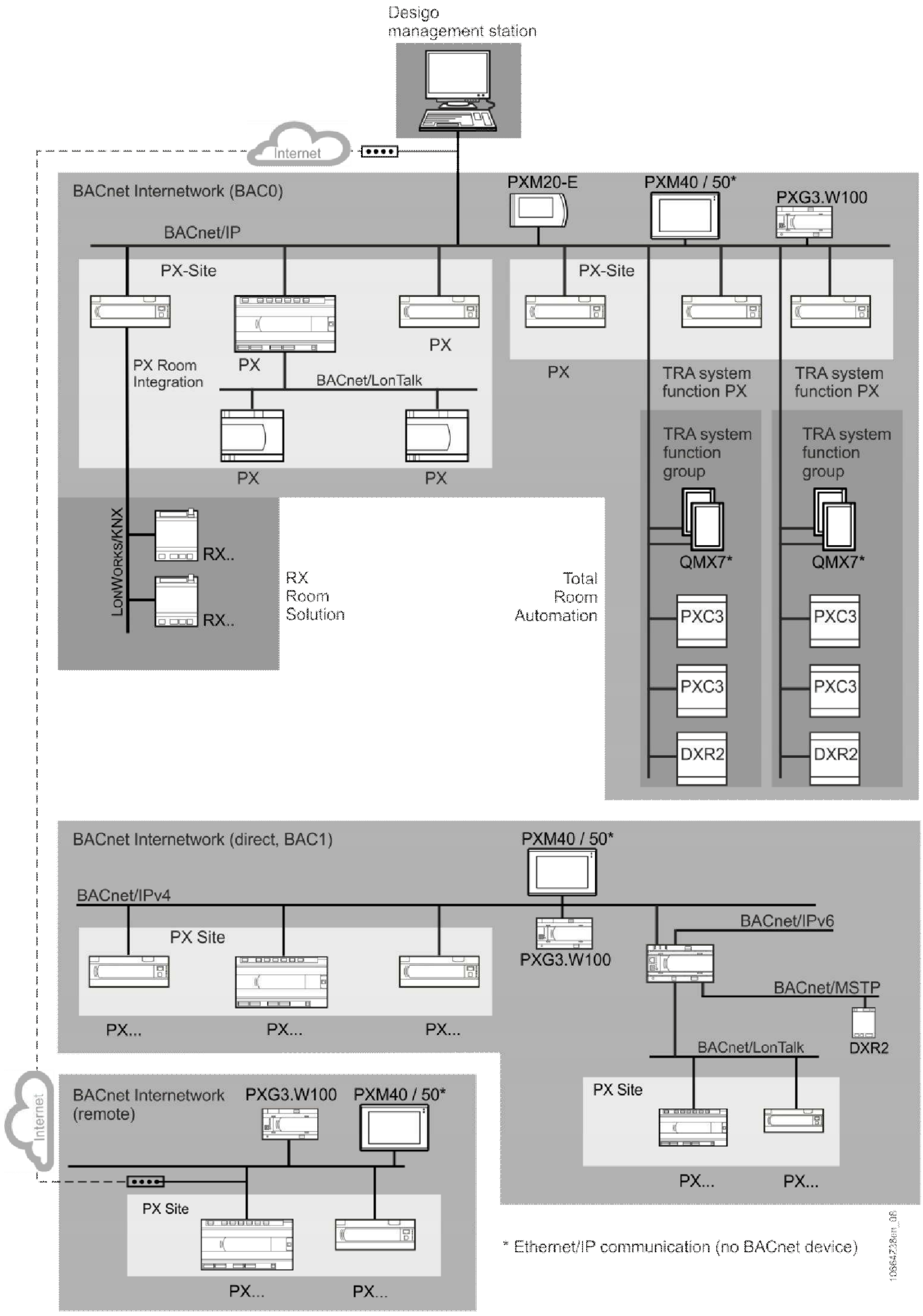


Figure 268: System overview

Terms

Desigo system

Covers all the devices on the MLN (Management Level Network), ALN (Automation Level Network) and FLN (Field Level Network).

One Desigo system may comprise several BACnet internetworks. These are connected into a system with the Desigo management station. In this case, a management station appears as a BACnet device in several BACnet internetworks.

BACnet internetwork

A BACnet internetwork consists of one or several BACnet networks. Individual BACnet networks are connected to BACnet routers.

Each BACnet device can communicate with another BACnet device in the internetwork. A BACnet device in one internetwork cannot communicate with a device in another internetwork.

A Desigo management station can be used to integrate the operation of several BACnet internetworks and other systems (see Desigo system).

When defining the system configuration, FLN integrations (LonWorks, KNX) are also added to the BACnet internetwork. In this way, the Desigo system can be seen as a combination of several BACnet internetworks. Technically, the individual FLN devices are not BACnet devices. They do not communicate via the BACnet protocol.

BACnet PTP internetwork

A BACnet PTP internetwork is connected to Desigo Insight via BACnet PTP communication.

BACnet PTP communication uses modem (telephony) or null-modem (RS232) connections. Owing to the slow rate of data transfer via these connections, the limits are lower for a BACnet PTP internetwork. Modem-based PTP connections are considered obsolete and are therefore no longer used.

The BACnet PTP communication connects BACnet networks via BACnet half routers. When Desigo Insight uses several modems to establish simultaneous connections to different BACnet PTP internetworks, these are interconnected into one BACnet internetwork. Consider this when defining individual BACnet PTP internetworks, to ensure that network and site numbers, etc. are unique.

In Desigo Insight only one PTP internetwork can be defined (this defines the type of connection). All sites are assigned to this network by one or more BACnet PTP internetworks. When communication is established by a BACnet PTP internetwork (PX) it is not possible to identify the specific BACnet PTP internetwork concerned. This problem is solved by fixed allocation to a Desigo Insight PTP internetwork.

BACnet network

A quantity of BACnet devices connected within an IP or LonTalk or MS/TP network with specific (that means, the devices are in the same BACnet Broadcast Domain) limits. In the case of the LonTalk or MS/TP network, the limit is physical. In the case of an IP network, the network can be physically the same, but the limit is determined by different UDP ports.

Local communication between two BACnet devices in a BACnet network is not visible in another BACnet network.

IP segment

Sub-area of an IP network. IP segments are connected by IP routers.

In order to ensure that BACnet communications (Broadcasts) can always take place across IP routers, BBMDs (BACnet Broadcast Management Devices) are required. PXG3.. and PXG80-N and PXC…-E.D or PXC..-U over IP can be configured as BBMDs. Individual BACnet devices in an IP segment can register with a BBMD as foreign devices.

LonWorks segment (ALN)

Sub-area of a BACnet/LonTalk network. LonWorks segments are connected by LonWorks routers. In most cases it is not necessary to divide a BACnet/LonTalk network into several LonWorks segments (ALN).

It is not possible to use a LonWorks router because of the restricted length of the data packets. An L-Switch can be used as a router on the ALN.

LonWorks segment (FLN)

Sub-area of a LonWorks network. LonWorks segments are connected by LonWorks routers.

An L-Switch or a LonWorks router can be used as a router on the FLN.

LonWorks trunk (FLN)

Comprises all the devices connected on the FLN side of the PXC00.D/-E.D + PXX-L1…. Consists of one or several LonWorks segments (FLN).

A LonWorks trunk (FLN) is the equivalent of a LonWorks network (FLN).

PX KNX integration
Comprises all the devices connected on the FLN side of the PXC001.D/-E.D or the PXC00-U with extension module PXA30-K11.

PX site
A Desigo PX automation system site.

The PX BACnet devices which control the plant in a PX site are interconnected via the global objects and the primary copy procedure.

A PX site is independent of the limits affecting the BACnet network. A site can extend over several BACnet networks. One BACnet network may include several sites. All the associated limits must be maintained simultaneously.

A PX site cannot be extended beyond the limits of a BACnet internetwork. This is particularly important in the case of BACnet PTP internetworks.

PX plant
A PX plant is part of a PX site and generally comprises several partial plants (plant structure).

A PX plant can be distributed over several PX BACnet devices. In principle PX BACnet devices can be distributed to different BACnet networks. However, owing to the communications load between partial plants, this is not recommended.

The plant structure is mapped to BACnet by means of hierarchy objects. Operator units with generic operation (PXM20, PX Web) automatically read this structure.

BACnet MS/TP
A BACnet MS/TP network is a BACnet network that is physically based on EIA-485 and operated using a BACnet-specific MasterSlave/TokenPassing data link protocol (see BACnet standard clause 9). An MS/TP network is linked via a BACnet router to a BACnet/IP or BACnet/LonTalk network.

Desigo Room Automation
Includes the BACnet devices connected directly to BACnet/IP or BACnet MS/TP, used for room automation.

These BACnet devices are not part of a PX site. There is no connection via global objects and the primary copy procedure.

Desigo Room Automation system functions
In Desigo Room Automation, primary subsystem control functions are centralized as Desigo Room Automation system functions.

PX system functions
A PXC.. of a PX site as PX system function can assume Desigo Room Automation subsystem functions such as scheduling, life check, time synchronization for a Desigo Room Automation system function group for BACnet devices for room automation.

System function group
A Desigo Room Automation system function group cannot be identified or defined via the network topology. Engineering the Desigo Room Automation system functions of the PX system functions determines the Desigo Room Automation system function group.

For more information, see chapter *System Overview* and *Network Architecture*.

23.1 Technical Limits and Limit Values

There are two types of limits:

- Technical limits (hard-coded limits) are maintained by technical means. They cannot be exceeded.
- Recommended limits (soft limits) are not enforced by technical means. They can be exceeded.

  The limits are defined to ensure the full and correct functioning of the system. Consult Headquarters before exceeding the recommended limits. HQ can modify the recommended limits on the basis of new findings at any time. Changes are notified in Facts bulletins.

Certain limits cannot be verified (for reasons of cost or quantity). These limits are identified in this document as follows:

Limit type	Identification	Example
Technical limit verified	Limit*	60* RXC integrated with PXC00.D/E.D+PXX-L11/12 per LonWorks Trunk
Technical limit NOT verified	[Limit*]	[50*] IP segment per BACnet/IP network
Recommended limit verified	Limit	30 PX per BACnet/LonTalk network
Recomended limit NOT verified	[Limit]	[1'000] PX per BACnet internetwork
Limit subject to proviso (refer to footnotes)	(Limit)	(10)[9] PXM20 per BACnet internetwork

Table 114: Verified and non-verified limits

23.2 Networks

The following table shows the maximum number of elements, permitted in a network area.

The columns show the network area. The rows show the maximum number of elements permitted in the network area. For example, network area: BACnet internetwork; number of elements: BACnet/LonTalk network. Maximum number of BACnet/LonTalk networks per internetwork = 100.

Number of elements / Per network area	Desigo system	BACnet inter-network	BACnet PTP inter-network	BACnet/ IP network	BACnet MS/TP network	BACnet/ LonTalk network	LonWorks trunk (FLN)	LonWorks segment (FLN)	PX KNX inte-gration	PX site
Desigo topology										
BACnet internetwork	200	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
BACnet PTP internetwork	1[18]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
BACnet/IP network	n/a	1	[1][19]	n/a	n/a	n/a	n/a	n/a	n/a	[total 20]
BACnet/LonTalk network	[3]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
BACnet MS/TP network	n/a	[50]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PXG3 (BACnet router)	n/a	[100]	[30]	[100]	1	1	n/a	n/a	n/a	n/a
IP segment	n/a	10* [6a] / [50*] [6b]	10* [6a] / [50*] [6b]	10* [6a] / [50*] [6b]	n/a	n/a	n/a	n/a	n/a	n/a
LonWorks segment (ALN)	n/a	[100]	[30]	n/a	n/a	1	n/a	n/a	n/a	n/a
PX site	[1,000]	[30]	5	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PX plant	[4,000]	[2,000]	[60]	n/a	n/a	n/a	n/a	n/a	n/a	100
LonWorks trunk (FLN)	[200]	[100]	[30]	n/a	n/a	n/a	n/a	n/a	n/a	[50]
LonWorks segment (FLN)	n/a	n/a	n/a	n/a	n/a	n/a	[5]	n/a	n/a	[250]
PX KNX integration	[200]	[100]	[30]	n/a	n/a	n/a	n/a	n/a	n/a	[50]
Desigo devices										
PX… without DXR2/PXC3[15]	[2,000]	[1,000][9]	[30]	[200][8]	n/a	30	n/a	n/a	n/a	50/100[17]

Number of elements / Per network area	Desigo system	BACnet inter-network	BACnet PTP inter-network	BACnet/ IP network	BACnet MS/TP network	BACnet/ LonTalk network	LonWorks trunk (FLN)	LonWorks segment (FLN)	PX KNX inte-gration	PX site
PXC3 (Desigo Room Automation)	n/a[16]	[500]	n/a	[200]	n/a	n/a	n/a	n/a	n/a	n/a[15]
DXR2 (Desigo Room Automation)	n/a[16]	[1,000]	n/a	[200][20]	32[21]	n/a	n/a	n/a	n/a	n/a[15]
Desigo CC	10	10	n/a	10	n/a	n/a	n/a	n/a	n/a	n/a
Desigo Insight / Desigo Insight Terminal Server / Desigo Web[13]	10	10	1	10	n/a	[5]	n/a	n/a	n/a	10[10]
PXM20	n/a	(10)[9]	10	n/a	n/a	10	n/a	n/a	n/a	total 15[10]
PXM20-E	n/a	(50)[9]	[20]	[50]	n/a	n/a	n/a	n/a	n/a	total 15[10]
PXA30-W1/W2, PXA40-W1/W2 (integrated web server)	n/a	(15)[9]	[15]	[15]	n/a	[15][14]	n/a	n/a	n/a	total 15[10]
Desigo Xworks Plus (XWP) (commissioning)[12]	n/a	[10]	[10]	[10]	n/a	[5]	n/a	n/a	n/a	total 15[10]
Total LonWorks nodes (RXC, QAX50/51, third-party)	[40,000]	[20,000]	[6,000]	n/a	n/a	n/a	300[2]	60	n/a	[10,000]
RXC integrated	[20,000]	[5,000]	[3,000]	n/a	n/a	n/a	60* [7a] / [120*][7b]	60	n/a	[5,000]
QAX50/QAX51	[20,000]	[10,000]	[,000]	n/a	n/a	n/a	[120]	[40][5]	n/a	[5,000]
RXB	[8,000]	[2,000]	[1,200]	n/a	n/a	n/a	n/a	n/a	45[4]	[2,000]
RXL	[8,000]	[2,000]	[1,200]	n/a	n/a	n/a	n/a	n/a	45[4]	[2,000]
System devices										
LonWorks router	n/a	n/a	n/a	n/a	n/a	n/a[3]	[4]	n/a	n/a	n/a
LonWorks physical repeater	n/a	n/a	n/a	n/a	n/a	[1]	[5]	1	n/a	n/a
L-Switch	n/a	n/a	n/a	n/a	n/a	[1]	1	n/a	n/a	n/a
Data points and BACnet objects										
Physical data points	[100,000]	[100,000]	[3,000]	[20,000]	[1,920][22]	[3,000]	n/a	n/a	n/a	[6,000]
Total BACnet objects	[500,000]	[100,000]	[30,000]	[100,000]	[3,000]	[30,000]	n/a	n/a	n/a	[50,000]
Trendlog object	[30,000]	[2,500]	[200]	[2,500]	[540]	[600]	n/a	n/a	n/a	[1,000]

Table 115: Number of elements per network area

Key:

n/a Not applicable.

– No restrictions.

2 Not the same as the number of integrated devices (PXC00.D/-E.D + PXX-L…).

3 LonWorks routers must not be used at the automation level.

4 Limit applies only if this device type is used exclusively.

[5] Observe the Installation guidelines Desigo RXC for LPT 10 devices (QAX5x) and the bus power supply.

[6a] Limit when PXG80-N is configured as a BBMD (BDT: max. 10. FDT: max. 10.).

[6b] Limit when PXC…U over IP is configured as a BBMD (BDT: max. 50. FDT: max. 50.). Also applies to PXC…-E.D and PXG3.

[7a] Limit for PXC00.D/-E.D + PXX-L11.

[7b] Limit for PXC00.D/-E.D + PXX-L12.

[8] Limit for PX devices without Desigo Room Automation (due to PX web support of a PX site). Do not exceed the number of PXC devices per site.

[9] The limit on the number of PX automation stations per internetwork can only be maintained if no PX clients (PXM20, PXM20-E, PXG80-W/WN, PXA40-W1/W2 or PXA30-W1/W2) are used. PX clients limit the permissible number of PX per internetwork. The values can be obtained by reference to the relevant automation station columns. The restricted view option does not affect the system configuration of PX clients.

[10] The number of temporary alarm receivers in a PX is a technical limit. The recommended limit is lower. This takes account of the fact that additional devices may be connected for service purposes.

[11] The number of temporary alarm receivers in a PX is a technical limit. The recommended limit is lower. This takes account of the fact that additional alarm receivers (third-party) may have entries in this list.

[12] Parallel engineering (commissioning) is possible subject to the following restrictions:

- Node setup: Only one XWP per LonTalk/IP segment.

- Download and online operation: only one XWP for each automation station.

[13] A maximum of two Desigo Insight Terminal Servers may be operated concurrently. A maximum of two Desigo web clients (server) may be operated concurrently.

[14] Only PXA30-W1/W2 (together with PXC..U) can be used in BACnet/LonTalk networks.

[15] Desigo Room Automation automation stations do not belong to a PX site (no primary copy function).

[16] Max. 3,0000 rooms/project on CC, 4,000 rooms/project and 2,000 rooms/site on Desigo Insight. Additional Desigo Room Automation system function PX required. See chapter *Desigo Room Automation System Function Group*.

[17] 50: If Lon PX exists in the PX site. 100: If no Lon PX exist in the PX site (only IP PX).

[18] These limits in the Desigo system refer in particular to Desigo Insight. The limits may be significantly lower due to the PTP connection(s) outside the Desigo system and their technical limitations. Examples of such limitations outside the Desigo system can include available bandwidth for the PTP link or available modem speeds.

[19] This limit can be exceeded if all BACnet devices are located within the same IP subnetwork, or if no communication between the various BACnet/IP networks is required.

[20] These limits apply only to IP-based DXR2 devices.

[21] These limits apply to MS/TP-based DXR2 devices.

[22] Max. number of physical data points for DXR2.M18 is 1,920 (60 I/Os per device and 32 devices per MS/TP trunk).

For more information about networks, see *Application Guide for IP Networks in Building Automation Systems* (CM110668).

23.2.1 Desigo Room Automation System Function Group

A Desigo Room Automation system function group comprises parts of the Desigo Room Automation automation stations on the BACnet internetwork. Grouping occurs based on Desigo Room Automation automation stations aassignment to PX system function responsible for the Desigo Room Automation subsystem functions.

Desigo Room Automation defines Desigo Room Automation system functions comprising life check, time synchronization, and scheduling.

The current limits for the Desigo Room Automation system function group are mainly imposed by life check and scheduling carried out by the Desigo Room Automation system function PX. To this end, the total number of the following external BACnet references are planned per Desigo Room Automation system function PX used: Approximately 200 (on PX V5.x) or approximately 500 (on PX V6.0).

A PXC3 generally controls several (about 5..8) multiple rooms. The number of rooms in the Desigo Room Automation system function group are the decisive factor for some limits.

Desigo Room Automation automation stations are not part of a PX site. Data are not aligned between the primary PX site and the Desigo Room Automation automation stations.

Desigo Room Automation automation stations cannot be operated using the generic operator units PXM20, PXC20-E, PXA30-W1/W2, PXA40W1/W2 (integrated web server) or XWP. Desigo Room Automation automation stations do not support the PX concept for generic operation.

Desigo Room Automation automation stations do not support BBMDs. This restricts the BACnet/IP network, that is, all Desigo Room Automation automation stations and their Desigo Room Automation system function PX or a PXG router must be located in the same IP segment.

Desigo Room Automation automation stations without own alarming

The Desigo Room Automation system function PX takes over the alarm functions

Item	Limit	Description
Trend per room	5	Assumption: An average of max. 5 trend points are logged. Assumption for logging interval: 15 minutes.
Rooms with three alarms per room	60*	Max. number of rooms per Desigo Room Automation system function group at three alarms per room. The number of Event Enrollment objects with external BACnet references that must reliably be supported by the Desigo Room Automation system function PX is limited.
Rooms with two alarms per room	100	Max. number of rooms per Desigo Room Automation system function group at 2 alarms per room. The number of Event Enrollment objects with external BACnet references that must reliably be supported by the Desigo Room Automation system function PX is limited.
Event Enrollment objects with external BACnet references	220	Max. number of Event Enrollment objects with external BACnet references in the Desigo Room Automation system function group. Event Enrollment objects on the Desigo Room Automation system function PX are used for the alarms per room and for the PXC3 life check.
PXC3	50	Max. number of PXC3 per Desigo Room Automation system function group. Central time synchronization serves as a limit. The Desigo Room Automation system function PX list for time synchronization recipients is limited. Note: This limit should never be reached. Assumption: One PXC3 controls an average of min. 5 rooms. As a result, max. 15 to 20 PXC3 are assigned to one Desigo Room Automation system function PX.

Table 116: Desigo Room Automation automation stations without own alarming

Key:

* 60 rooms are an estimation based on the assumptions: about 3 alarms per room and ~5 rooms per PXC3.

The values listed in this table are guide values.

A more precise calculation would have to be based on the rule that the amount of PXC3-based alarms plus the amount of PXC3 themselves may not exceed the maximum number of external BACnet references.

60 rooms thus translate into 60x3 = ~180 alarms and 60/5 = ~12 PXC3, resulting in ~192 external BACnet references. This is a conservative estimation compared to the ~220 max. allowed external references.

Desigo Room Automation automation stations with own alarming

Item	Limit	Description
Trend per room	5	It is assumed that a maximum of 5 trend points are logged on average. Assumption for the trend interval: 15 minutes.
Number of external BACnet references	500	Maximum number of external BACnet references that support a Desigo Room Automation system function PX. The Desigo Room Automation system function PX requires external references for the life check and for scheduler functions. Examples of objects with external references: - EventEnrollment: 1reference - Schedule: 1-5 references
Event Enrollment per Desigo Room Automation automation station	1	Number of Event Enrollment objects required on the Desigo Room Automation system functions PX for the life check per Desigo Room Automation automation station.
Sample number of Desigo Room Automation automation stations per Desigo Room Automation system function group	250	Desigo Room Automation system function PX with maximum scheduler functions. The limit designates the maximum number of Desigo Room Automation automation stations in the Desigo Room Automation system function group. In this example, it is assumed that the following scheduler objects are available on the Desigo Room Automation system function PX: - Maximum number of scheduler objects - Per scheduler object, maximum number of external references
Sample number of Desigo Room Automation automation stations per Desigo Room Automation system function group	500	Desigo Room Automation system function PX without scheduler functions. The limit designates the maximum number of Desigo Room Automation automation stations on the Desigo Room Automation system function group. In this example, it is assumed that no scheduler objects are available on the Desigo Room Automation system function PX.

Table 117: Desigo Room Automation automation stations with own alarming

23.3 Devices

23.3.1 PXC..D/-U Automation Stations / System Controllers

Item	PXC..-E.D PXC...D PXC..-T.D PXC52 (PPC) PXC-NRUF compact	PXC64 / 128-U modular	PXC50.D PXC50.E.D modular	PXC100.D PXC100-E.D modular	PXC200.D PXC200-E.D modular	PXC00.D PXC00-E.D	PX Open[10] PXC001.D PXC001-E.D + PXA40-RS.. or PXC00-U + PXA30-RS..	PX KNX[9] PXC001.D PXC001-E.D or PXC00-U + PXA30-K11
Temporary alarm receiver[1]	18*	18*	18*	18*	18*	18*	18*	18*
Configured alarm receivers[2]	20*	20*	20*	20*	20*	20*	20*	20*
BACnet references COV server resources[3]	[1,400*]	[1,400*]	[1,400*]	[1,400*]	[1,400*]	[1,400*]	[1,400*]	[1,400*]
BACnet references COV client resources[4]	400* PXC36-E.D 950*	400*	650* PXC50-E.D 950*	650* PXC100-E.D 950*	650* PXC200-E.D 950*	650* PXC00-E.D 950*	650*	400*
Total BACnet objects	[4,000]	[4,000]	[4,000]	[4,000]	[4,000]	[4,000]	[4,000]	[4,000]
Number of function block instances (application size)	1,900*	1,900*	1,900*	1,900*	2,900*	1,900*	2,900*	2,900*
Trend log[5]	100	100	100	200	350	200	600	100
Trend log multiple[19]	20	20	20	20	20	20	120	20
Scheduler	15[17]	15[17]	50[18]	50[18]	50[18]	50[18]	15[17] PXC001:50[17]	15[17] PXC001:50[17]
Calendar[14]	10	10	50	50	50	50	10 PXC001:50	10 PXC001:50
PXM10	1	1	1	1	1	1	1	n/a
PPS2 devices (ALN)[8] (e.g. QAX3.x, RXZ90.1)	5	5	n/a	n/a	n/a	n/a	5	n/a
Physical data points I/O module (TX-I/O, PTM)	n/a	Gem. Bel. Einheiten I/O-Mod.[6]	52*	200* [15]	(350)[15]	n/a	n/a	n/a
Total number of data points (TX-/I/O, PTM and TX Open)	n/a	n/a	200*	200* [15]	(350) [15]	n/a	n/a	n/a
TX Open per island bus	n/a	n/a	5[16]	5[16]	5[16]	n/a	n/a	n/a
PXX-PBUS	n/a	n/a	1	1	1	n/a	n/a	n/a
P bus BIM TXB1.PBUS[12]	n/a	1	n/a	n/a	n/a	n/a	n/a	n/a
Dynamic calendar objects[20]	10*	10*	10*	10*	10*	10*	10*	10*
Dynamic event enrollment objects[20]	50*	50*	50*	50*	50*	50*	50*	50*

Item	PXC..-E.D PXC...D PXC..-T.D PXC52 (PPC) PXC-NRUF compact	PXC64 / 128-U modular	PXC50.D PXC50.E.D modular	PXC100.D PXC100-E.D modular	PXC200.D PXC200-E.D modular	PXC00.D PXC00-E.D	PX Open[10] PXC001.D PXC001-E.D + PXA40-RS.. or PXC00-U + PXA30-RS..	PX KNX[9] PXC001.D PXC001-E.D or PXC00-U + PXA30-K11
Dynamic notification class objects[20]	50*	50*	50*	50*	50*	50*	50*	50*
Dynamic schedulers	10*	10*	10*	10*	10*	10*	10*	10*
Dynamic trend log objects[20]	100*	100*	100*	100*	100*	100*	100*	100*
Dynamic trend log multiple objects[20]	20*	20*	20*	20*	20*	20*	20*	20*

Table 118: Automation stations / system controllers PXC..D/-U

Key:

n/a Not applicable

1 PXM20, PX-Web and XWP are temporary alarm receivers.

2 Desigo CC and Desigo Insight are configured as an alarm receiver.

The number of entries in the notification class is limited to 20. The total number of different configured alarm receivers across all notification classes is limited to 30.

3 Max. number of SubscribeCOV requests which can be accepted.

Example: 400 1 client and 400 values 2 clients and 200 values.

4 Max. number of BACnet client references, values read from or written to (commanded) your own automation station or a remote automation station.

BACnet client references are used in Input, Output, Scheduler, Trendlog and Group objects (all NameRef_Type inputs with AddrKind = B). The configured alarm receivers of the Notification Class objects do NOT require any BACnet client references.

The available number of BACnet client references shall address not more than 50 different remote automation stations. If this value is exceeded the number of BACnet broadcast messages on the network will increase.

5 Every active Trendlog object needs a BACnet reference.

Trends need 12 bytes per entry (irrespective of data type). Max. 64 KB can be allocated to the log buffer (approx. 5,000 entries) for each Trendlog object. These log buffers are assigned in D-MAP RAM. If the log buffer size is changed and there is insufficient D-MAP RAM available, the Reliability property of the Trendlog object is set to Memory limit reached.

6 Max. number of physical data points (TX-I/O module) for PXC64-U is 200.

Max. number of physical data points (TX-I/O module) for PXC128-U is more then 200, however the reaction times are in accordance with following table and the system limits to consider.

The number of physical data points influences the reaction time of the application. If minimum reaction times are specified, the number of physical data points may have to be reduced.

The following relationship between reaction times and the number of physical data points can be assumed:

- up to 150 physical data points = Reaction times < 1s

- up to 250 physical data points = Reaction times 1…2 s

- up to 350 physical data points = Reaction times 2…3 s

8 The address of the PPS-2 devices QAX84.1 and RXZ90.1 is always 1 (no address selection).

9 PX KNX = PXC001.D / PXC001-E.D or PXC00-U with extension module PXA30-K11 and with PX KNX firmware loaded.

10 PX Open = PXC001.D / PXC001-E.D with option module PXA40-RS1/RS2 or PXC00-U or PXC64-U with extension module PXA30-RS… and with PX Open firmware loaded.

14 Maximum 30 calendar entries.

15 Max. number of physical data points for PXC100.D/-E.D is 200.

Max. number of physical data points for PXC200.D/-E.D is more then 200, however the reaction times are in accordance with following table and the system limits to consider.

The number of physical data points influences the reaction time of the application. If minimum reaction times are specified, the number of physical data points may have to be reduced.

The following relationship between reaction times and the number of physical data points can be assumed:

- up to 150 physical data points = Reaction times < 1s
- up to 250 physical data points = Reaction times 1…2 s
- up to 350 physical data points = Reaction times 2…3 s

16 Max. 5 TX Open per PXC50/100/200…D.

17 Number of switching times per day: 10; max. 5 BACnet references.

18 Number of switching times per day: 20; max. 5 BACnet references.

19 Every active trendlog multiple object needs a BACnet reference per logged value.

5 logged values are assumed for the number of trendlog multiple objects (number of Trendlog / 5).

Trends need 12 bytes per entry (irrespective of data type).

Max. 64 KB can be allocated to the log buffer (approx. 5,000 entries) for each trendlog object.

These log buffers are assigned in D-MAP RAM.

If the log buffer size is changed and there is insufficient D-MAP RAM available, the Reliability property of the Trendlog object is set to Memory limit reached.

20 Dynamic objects are counted the same as non-dynamic objects for total limits.

D-MAP RAM

If the whole D-MAP RAM is taken up with trendlog objects, a delta (differential) download will no longer be possible.

The overall size of the free and used D-MAP RAM can be viewed with XWP, Desigo CC, Desigo Insight or the PXM20 unit. The information concerned is stored in the device object under the memory statistics property [MemStc].

Access rights management

Access rights are managed via USPRF. You can define a maximum of 10 user groups and 20 users. 10 user groups and 6 users are already predefined as a template (global chart).

23.3.2 LonWorks System Controllers

Device combination: PXC00.D/-E.D + PXX-L11/12

Item	Limit
LonWorks devices: PXX-L11 PXX-L12	 60* (for example: 5 Group Members are defined, that means 5 x 12 = 60 COV resources are needed) 120* Max. number of integrated LonWorks devices covers RXC..., QAX50/QAX51 and third-party LonWorks devices.
Discipline I/Os	[600] max. number of discipline I/O objects
Groups	[50] max. Number of groups
Room members	No limits
Group members	Cross-disciplinary groups can have more than 5 destinations. The number of cross-disciplinary groups depends on the COV client resources (max. 250). A different number of COVs is required, depending on the group type. These must be multiplied by the number of destinations.

Table 119: LonWorks system controllers

Calculation basis:

HVAC	CHOGRP	1 COV client resource per destination
	SPGRP*	12 COV client resources per destination
	EMGGRP	1 COV client resource per destination
Lighting	LIGHTGRP	2 COV client resources per destination
Blinds	BLSGRP	4 COV client resources per destination
Building use	USEGRP	3 COV client resources per destination
Room occupancy	OCGRP	3 COV client resources per destination

LonWorks system controllers with physical I/Os and TX Open

Device combination: PXC50/100….D + PXX-L11/12

If the PXC50/100…D is used instead of the PXC00…D as a system controller, physical I/Os can be integrated via TX-I/O modules and TX Open data points. The reaction time can be greater for a larger number of physical I/Os or TX Open data points, and depending on the complexity of the CFC program.

23.3.3 Automation Stations with LonWorks Integration

Device combination: PXC50/100/200…D mit PXX-L11

The modular automation stations PXC50/100/200.D and PXC50/100/200-E.D allow the integration of LonWorks devices (RXC…, QAX50/QAX51 and third-party devices) via PXX-L11 in addition to the use of I/O modules or third-party devices via TX Open.

The integration on PXC50…D is limited to a maximum of 10 LonWorks devices.

The integration of LonWorks devices for PXC100/200…D is limited by response times.

The following values can be assumed for reaction times depending on the number of physical data points:

Reaction times depending on number of physical data points	Without LonWorks devices	Up to 5 LonWorks devices	5 to 20 LonWorks devices
Max. 150 data points	< 1s	1-2s	3-4s
Max. 250 data points	1-2s	2-3s	4-5s
Max. 350 data points	2-3s	3-4s	5-6s

Table 120: Reaction time

23.3.4 PX Open Integration (PXC001.D/-E.D)

These limits also apply to PXC00-U + PXA30-RS.

Item	Limit	Description
Modbus data points	[250*]	Max. number of data points per PX Modbus.
SCL data points	[250*]	Max. number of data points per PX SCL.
M-bus data points	[250*]	Max. number of data points per PX M-bus.
M-bus meters	[250]	Max. number of M-bus meters in PX M-bus applications.

Table 121: PX Open Integration (PXC001.D/-E.D)

23.3.5 PX Open Integration (PXC001.D/-E.D + PXA40-RS1)

These limits also apply to PXC00-U + PXA30-RS1.

Item	Limit	Description
Modbus data points	[800*]	Max. number of data points per PX Modbus.
SCL data points	[800*]	Max. number of data points per PX SCL.
M-bus data points	[800*]	Max. number of data points per PX M-bus.
M-bus meters	[250]	Max. number of M-bus meters in PX M-bus applications.

Table 122: PX Open Integration (PXC001.D/-E.D + PXA40-RS1)

23.3.6 PX Open Integration (PXC001.D/-E.D + PXA40-RS2)

These limits also apply to PXC00-U + PXA30-RS2.

Item	Limit	Description
Modbus data points	[2,000*]	Max. number of data points per PX Modbus.
SCL data points	[1,000*]	Max. number of data points per PX SCL.
M-bus data points	[2,000*]	Max. number of data points per PX M-bus.
M-bus meters	[250]	Max. number of M-bus meters in PX M-bus applications.

Table 123: PX Open Integration (PXC001.D/-E.D + PXA40-RS2)

23.3.7 PX KNX Integration (PXC001.D/-E.D)

These limits also apply to PXC00-U + PXA30-K11.

The maximum number of devices only applies in cases where only one device type is used. The following formula applies to mixed operation with third-party devices: 50 * RXB/RXL + third-party devices < 2,000 data points.

Item	Limit	Description
KNX/EIB data points	[2,000*]	Max. number of KNX data points that can be integrated (KNX communication objects).
RXB	45	Max. number of RXB devices per KNX (approx. 50 KNX data points per RXB, depending on the application).
RXL	45	Max. Number of RXL devices per KNX (approx. 50 KNX data points per RXL, depending on the application).

Table 124: PX KNX-Integration (PXC001.D/-E.D)

23.3.8 TX Open Integration (TXI1.OPEN)

Item	Limit	Description
TX OPEN (TXI1.OPEN)	100*	Max. number of data points per TX Open.

Table 125: TX Open Integration (TXI1.OPEN)

23.3.9 TX Open Integration (TXI2.OPEN)

Item	Limit	Description
TX OPEN (TXI2.OPEN)	160*	Max. number of data points per TX Open.

Table 126: TX Open Integration (TXI2.OPEN)

23.3.10 Number of Data Points on Desigo Room Automation Automation Stations

Number of data points on the TX-I/O subsystem

Every used data point on TX-I/O is counted.

ASN	Product description	Data points	Description
TXM1.6RL	6 I/O relay modules, bistable	max. 6	Used TX-I/Os are counted.
TXM1.8RB	8 I/O blinds modules	max. 8	Used TX-I/Os are counted (1 data point per relay).
TXM1.8T	8 I/O triac modules	max. 8	Used TX-I/Os are counted.
TXM1.8U	8 I/O universal modules (DI, AI, AO)	max. 8	Used TX-I/Os are counted.
TXM1.6R	6 I/O relay modules	max. 6	Used TX-I/Os are counted.
TXM1.8D	8 I/O digital input modules	max. 8	Used TX-I/Os are counted.
TXM1.16D	16 I/O digital input modules	max. 16	Used TX-I/Os are counted.

Table 127: Number of data points on the TX-I/O subsystem

Number of data points on DALI subsystem

Each individually controlled DALI lighting group and each individually controlled ECB counts as 1 data point.

ASN	Product description	Data points	Description
PXC3.E7xA PXC3.E16A-100A	Automation station	max. 64	DALI lighting groups and/or individual DALI ECBs are counted.

Table 128: Number of data points on DALI subsystem

Additional DALI limits:

- Max. number of devices: 64
- Max. number of addresses: 64
- Max. number of groups: 16

Number of data points on KNX PL-Link subsystem

KNX PL-Link devices have a set count whereas KNX S-Mode devices are counted according to the used group addresses.

ASN	Product description	Data points	Description
RXM21.1	Fan coil PL-I/O	5	Fixed count
RXM39.1	Fan coil PL-I/O	5	Fixed count
QMX3.P02	Freely configurable operator unit, wall mounted	9	Fixed count
QMX3.P30	Freely configurable operator unit, wall mounted	1	Fixed count
QMX3.P36	Freely configurable flush-mounted room unit	3	Fixed count
QMX3.P34	Freely configurable operator unit, wall mounted	3	Fixed count
QMX3.P37	Freely configurable operator unit, wall mounted	11	Fixed count
QMX3.P70	Freely configurable operator unit, wall mounted	3	Fixed count
QMX3.P74	Freely configurable operator unit, wall mounted	5	Fixed count

ASN	Product description	Data points	Description
AQR253… AQR257…	Flush-mounted room sensor with: Front module Base module	1-3	Fixed count, 1 data point per measured value (optional potential-free, passive NTC sensors are not counted)
UP220/31	Switch interface	4	Fixed count
UP221/x	Single switch	2	Fixed count
UP222/x	Double switch	4	Fixed count
UP223/x	Triple switch	6	Fixed count
UP287/x	Quadruple switch	8	Fixed count
UP258D1x	Occupancy, light sensor	2	Fixed count
UP255/D12	Brightness sensor	1	Fixed count
RL260xx	4 x binary input	4	Fixed count
RL512xx	1 x light 16A	1	Fixed count
RL513xx	3 x light 6A	3	Fixed count
RL521xx	2 x blinds	4	Fixed count
RS510xx	2 x light 10A	2	Fixed count
RS520xx	1 x blind	2	Fixed count
RS525xx	1 x light universal dim	1	Fixed count
UP285/x	1 x switch	2	Fixed count
UP286/x	2 x switch	4	Fixed count
UP287/x	4 x switch	8	Fixed count
UP510/xx	2 x light 10A	2	Fixed count
UP520/xx	1 x blind	2	Fixed count
UP525/xx	1 x light universal dim	1	Fixed count
GLB181.1E/KN	Damper actuator VAV KNX, AC 24 V, 10 Nm	2	Fixed count
GDB181.1E/KN	Damper actuator VAV KNX, AC 24 V, 5 Nm	2	Fixed count
KNX S-Mode	Third-party device		Group addresses used are counted

Table 129: Number of data points on KNX PL-Link subsystem

Additional PL-Link limitations:

- Max. number of devices: 64 on PXC3.xx
- The range of the Individual Address (IA) can be defined as follows in Desigo Room Automation V6.0:
  - S-Mode: 1 … 179
  - KNXnetIP: 180 und 181
  - PL-Link devices: 182 … 250
  - Desigo Room Automation automation station: 251
  - Max. number of KNX S-Mode group addresses: 238

23.3.11 Number of Data Points for PXC3

A PXC3.E72x supports max. 4 rooms or 8 room modules and is limited to 72 TX-I/O data points.

A PXC3.E.75 supports max. 8 rooms or 16 room modules and is limited to 200 TX-I/O data points.

These criteria must be satisfied to be able to select the correct PXC…:

- The physical TX-I/O data points used
- The total number of I/O data points used from TX-I/O, KNX PL-Link, and DALI

ASN	Physical TX-I/O data points used	Total I/O data points (TX-I/O, DALI, KNX PL-Link)
PXC3.E16A	n/a	64
PXC3.E72	72	140
PXC3.E72A	72	140
PXC3.E75	200	280
PXC3.E75A	200	280

Table 130: Number of data points for PXC3

Web clients for room operation

Item	Limit	Description
QMX7.E38 and standard web clients[1]	8	Recommended number of web clients that can simultaneously access a PXC3.
Templates with standard background pictures[2]	6	Maximum number of different templates which are using the default background pictures.
Customized background pictures[2]	1.5 MB	Maximum total size of all customized background pictures (the PNG file format is used as a reference).

Table 131: Web clients for room operation

Key:

[1] Restriction: When using standard web clients (web browser on PCs, smart phones, tablets, etc.), the screen display and operation (touch or mouse) are neither modified nor tested for the available browsers.

[2] Valid values when using 8 room applications at the boundary of maximum system limits.

23.3.12 Number of Data Points for DXR...

ASN	Max. number of onboard IO- and PL-Link data points	Description
DXR2.x11	30	1 DI, 2 UI, 6 Triac, 2 AO
DXR2.x12P	30	1 Pressure, 1 DI, 2 UI, 6 Triac, 2 AO
DXR2.x12PX	60	1 Pressure, 1 DI, 2 UI, 6 Triac, 2 AO
DXR2.x18	60	2 DI, 4 UI, 8 Triac, 4 AO
DXR2.x09	30	1 DI, 2 UI, 3 AO, 3 Relay
DXR2.x09T	30	1 DI, 2 UI, 4 Triac, 1 AO, 1 Relay
DXR2.x10	30	1 DI, 2 UI, 4 Triac, 3 Relay

Table 132: Number of data points for DXR…

Web clients for room operation

Item	Limit	Description
QMX7.E38 and standard web clients[1]	3	Recommended number of web clients that can simultaneously access a DXR2.
Templates with standard background pictures[2]	2	Maximum number of different templates which are using the default background pictures.
Customized background pictures[2]	1.5 MB	Maximum total size of all customized background pictures (the PNG file format is used as a reference).

Table 133: Web clients for room operation

Key:

[1] Restriction: When using standard web clients (web browser on PCs, smart phones, tablets, etc.), the screen display and operation (touch or mouse) are neither modified nor tested for the available browsers.

[2] Valid values when using 8 room applications at the boundary of maximum system limits.

23.3.13 PXM20 Operator Unit

Item	Limit	Description
PX (no PXC3)	50	Number of PX that can be operated. The visibility of the PX automation stations can be limited on the BACnet network. This is only useful if the site is restricted to one BACnet network. For hardware series A devices (1 MB memory), the number of PX automation stations per site should be limited to 30.
Alarm administration		Only the alarms from the site where the user is logged on are displayed (PXM20 self-registers as temporary alarm recipient for all devices of a site).
BACnet objects in alarm per site	50*	Maximum number of BACnet objects per site. The administration of the number of BACnet objects in alarm per site is limited. Others cannot be displayed or operated in Alarm Viewer when there are more BACnet objects in alarm.
Alarm History	50*	Maximum number of entries in the Alarm History. The oldest entries are deleted when this limit is exceeded.

Table 134: PXM20 operator unit

23.3.14 PXM20-E Operator Unit

Item	Limit	Description
PX (no PXC3)	[200]	Number of PX that can be operated. The visibility of the PX automation stations can be limited on the BACnet network. This is only useful if the site is restricted to one BACnet network.
Alarm administration		Only the alarms from the site where the user is logged on are displayed. (PXM20-E self-registers as temporary alarm recipient for all devices of a site).
BACnet objects in alarm per site	[250*]	Maximum number of BACnet objects per site. The administration of the number of BACnet objects in alarm per site is limited. Others cannot be displayed or operated in Alarm Viewer when there are more BACnet objects in alarm.
Alarm History	[100*]	Maximum number of entries in the Alarm History. The oldest entries are deleted when this limit is exceeded.

Table 135: PXM20-E operator unit

23.3.15 PXM10 Operator Unit

Item	Limit	Description
PX (no PXC3)	1*	Only the connected automation station / system controller can be operated.
Alarm administration		Management of the alarms of the PXC to which the PXM10 is connected.
BACnet objects in alarm per PXC	25*	Max. number of BACnet objects in alarm per PXC. The management of the number of BACnet objects in alarm per PXC is limited. Others cannot be displayed or operated in Alarm Viewer when there are more BACnet objects in alarm.

Table 136: PXM10 operator unit

23.3.16 PXA30-W0 and PXA40-W0 Web Controller Option Modules

Item	Limit	Description
PX (no PXC3)	1*	Only one PX with web controller can be operated, with attached module PXA30/40-W0.
Alarm administration		Alarm Viewer only handles the alarms from the local device.
SMS/Email messages	50*	Maximum number of SMS/email messages that can be sent. There is a limit to the number of messages sent by SMS/email. If more than this number of BACnet objects are in alarm in the BACnet internetwork, no SMS/email objects will be sent for these.
Alarm History	[250*]	Maximum number of entries in the Alarm History. The oldest entries are deleted when this limit is exceeded.
Web graphic pages	[100]	Number of web graphics: Limited at present by the available memory for the sum of all files of max. 7 MB.
Objects per web graphics page	60	Number of objects per web graphic.
Web clients	4	Number of simultaneously active web clients.

Table 137: Web-Controller Optionsmodule PXA30-W0 und PXA40-W0

PXA40-W0 can only be used together with PXC00/100/200-E.D (BACnet/IP).
PXA30-W0 can only be used together with PXC00/64/128-U.

23.3.17 PXA30-W1/W2 and PXA40-W1/W2 BACnet/IP Web Controller Option Modules

Item	Limit	Description
PX (no PXC3)	[20]	Number of PX that one web controller can operate.
Alarm administration		Management of all alarms in the BACnet internetwork (from all sites) (PXA30/40-W1/W2 registers as a temporary alarm recipient with all devices in the BACnet internetwork). In Alarm Viewer, only the alarms from the site where the user is logged on are displayed. However, alarms from all sites can be forwarded via SMS and/or email.
BACnet objects in alarm per internetwork	1,000*	Maximum number of BACnet objects in the alarm per BACnet internetwork. Administration of the number of BACnet objects in alarm per BACnet internetwork is limited. Others are not handled when there are more BACnet object in alarm.

Item	Limit	Description
BACnet objects in alarm per site	250*	Maximum number of BACnet objects per site. The administration of the number of BACnet objects in alarm per site is limited. Others cannot be displayed or operated in Alarm Viewer when there are more BACnet objects in alarm.
SMS/Email messages	50*	Maximum number of SMS / email messages that can be sent. The number of messages sent via SMS/email is limited. No SMS/emails messages are sent when there are more BACnet object in alarm in the BACnet internetwork.
Alarm History	[250*]	Maximum number of entries in the Alarm History. The oldest entries are deleted when this limit is exceeded.
Web graphic pages (VV2 only)	[100]	Number of web graphics: Limited at present by the available memory for the sum of all files of max. 7 MB.
Objects per web graphics page (VV2 only)	60	Number of objects per web graphic
Web clients	4	Number of simultaneously active web clients

Table 138: PXA30-W1/W2 and PXA40-W1/W2 BACnet/IP web controller option modules

PXA40-W1/W2 can only be used together with PXC00/100/200-E.D (BACnet/IP).
PXA30-W1/W2 can only be used together with PXC00/64/128-U.

23.3.18 PXA30-W1/W2 BACnet/LonTalk Web Controller Option Modules

Item	Limit	Description
PX (no PXC3)	[15]	Number of PX that one web controller can operate.
Alarm administration		Management of all alarms in the BACnet internetwork (from all sites) (PXA30/40-W1/W2 registers as a temporary alarm recipient with all devices in the BACnet internetwork). In Alarm Viewer, only the alarms from the site where the user is logged on are displayed. However, alarms from all sites can be forwarded via SMS and/or email.
BACnet objects in alarm per internetwork	100*	Maximum number of BACnet objects in the alarm per BACnet internetwork. Administration of the number of BACnet objects in alarm per BACnet internetwork is limited. Others are not handled when there are more BACnet object in alarm.
BACnet objects in alarm per site	50*	Maximum number of BACnet objects per site. The administration of the number of BACnet objects in alarm per site is limited. Others cannot be displayed or operated in Alarm Viewer when there are more BACnet objects in alarm.
SMS/Email messages	50*	Maximum number of SMS / email messages that can be sent. The number of messages sent via SMS/email is limited. No SMS/emails messages are sent when there are more BACnet object in alarm in the BACnet internetwork.
Alarm History	[50*]	Maximum number of entries in the Alarm History. The oldest entries are deleted when this limit is exceeded.
Web graphic pages (VV2 only)	[100]	Number of web graphics: Limited at present by the available memory for the sum of all files of max. 7 MB.
Objects per web graphics page (VV2 only)	60	Number of objects per web graphic
Web clients	4	Number of simultaneously active web clients

Table 139: PXA30-W1/W2 BACnet/LonTalk web controller option modules

PXA40-W1/W2 can only be used together with PXC00/100/200-E.D (BACnet/IP).

PXA30-W1/W2 can only be used together with PXC00/64/128-U.

23.3.19 PXG3.W100 Desigo Web Server

General

Item	Limit	Description
Automation station (PX…)		Unlimited number of PX (limited only by the BACnet object and the number of customized views). Adhere to the specified Desigo PX.. limits.
Configuration data size	7 MB*	Limited by the available memory for all configuration data (Configurationdata.tar).
BACnet objects, total number	2,000*	Max. number of BACnet objects engineered on PXG3.W100.
Permanently displayed BACnet objects	300	Total number of permanently displayed BACnet objects which are updated by PXG3.W100.
Customized Views	25*	Max. number of customized views (memory limit of PXG3.W100).

Table 140: General

Customized views

Item	Limit	Description
BACnet objects	100*	Max. number of BACnet objects per customized view.
Trends	10	Number of trends per customized view.
Scheduler	10	Number of schedulers per customized view.
Graphics pages	5	Number of graphics pages per customized view.

Table 141: Customized views

Graphics pages

Item	Limit	Description
BACnet objects	60*	Max. number of BACnet objects per graphics page.

Table 142: Graphics pages

Connected web clients

Item	Limit	Description
Touch panel	10*	Max. number of touch panels per PXG3.W100 with overview pages.
Web clients, max. system design	3*	Max. number of registered users per PXG3.W100, where the limit of permanently displayed BACnet objects of all clients may not be exceeded at maximum system design[1].
		At low system design, more than 3 users can be logged in concurrently. Example: 1 customized view at 3 graphics pages at 10 BACnet objects each. If 10 web clients are connected to it, the system limit (300 permanently displayed BACnet objects) is reached. All system limits must be adhered to simultaneously.

Table 143: Connected web clients

Key:

[1] An example of a maximum system design:

- 20 customized views
- 5 graphics pages per customized view
- 20 BACnet objects per graphics page. System limit: 2000 BACnet objects total and 100 BACnet objects per customized view.
- 3 Web clients with the above design. System limit: 300 permanently displayed BACnet objects.
- 10 trends per customized view
- 10 schedulers per customized view. System limit: The configuration data size < 7MB applies to all of the above.

23.3.20 PXG3.L and PXG3.M BACnet Routers

Item	Limit	Description
BDT (Broadcast Distribution Table)	[50*]	Max. number of BBMDs (BACnet Broadcast Management Devices) in a BACnet internetwork. If a BACnet router is in its own IP segment, it must be configured as a BBMD.
FDT (Foreign Device Table)	[50*]	Maximum number of foreign devices which can register with the BACnet router. Desigo CC and Desigo Insight management stations in a remote IP segment count as foreign devices.
Ethernet bit rate	10/100 Mbit/s	The router supports 10/100 Mbps.
MS/TP telegrams	[100 - 140] pkt/s @115,200 bps [-120] pkt/s @76,800 bps Max. [~4,5] KB/s	The BACnet router integrates BACnet MS/TP not as a field bus in the network. The router operates transparently and routes all data traffic addressed to the subnet. This is why global broadcast telegrams negatively impact transmission performance of the router and end devices. Recommendation: Do not carry out time and security-critical process controls using BACnet MS/TP. Depends on baudrate, number of nodes and maximum number of data frames (N max_info_frames).
BACnet/LonTalk	[100 - 120] pkt/s @78 KB/s Max. [~4,5] KB/s	The BACnet router integrates one (1) BACnet/LonTalk network. The router operates transparently. The same restrictions apply to global broadcast telegrams as for MS/TP.
BACnet/IPv4	[~2500] pkt/s Max. [~500] KB/s	The BACnet router can route between two BACnet/IP networks. The BACnet/IP networks have different UDP ports.
BACnet/IPv6	1	The BACnet router integrates one (1) BACnet/IPv6 network. The router works transparent, but when connection ports for BACnet/IPv4 and BACnet/IPv6 are used simultaneously, make sure that no unintentional ethernet loops are created on the IT side.

Table 144: PXG3.L and PXG3.M BACnet routers

23.3.21 PXG80-N BACnet Router

Item	Limit	Description
BDT (Broadcast Distribution Table)	10*	Max. number of BBMDs (BACnet Broadcast Management Devices) in a BACnet internetwork. If a BACnet router is in its own IP segment, it must be configured as a BBMD.
FDT (Foreign Device Table)	10*	Maximum number of foreign devices which can register with the BACnet router. Desigo CC and Desigo Insight management stations in a remote IP segment count as foreign devices.
Ethernet bit rate	10 Mbit/s	The router only supports 10 Mbps. Use dual-speed hub/switch.

Table 145: PXG80-N BACnet router

23.3.22 SX OPC

Item	Limit	Description
SX OPC applications	1	SX OPC application per PC. The performance depends on the PC hardware.
OPC server	[10]	Max. number; OPC data access 2.x or 3.0 specification.
BACnet objects	20,000*	Maximum number of BACnet objects.
Configured alarm recipients	3*	
Temporary alarm receiver	20*	Minus configured alarm recipients.
Alarm-generating objects	[2,000]	Alarm-generating objects (of total 20,000 BACnet objects).
SX BACnet references client resources[1]	[1,000]	
Trendlog objects	1000	Maximum number.
Scheduler program / Scheduler objects	[15]	Per BACnet server.
Calendar objects	[10]	

Table 146: SX OPC

Key:

[1] Max. number of BACnet client connections (COF or polling), that is, values read from or written to (commanded) the own automation station or a remote automation station.

BACnet client connections are used in Input, Output, Scheduler, Trendlog and Group objects (all NameRef_Type inputs with AddrKind = B). The configured alarm receivers of the Notification Class objects do NOT require any BACnet client references.

The available number of BACnet client references does not address more than 50 different remote automation stations.

23.3.23 Desigo CC

Ensure that your project does not violate any of the listed system limitations.

Item	Limit
Maximum number of objects handled by the Management System Server	150,000 (requires HW Category D, restricted to 2 languages)
Maximum number of Installed Clients	10
Maximum number of Windows App and Web Clients	27
Maximum number of active Web service sessions	100
Maximum number of FEPs	5
Maximum number of drivers per FEP and Server	5
Maximum of tags exposed by the OPC Server	40,000
Minimum network throughput for Windows App or Web Clients using VPN	Minimum 512 kbps up / 6 Mbps down (ADSL) Maximum Latency: 100 ms

Item	Limit
Alarm load (rate of new alarms)	Desigo CC has been tested for the alarm loads listed below. Do not exceed: Constant load of 1 alarm per second in average 10 alarms per second in average over a time period of 20 minutes 50 alarms per second over a time period of 20 seconds (alarm burst) (the test was measured with one alarm burst per hour). "Alarm per second" indicates the arrival of a new event/fault/alarm and includes the handling cycle until it is closed later. If Operating Procedures (OPS) are used during event handling, the maximum load is reduced depending on the complexity of the OPS.
Maximum number of Activity logs per day	1,000,000
Maximum number of Event records per day	1,000,000
Maximum number of Trend records per day	4,200,000

Table 147: Desigo CC system limits

For further system configurations of the Desigo CC management platform, see *Desigo CC System Description Part C Appendix* (A6V10415500).

Desigo CC V2.1 does not support Terminal Server.

Visonik is not integrated in Desigo CC.

NCRS is not integrated in Desigo CC.

NITEL is not integrated in Desigo CC.

Unigyr is not integrated in Desigo CC.

A pharma solution will be implemented in Desigo CC V3.0.

23.3.24 Desigo CC with Desigo Room Automation

Item	Limit	Description
Rooms per Desigo CC device	[3,000]	Max. number of rooms per Desigo CC V2.1 device.

Table 148: Desigo CC with Desigo Room Automation

23.3.25 Desigo CC with PX Subsystem

Item	Limit	Description
BACnet internetworks	10	Internetwork can be extended with additional FEPs. Max. FEPs: 5
Connected sites	80*	Max. number of sites that can be simultaneously connected. This corresponds as well to max. 80 defined sites, since Connect does not exist.
Defined users	[100]	Max. number of definable users. This is not a fixed, definable limit. Theoretically, the maximum number would be 65535, but that does not make much sense.
Active users	10	Max. number of users that can be active at the same time. The limits for maximum number of clients apply to operating a PX subsystem through Desigo Web.
BACnet objects	[65,000]	Max. number of physical BACnet objects (corresponds to 150,000 data points).

Table 149: Desigo CC with PX subsystem

23.3.26 Desigo Insight General Limits

The limits are valid per Desigo Insight project.

Item	Limit	Description
Physical data points	[100'000*]	
Citect tags	[200'000*]	
Users	[100]	Defined.
Users	10	Concurrently active for Desigo Insight workstation.
Users	14	Concurrently active for Terminal Server (7 per server) – 32 bit.
Users	40	Concurrently active for Terminal Server (20 per server) – 64 bit.
Users	100	Concurrently active for Web Server (50 per server).
Citect graphic pages	[2'000]	
Data points on one side	200	Typically 50. To ensure satisfactory performance, do not use more than 50 data points per page for web pages.
RX displayed on one page	[100]	Typically one floor.
Reaction time when opening a graphic	Typically 4s	Depends on topology, hardware configuration, project size, user activity, etc.
Online trends per desktop user	[100]	Channels (curves).
Online trends per desktop user	[150'000]	Number of trend values sampled online. This restriction limits the length of time an online trend may run: Max. 24 hours of live sampling, with 100 channels and a sample rate of 1 minute. With fewer channels or a reduced number of samples, the running time can be increased.
Online trends per server (RDT or Web)	[100]	Channels (curves). The limits are per server. Correspondingly fewer trend channels per web or RDT client can be used.
Online trends per server (RDT or Web)	[150'000]	Number of values sampled online. This restriction limits the length of time an online trend may run: Max. 24 hours of live sampling, with 100 channels and a sample rate of 1 minute. With fewer channels or a reduced number of samples, the running time can be increased.
Tendlog values per day	[3'000'000]	We recommend no more than 100,000 queries of trend log values per day via PTP. The maximum data amount can be limited by project-specific engineering.
Trendlog objects	[10'000]	The defining limit is the number of trendlog values per day. The maximum number of trendlog objects is based on the assumption that approximately 100 values are recorded per trendlog object per day. We recommend no more than 1,000 queries of trend log values per day via PTP. The maximum data amount can be limited by project-specific engineering.
Trendlog values available in database	[135'000'000]	135 million. If 3,000,000 values are logged daily, the database capacity must be set to 1 month. At 2 million, capacity can be increased to 2 months, that is, users can view trends from the past 2 months without having to get them from the archive.
Log entries per day	[32'000]	The system is able to process 1 entry per second. A higher load is possible for a brief period (max. 500 per minute). To ensure the max. number of entries in the database is not exceeded, 32,000 entries per day cannot be exceeded for 1-month database capacity (2 months: 16,000, 3 months: 11,000, 1 year: 2750).

Item	Limit	Description
Log entries available in database	[1'000'000]	1 million. If 10,000 entries are logged daily, database capacity can be set at 3 months, that is, users can view log entires from the past three months without having to get them from the archive.
Active alarms in alarm database	[400]	
Alarms per minute (including routing)	3	Average per day. Typical maximum is 1. Alarms are processed, for example, acknowledged and forwarded.
Alarms per alarm cascade	[350]	Alarm cascades may occur up to once per day.
Communication time for an event	Typically 3s	Depends on topology, hardware configuration, project size, user activity, etc. Typically 10 … 15 s for web pages, depending primarily on network bandwidth.
Queued router jobs	[5000]	Including unacknowledged popup
Router groups	[500]	
SMS recipients	[100]	
Router table entries	[1000]	
Report definitions	[1'000]	The main factor is the number of simultaneously run reports and hence, the number of objects of the same type (alarm, log or online entries) that are read simultaneously.
Alarm report entries	[1'000]	
Alarm reports executed	[720]	Per day, if the number of entries in average in the alarm database is < 100.
Log report entries	[1'000'000]	Given by the max. number of log entries in the database.
Log reports executed	[144]	Per day, if the number of entries if the average number of entries in the log database is < 100,000.
Point report entries	[10'000]	Including emergency lighting and group reports
Point reports executed	[288]	Per day, if the number of online objects per report is < 500 and is already limited accordingly in the address binding (does not apply to telephony connections).
Maximum number of Reaction Processor entries	[1'000]	Maximum number of entries in the reaction catalog.
Maximum number of output objects	[300]	Maximum number of output objects in the reaction catalog.
Reaction time on COV	Typically 3s	Reaction time to COVs.
Time resolution for reaction entries	[1 min]	Time resolution for reaction time entries.
Sites	[1'000]	
Simultaneous connections to sites	[8]	Serial.
Simultaneous connections to sites	[255]	LAN/WAN
Maximum number scope rules per definition	[50]	Maximum number of entries for rules in the scope designer per scope definition (valid for categories and disciplines).
Maximum number scope definitions for categories	[unlimited]	Maximum number of scope definitions for categories in the System Configurator.
Maximum number scope definitions for disciplines	[unlimited]	Maximum number of scopes definitions for disciplines in the System Configurator.
Maximum number scope definitions per user group / user	[25]	Maximum number to a user group / user assigned scope definition (total number – valid for categories and disciplines).

Table 150: Desigo Insight general limits

Reaction times with Desigo Web are slower than with Desigo Insight or Desigo Insight Terminal Server. Reaction times are highly dependent on the available bandwidth and the contents of the requested page.

The values defined above for trend, logging, alarms, reporting and reactions refer to the limits for the application concerned. Above all, a limit is imposed in the network by the number of channels available. This means that Desigo Insight cannot run in a stable manner if all these applications are operated at or close to their upper system limits. The channels available vary depending on the subsystem (see the following chapters).

23.3.27 Desigo Insight Terminal Server

Item	Limit	Description
Remote Desktop Client per Server	7	32-bit: The limit is heavily dependent on the performance of the server (CPU, memory). Min. memory required: 512 MB + 256 MB per active client.
Remote Desktop Client per Server	20 - 40	64-bit: The limit is heavily dependent on server performance (memory, CPU). Minimum RAM: 512 MB basic required + 256 MB per active client.
Minimum Bandwith	56 kb/s	Recommended: 100 kbps or higher. Desigo Insight Terminal Server requires Windows 2008 R2 or Windows 2012 Server.

Table 151: Desigo Insight Terminal Server

23.3.28 Desigo Insight with Desigo Room Automation

Item	Limit	Description
Rooms per site	[4,000][1]	Max. number of rooms per Desigo Insight site.

Table 152: Desigo Insight with Desigo Room Automation

Key:

1 Desigo Insight can import up to 2,000 rooms in one site. If more rooms are needed, you must engineer an additional site. The Desigo Insight Group Editor cannot handle groups over multiple sites.

23.3.29 Desigo Insight with PX Subsystem

Item	Limit	Description
BACnet internetworks	200 IP + [3 LonTalk] + 1* PTP	For each data link layer a BACnet internetwork is configured in Desigo Insight. Several internetworks could be created for LonTalk and IP. For PTP connections (remote sites) only one internetwork can be defined.
Update channels	[1'000]	Max. number of simultaneously active BACnet COVs (Change of Value).
Load due to the Reaction Processor in Desigo Insight	[100]	Per PX controller (25% of 400 channels).
Connected sites	255*	Max. number of concurrently connected sites.

Item	Limit	Description
Defined sites	[1'000]	Max. number of sites which can be defined.
Defined users	[100]	Max. number of users which can be defined.
Active users	10	Max. number of users which can be active simultaneously. When operating a PX subsystem via Desigo Web or Desigo Insight Terminal Server, the limits on the maximum number of clients apply.
BACnet objects	[100'000]	Max. number of BACnet objects that can be integrated into Desigo Insight.

Table 153: Desigo Insight with PX subsystem

23.3.30 Desigo Insight with Visonik DCS

Item	Limit	Description
Desigo Insight per subsystem / device	[4]	Perr Visonik DCS.
Desigo Insight per subsystem device	[10]	Per Visonik system network.
DCS objects	[100'000]	Max. number of DCS objects that can be integrated into Desigo Insight.
Connected sites	20	Max. number of concurrently connected sites.
Update channels (COV based)	[1'400]	Per Visonik DCS.
Load due to the Reaction Processor in Desigo Insight	[350]	Per DCS (25% of 1400 channels).

Table 154: Desigo Insight with Visonik DCS

23.3.31 Desigo Insight with Integral NCRS Controller

Item	Limit	Description
Number of Desigo Insight workstations or servers per NCRS system controller	2*	Max. number of active connections per NCRS (for more connections, additional NCRS controllers are required).
NCRS objects/blocks	[200'000]	Max. number of NCRS objects that can be integrated into Desigo Insight.
Connected sites	[50]	Max. number of concurrently connected sites.
Update channels (COV based)	512*	Per NCRS connection.
Load due to the Reaction Processor in Desigo Insight	[128]	Per NCRS (25% of 512 channels).

Table 155: Desigo Insight with Integral NCRS controller

23.3.32 Desigo Insight with Integral NITEL Interface

Item	Limit	Description
Number of Desigo Insight workstations or servers per NITEL communications interface	1*	Max. number of concurrently active connections per NITEL. A maximum of 4 dial-up connections may be defined per NITEL (additional NITEL communications interfaces are required in the case of several concurrent connections, max. 3 allowed per RS bus).
NITEL/RS data point objects	[200'000]	Max. number of RS data points that can be integrated into Desigo Insight.
Connected sites	8	Max. number of concurrently connected sites.

Item	Limit	Description
Update channels (COV based)	[200]	Per NITEL.
Load due to the Reaction Processor in Desigo Insight	[25]	Per NITEL (25% of 100 channels).
Users in Desigo Insight Terminal Server mode for NITEL Terminal (per NITEL)	1*	Max. number of users. This interrupts the operation of the other Desigo Insight applications.
Users in Desigo Insight Terminal Server mode for RS access (per NITEL)	1*	Max. number of users. This interrupts the operation of the other Desigo Insight applications.

Table 156: Desigo Insight with Integral NITEL interface

23.3.33 Desigo Insight with Unigyr

Item	Limit	Description
Desigo Insight per subsystem/device	2	Per Unigyr BLN. If more than 2 Desigo Insight workstations are used, I/O servers are required on the LAN.
Unigyr controllers per system	200	Typical limit 30. 200 controllers with remote connections (as in Unigyr system).
Number of Profibus cards per PC		See Unigyr limitation.
Unigyr physical data points per system	[6,000]	Typical limit 3,000. An average of 30 Citect tags is required per physical data point.
Unigyr parameters/pins per system	[200,000]	Typical limit 30,000. The number of Unigyr parameters/pins is limited by the permissible number of Citect tags. The number of Citect tags per I/O server is limited.
Connected sites	[4]	Max. number od concurrently connected sites. Limited by the permitted number of I/O servers.
Transfer rate at BLN	[10 values/s]	Typical value with 30 controllers.
Transfer rate over dialup telephone network	[2 values/s]	

Table 157: Desigo Insight with Unigyr

23.3.34 Desigo Insight with OPC/SCADA Subsystem

Item	Limit	Description
Number of remote OPC Servers that can be integrated to one I/O server machine	[32*]	There is a maximum limit of 32 remote OPC servers, for each of which one board and one port must be created.
Maximum number of variable tags per I/O Server	[25,000]	For every additional 25,000 tags, use additional I/O server(s).
Maximum number of variable tags per OPC I/O device	[300]	Each OPC server can be configured as a multiple I/O device, thereby creating multiple logical groups. If OPC quality stamps and timestamps are engineered, these are counted as additional tags.
Minimum OPC group refresh rate	1,000 ms	Depending upon the machine resource consumption, the refresh rate may have to be increased.
Minimum alarm scan period	500 ms	Depending upon the machine resource consumption, the scan period may have to be increased.
Maximum number of alarm tags (of all types) running on the same machine as the I/O server	[5,000]	If the number of alarm tags exceeds 5,000, we recommend that you run the alarm server on a separate machine.

Item	Limit	Description
Maximum number of trend tags	[5,000]	If the number of trend tags exceeds 5,000, we recommend that you run the alarm server on a separate machine. Only periodic trend tags are supported.
Minimum sample period for trend tags	1* sek	
Maximum load on trend export	[1,000 samples / minute]	The trend export load is calculated as follows: Number of trend tags, sample period and export upload period. If the load exceeds this amount, we recommend that you run the trend server on a separate machine and use SQL server edition instead of MSDE.
Minimum bandwidth required between I/O/trend/alarm server and clients	[100 Mbit/s]	

Table 158: Desigo Insight with OPC/SCADA subsystem

23.3.35 Desigo Insight Pharma Solution

The integrated Pharma solution introduced as part of Desigo Insight V4.0, with the functions Audit Trail and XML archive file format, is also an integral component of Desigo Insight V6.0. The mandatory comment option is supported as part of the standard license as of Desigo V5.0 together exclusively with Desigo PX.

With Desigo Insight V5.0, the high requirements placed on IT integration, availability and long-term data backup are tested and secured.

23.3.36 Desigo Connect

Item	Limit	Description
Data connections	200	Max. number of definable data connections. Desigo Connect allows the exchange of data between the automation stations of a PX site and the automation stations of a Unigyr, Integral or Visonik site via Desigo Insight. The Unigyr, Integral and Visonik sites cannot exchange data between themselves. The data exchange is only possible when the Desigo Insight management station is active. The exchange of critical values is not permitted.

Table 159: Desigo Connect

23.3.37 Desigo Reaction Processor

Item	Limit	Description
Maximum number of entries	[1,000]	Maximum number of entries in the reaction catalog.
Maximum number of output objects	[300]	Maximum number of output objects in the reaction catalog.
Reaction time on COV	[3 Sek]	Reaction time to COVs.
Maximum reaction frequency	[1/5 Sek]	The maximum frequency of all reactions, that is, a reaction can be processed every 5 seconds.
Maximum number of reactions	[10,000/24h]	The maximum number of all reactions that can be processed during a 24 hour period.
Limit: Load created by Reaction Processor in Desigo Insight		Limit control of load created by reaction program.
	[100]	Per PX compact (25% of 400 channels).
	[400]	Per PX modular (25% of 1600 channels).
	[350]	Per DCS (25% of 1400 channels).
	[128]	Per NCRS (25% of 512 channels).
	[25]	Per NITEL (25% of 100 channels).

Table 160: Desigo Reaction Processor

23.3.38 ADP/CC

Item	Limit	Description
ADP/CC clients	[99]	Max. 99 clients (hard coded).
Database size [GB]	[10]	Limitation with Microsoft SQL Server 2012 R2 Express.
Database size [GB]	-	No limit with SQL server.
ADP reporting series		
- Excel data series	[128]	Max. number of data series in Excel.
- List data series	[256]	Max. number of data series in list.
- Trend data series	[10]	Max. number of data series in trend.
- Values per data series	[10,000]	Max. number of values per data series in a trend.
Link to Desigo from V2.3	[255]	Links to Desigo Insight as of V2.3 with DataStudio.
Links to other SBT systems and devices	[255]	Links to DataStudio with Unigyr, TS1500, MS2000, Siclimat, and Desigo Insight V1.1. Direct link to DataComm with Visonik.
CC node in the building structure	[1,000]	1,000 nodes recommended (technical limit is 9,500* nodes).
CC meters	[2,000 – 4,000]	Depends on PC performance.

Table 161: ADP/CC

23.3.39 InfoCenter

Item	Limit	Description
InfoCenter clients	[99*]	Max. 99 clients with the SQL server.
Database size [GB]	[6]	For active and auxiliary databases.
Auxiliary databases	[20]	Max. number of auxiliary databases.
InfoCenter reporting series		
- Import data series	[50,000]	Max. number of trend data series from data servers (recommended).
- Extracted values	[10,000]	Max. number of summary data series.
- Tree branches	[2,000]	Max. number of branches in the hierarchical structure.
- InfoCenter users	[1,000*]	Max. number of users per Windows users group.
- Data collection performance	50,000	Max. number of records per data sampling intervall.
- Links to Desigo Insight	[5]	Links to Desigo Insight with InfoCenter data server.
- Links to OPC server	5*	Links to OPC servers with the InfoCenter OPC option.
Report Manager		
- Report templates	[1,000]	Max. number of report templates.
- Data series per graph	10	Max. number of data series per graphic template.
- Data series per report object	50*	Max. number of data series per report object template.

Table 162: ADP/CC

23.3.40 Desigo Xworks Plus (XWP)

Item	Limit	Description
Length of site name	9	Max. 9 characters.
Number of XWP per BACnet internetwork (parallel engineering)	10	Parallel engineering is possible under the following limitations: Node setup: Only one XWP per LonWorks/IP segment. Download and online operation: Only one XWP per automation station.
Number of I/O function block instance per plan	200	The number of I/O function block instances are limited per plan (compound). Mapping of function blocks on BACnet sets the limit. The limit is lower for other function blocks mapped to BACnet.

Table 163: Desigo Xworks Plus (XWP)

Problems with a high number of data points per automation station

When the maximum number of data points for a PXC..U is reached (350), it may no longer be possible to load the program into the PX automation stations due to the number of data blocks generated during compilation.

In this case, carry out the following steps on the PX automation station:

1. Reload parameters.
2. Run Reorganize in the **PX Design Manager**.
3. Go to **Tools > Settings > Compilation download** and select the **Compress** check box.
4. Recompile the data.
5. Perform a full download.

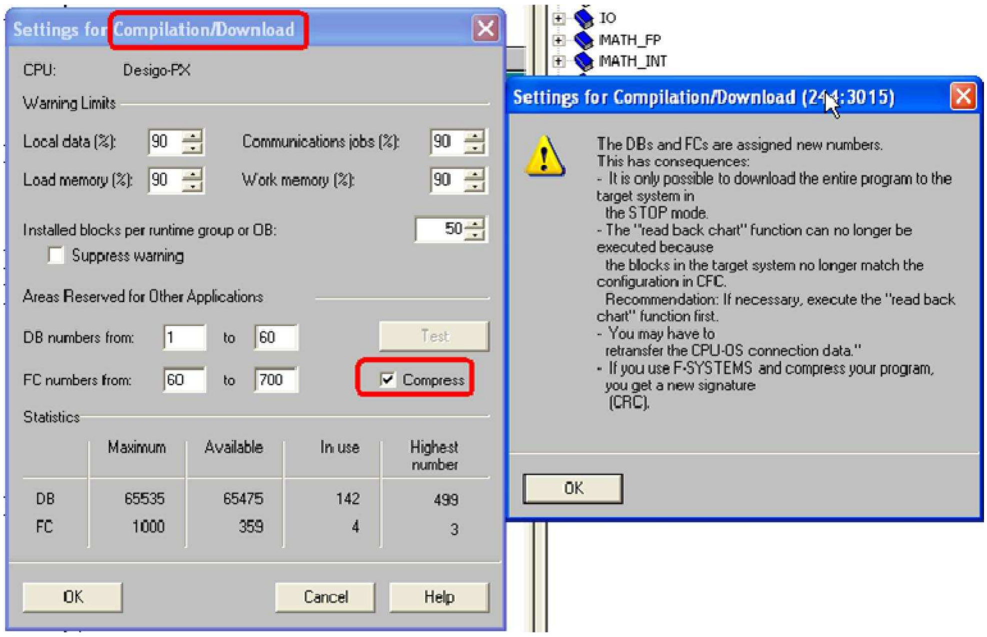


Figure 269: Compress data blocks in PX

23.3.41 Desigo Automation Building Tool (ABT)

Item	Limit	Description
Function blocks	[8,000]	Max. number of function blocks per application function.

Table 164: Desigo Automation Building Tool (ABT)

23.4 Applications

23.4.1 Peak Demand Limiting (PDL)

Item	Limit	Comment
Monitored loads	[28*]	Max. number of monitored loads.
Tariff limits	4*	Max. number of configurable tariff limits.
Cycle time [ms]	500	Minimum cycle time required to ensure the functioning of the PDL application. To guarantee the cycle time, use a PX modular automation station (PXC64/128 U, PXC 100/200…D, PXC12/22/36…D, or PXC52 from hardware version D). Do not use the the automation station with the PDL application to control any other plant. The PDL application must be confined to one automation station only. Limit control is binary only (enabled/disabled). Step control (Stage1, Stage2, Stage3) or modulating control (0…100%) is not possible. Commissioning and operation are only possible with XWP. There is no provision for backward compatibility with future PDL applications.

Table 165: Peak Demand Limiting (PDL)

24 Compatibility

For information on the system compatibility with the Desigo CC management station, see *Desigo CC System Description* (A6V10415500).

For information on the compatibility of Desigo S7 with other Desigo system components, see chapter *Desigo S7 Automation Stations*.

24.1 Glossary

Abbreviations

The following abbreviations are used in this document:

Abbreviation	Description
ABT	Automation Building Tool (XWP program component for engineering Desigo Room Automation)
ADP	Advanced Data Processing
AS	Automation Station
BOS	Branch Office Server
CC	Desigo CC management station / Consumption Control
CAS	Corporate Application Solutions (standard PX application libraries provided by HQ)
DCM	Desigo Configuration Module
Desigo PX	Compact and modular automation stations and system controllers (PXC…D and PXC..-U)
DI	Desigo Insight
DIGG	Desigo Insight Graphic Generator
DNT	Discovery Network Tool
DPT	Desigo Point Test Tool (for Desigo PX)
DTS	Desigo Toolset
ETS	Engineering Tool Software (KNX commissioning tool for RXB and KNX third-party devices)
FEP	Front End Processor (the computer serving as the interface between the automation level and Desigo CC)
FW	Firmware
HQ	Headquarters of Siemens Building Technologies in Zug (Switzerland)
HW	Hardware
IE	Internet Explorer
IIS	Internet Information Services
LED	LibSet Extension of Desigo (assigned LibSet numbering system displaying functional extensions of Libsets)
LibSets	Library Set. Standard application libraries. Each LibSet delivery is assigned to a Desigo system version.
LMU	Library Maintenance Utility (library maintenance tool for XWP)
OS	Operating System
Operator units	Operator units Desigo Touch and Web (PXM40/50 with PXG3.W100), PXM20(-E), PXM10, PX Web and Desigo Insight
RC	Regional Company (Siemens regional company)
RXT	LonWorks commissining tool for RXC
SD	System Design (part of the Desigo tool set)
SP	Service Pack

Abbreviation	Description
SSA	Service & Setup Assistant (commissioning tool for Desigo Room Automation)
SW	Software
V5.1 SP	Service Pack version for Desigo V5.1
VVS	Valid Version Set (set of released versions)
WEoF	Internal Siemens PC standard (only relevant for Siemens employees)
XWP	Desigo Xworks Plus

Table 166: Abbreviations

Terms

The following terms are used in this document:

Term	Description
Project data	Desigo engineering and project data required to create runtime systems, but that are no longer needed for operation (offline data).
Runtime system	Firmware (loaded) installed on the hardware of the customer plant or software with compiled project data including libraries (online data).
New	New Desigo customer project with no Desigo runtime system and project data.
Extension	Existing plant or installation (existing Desigo runtime system with project data) that is being expanded or extended (for example, additional buildings).
Migration	Replacement of existing plant or installation (existing Desigo / Visonik / Unigyr / Integral runtime system with project data) by new technology with a change of software and/or hardware.
Upgrade	Functional improvement to existing plant or installation (existing Desigo runtime system with project data) by deploying developments for a new Desigo system version.
Update	Existing plant or installation (existing Desigo runtime system with project data) is updated within the same version (for example, to eliminate errors with a service pack).
Project data conversion	Online Desigo project data from earlier Desigo versions > V2.3x are migrated to the current ABT/XWP V6.0 version when opened in ABT/XWP V6.0. During conversion, the existing database structure and/or associated tool landscape is migrated to the latest version. A conversion always impacts all project data of a tool project. The project data and libraries remain unchanged. The runtime system (online project data) does not change, that is, the original version status remains as is.

Table 167: Terms

24.2 Desigo Version Compatibility Definition

General definition

The Desigo V6.0 version compatibility describes the compatibility of Desigo products:

- Within a Desigo Xworks Plus (XWP) project (incl. ABT/SSA)
- With the same tool project data
- On a Desigo V6.0 runtime system

The compatibility also comprises Desigo project data at both the management level and room automation linked to the same Desigo Xworks Plus (XWP) project.

Any reference to Desigo V5.1 also includes the Service Pack version for Desigo V5.1 (V5.1 SP) unless otherwise mentioned.

Desigo system versions

The term refers to the various development phases of the Desigo building automation and control system. The currently supported versions are:

- Desigo V2.2
- Desigo V2.3
- Desigo V2.35
- Desigo V2.36
- Desigo V2.37 (Desigo Insight V3)
- Desigo V4.0
- Desigo V4.1
- Desigo V5.0
- Desigo V5.1
- Desigo V6.0

Desigo CC supports Desigo PX V5.1 SP and V6.0.

24.3 Desigo V6.0 System Compatibility Basics

24.3.1 Compatibility with BACnet Standard

Desigo V6.0 supports the following BACnet protocol revisions:

- Desigo Insight: 1.13
- Desigo CC: 1.13
- Desigo Room Automation devices: 1.13
- Desigo PX, PXM20: 1.12
- PXG3.W100: 1.10
- PXG3 router: 1.10

There are third-party BACnet devices on the market that support higher BACnet protocol revisions.

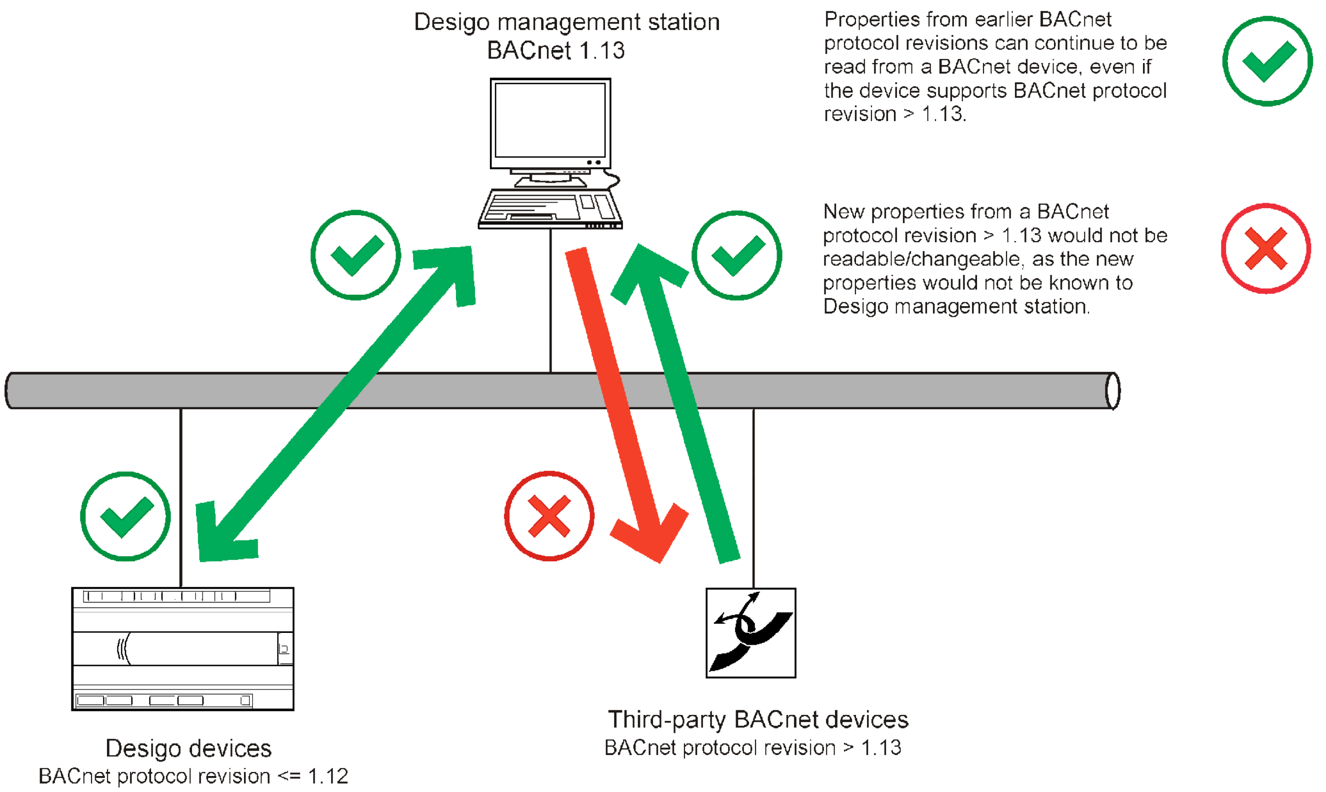


Figure 270: BACnet protocol revision

Desigo V6.0 does not support BACnet protocol revision functions higher than V1.13. Usually, BACnet devices of a specific BACnet protocol revision fully support earlier revision functions (downward compatibility). However, since this is not true in all cases, we recommend that you verify the compatibility in each case.

For an overview of the BACnet functions supported in Desigo, see *BACnet Protocol Implementation Conformance Statement (PICS)* (CM110665).

UTF-8 and ANSI 3.4

BACnet protocol revision 1.10 introduced UTF-8 instead of ANSI 3.4.

If ANSI 3.4 / UTF-8 is used for BACnet communications, and if devices featuring BACnet protocol revision < 1.10 (prior to Desigo V5.0) communicate with devices of BACnet protocol revision ≥ 1.10 (from Desigo V5.0):

- Received BACnet character strings of type ANSI 3.4 are handled properly, as only ANSI X3.4 code points (0..127) are sent that have coding identical to UTF-8.
- Sent BACnet character strings of type UTF-8 are added properly to data storage by Desigo devices < V5.0, provided the code points are in the range 0..127.
- If the code points are in range 128..255, UTF-8 coding (multibyte) is interpreted as ISO-Latin-1 (1 byte) and taken over into data storage. As a result, the data storage does not match the received string ("René" becomes "RenÃ©").

  To read back this type of string, Desigo devices < V5.0 use ANSI conversion and only code points in the range 0..127 are sent ("RenÃ©" becomes "RenA.").
- If the code points are in the range 128..255, UTF-8 coding (multibyte) is rejected either by third-party devices with BACnet protocol revision < 1.10 (not ANSI X3.4), or not interpreted along a defined rule.
- Desigo V5.0 supports UTF-8 coding for code points in the range 0..255.
- The following applies from Desigo V5.1:
  – Desigo PX / Desigo Room Automation fully supports UTF-8 coding.
  – Desigo Insight supports UTF-8 coding with the limitation that only the code points for one (1) code page can be correctly displayed.

Create and delete BACnet objects

As of Desigo V5.1 a function is available for Desigo Insight and PXC automation stations to create and delete dynamic BACnet objects. If you use this function with an older version, an error message will appear.

The function can be used on Desigo PXC automation stations. Desigo Room Automation room automation stations PXC3 are not supported.

Third-party devices can be processed using the same functionality as long as they support creating and deleting BACnet objects. The function can be used, for example, by Desigo Insight together with third-party device controllers and similarly by a third-party management station with PXC automation stations, as long as they are enabled to do so.

PXM20 operating units do not display dynamic objects.

Backup and restore BACnet devices

With the BACnet backup and restore function you can upload saved program data (application program) from a BACnet device to Desigo Insight and restore it to the same or a new BACnet device.

The backup and restore function can only be run if the third-party BACnet devices support it.

The backup and restore function is supported by PXC3 room automation stations from Desigo version V5.0.

Compatibility Desigo Insight

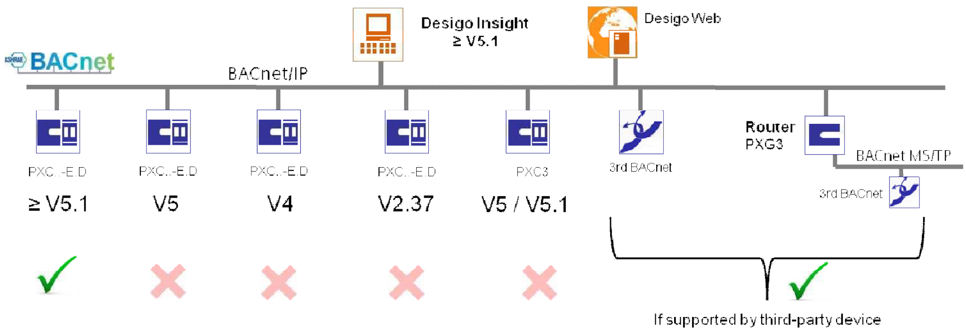


Figure 271: Version compatibility

For information on creating and deleting BACnet objects and backing up and restoring BACnet devices, see *Desigo Insight Engineering of user functions* (CM110592).

Compatibility Desigo CC

Desigo CC is designed as an open system and supports a variety of open protocols and IT standards. The information in the following sections compile the most important information on Desigo CC compatibility taken over from the *Desigo CC System Description* (A6V10415500).

24.3.2 Compatibility with Operating Systems

Microsoft client operating systems

The following table shows which Microsoft client operating systems are compatible with Desigo V6.0.

Desigo version	Compatibility with Microsoft client operating systems				
V6.0	Windows 7 Professional / Ultimate / Enterprise		Windows 7 / Windows XP-VMware Professional / Ultimate	Windows 8.1[3] Professional / Enterprise	
	32-Bit	64-bit	Windows 7 64-bit (physical host) Windows XP 32-bit (virtual client)	32-bit	64-bit
XWP ABT ABT Site[4]	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	No No No	No Yes Yes
Desigo CC	No	Yes[5]	See chapter *Compatibility with VMware*	No	Yes
Desigo Insight	Yes[2]	Yes[1]	See chapter *Compatibility with VMware*	No	Yes[1]
RXT10.3 RXT10.5[3]	Yes Yes	Yes Yes	Yes Yes	No Yes	No Yes
Desigo Configuration Module (DCM)	Yes	Yes	See chapter *Compatibility with VMware*	Yes	Yes

Table 168: Compatibility with Microsoft client operating systems

Key:

1 Including InfoCenter V1.7 and ADP/CC V6.0

2 Including ADP/CC V6.0

3 From Desigo V5.1 SP

4 As a stand-alone installation

5 Windows 7 Professional SP1

Unlisted Microsoft client operating systems/editions (especially Home Premium) are not supported.

BOS only supports server operating systems.

Microsoft server operating systems

The following table below shows which Microsoft server operating systems are compatible with Desigo V6.0 (the compatibility applies only to the Desigo V6.0 products listed below).

The end user is responsible for the correct licensing of any third-party licenses.

Desigo version	Compatibility with Microsoft server operating systems		
V6.0	Windows Server 2008 (with SP3) Standard / Enterprise	Windows Server 2008 R2 (with SP1) Standard / Enterprise	Windows Server 2012 R2[3] Standard
	32-bit	64-bit	64-bit
Desigo CC	No	Yes	Yes
Desigo Insight	No	Yes[1]	Yes[2]
Branch Office Server (BOS)	No	Yes	Yes

Table 169: Compatibility with Microsoft server operating systems

Key:

[1] Including InfoCenter V1.7 and ADP/CC V6.0

[2] Including ADP/CC V6.0

[3] From Desigo V5.1 SP

Unlisted Microsoft server operating systems/editions are not supported. They can, however, be used for stand-alone SQL servers and file hosts.

24.3.3 Compatibility with SQL Servers

The following table shows which Microsoft SQL server versions are compatible with Desigo V6.0.

Desigo version	Compatibility with Microsoft SQL servers					
V6.0	SQL server 2012		SQL server 2014		SQL Server 2016	
	Standard 64-bit	Express 64-bit	Standard 64-bit	Express 64-bit	Standard 64-Bit	Express 64-Bit
Desigo CC	Yes	Yes	Yes	Yes	No	No
Desigo Insight[1, 2, 3]	Yes	Yes	Yes	Yes	Yes	Yes
Branch Office Server (BOS)	Yes	No	Yes	No	No	No

Table 170: Compatibility with Microsoft SQL servers

Key:

[1] Including ADP/CC V6.0

[2] InfoCenter V1.7 supports only SQL Server 2014 32-bit standard. SQL 2014 32-bit can be installed in parallel to a 64-bit SQL server.

[3] MS SQL Express is supplied with the product installation DVD (Microsoft SQL Server 2014 Service Pack 2, Express Edition, Version 12.0.5000.0).

Unlisted SQL server versions/editions are not supported. Only the SQL server (as mere database server) can be operated on either a 32-bit or 64-bit operating system. At the product level, only 32-bit components are supported.

The Branch Office Server (BOS) is compatible with the following operating systems:

- Microsoft operating systems on SQL Server 2005 Express / 2005 Standard (on Windows 2003 R2 Server, 32-bit edition).
- Microsoft operating systems on SQL Server 2008 Standard (on Windows Server 2008 R2, 64-bit edition).

For detailed information on Desigo Insight, see chapter *Management Level Desigo Insight* and *Upgrade Management Level*.

24.3.4 Compatibility with Microsoft Office

The following table shows which Microsoft Office versions are compatible with Desigo V6.0.

Product	Version	Microsoft Office Versions
Desigo Xworks Plus (XWP) (including ABT/SSA and other additional tools)	V6.0	MS Office 2007 (32-bit edition) MS Office 2010 (32-bit edition)
Desigo CC	V6.0	MS Office 2007 (Standard, Small Business, Professional, Enterprise) MS Office 2010 (Standard, Small Business, Professional, Enterprise) MS Office 2013 (Standard, Small Business, Professional, Enterprise)
Desigo Configuration Module (DCM) Desigo Insight	V6.0	MS Office 2007 (32-bit edition SP2) MS Office 2010 (32-bit edition) MS Office 2013 (32 and 64-bit edition)

Table 171: Compatibility with Microsoft Office

24.3.5 Compatibility with Web Browsers

Desigo Touch and Web

Desigo Touch and Web support Desigo as of V4.0.

When using PXC3 room automation stations, note that the existing Desigo version does not yet support lighting and blinds functions of Desigo Touch and Web.

The following web browsers (standard clients) are supported in addition to the PXM touch panels:

Recommended web browser for standard operator units. Official support by Siemens BT:

- Firefox from V4.0

Tested and released browsers. Minor deviations of display and operation to the recommended browsers are possible. Official support by Siemens BT:

- Microsoft Internet Explorer from V10
- Safari iPad2/iPad3

Min. tested browsers. No support by Siemens BT:

- All other HTML 5.0-capable browsers, such as Chrome 10.0 and Safari 5

ABT/SSA

Supports HTML 5.0 capable browsers with native SVG format.

Desktop browser:

- Firefox as of V4.0
- Microsoft Internet Explorer as of V10
- Google Chrome 10.0
- Safari 5.1

Mobile browser:

- Firefox mobile 16
- Google Chrome mobile 18

- Android 4.0
- Safari iOS 5

Desigo CC

Supported web browser:

- Microsoft Internet Explorer 10

For notes on Desigo CC web client running in a browser shell, see *Desigo CC System Description* (A6V10415500).

Desigo Insight V6.0

Supports HTML 5.0-capable browsers with native SVG format.

- Microsoft Internet Explorer 10 and 11
- Mozilla Firefox ESR from V45
- Google Chrome from V50

Browsers with Adobe SVG plugin are not supported.

PX Web with PXA30/40-W..

A Microsoft Internet Explorer V6 and higher web browser is required to create and change graphical pages.

See *Web Controller Commissioning and Configuration Roller* (CM110763).

24.3.6 Compatibility with VMware (Virtual Infrastructure)

The following table shows which VMware versions are compatible with Desigo V5.0/6.0.

Product	Version	VMware version
Desigo Xworks Plus (XWP) (including ABT/SSA and other additional tools) Desigo Insight	V5.1 V6.0	VMware Workstation 10/11/12
Desigo CC	V2.1	VSphere 6.0, ESXi 6.0b
Desigo Insight	V5.1 V6.0 V6.0 SP2	VSphere 5.5 VSphere 6.0 VSphere 6.5

Table 172: Compatibility with VMware

24.3.7 Compatibility of Software/Libraries on the Same PC

The installed Desigo software and LibSets (standard application libraries) on the same PC must have the same version.

You can install Desigo Insight V6.0, Desigo CC V6.0, RXT10.3/RXT10.5 (if required) and Desigo Xworks Plus (XWP) V6.0 on one PC in any order. But you must install the libraries at the end.

Restrictions

RXT10.5 is only supported as of Desigo V5.1 Service Pack.

RXT10.3 and RXT10.5 do not operate if installed in the same Windows environment. The corresponding LNS server versions are not compatible. Solution: Install one of the two components in a VMware.

Installing Desigo software from different systems versions on the same PC is not supported. Check operating system compatibility prior to installing.

24.3.8 Hardware and Firmware Compatibility

Desigo V6.0 hardware and firmware is only partially compatible to products from earlier versions in the same Desigo project runtime system.

BACnet peer-to-peer communication between Desigo PX devices from Desigo V2.2 to Desigo V6.0 is guaranteed (see chapter *Automation Level Desigo PX / Room Automation*).

Restrictions

As soon as an automation station or a system controller with Desigo V6.0 firmware is used in a runtime system, all operating clients, such as PXM20, PXM20-E, PX-Web, and Desigo Insight must be upgraded to Desigo V6.0 . Otherwise, only limited operation is available.

No Desigo firmware ≥ V4 is available for PX Web interface PXG80-W(N).

24.3.9 Backward Compatibility

Desigo V6.0 software and libraries are downwards compatible. Desigo V6.0 products can process data compiled with earlier versions.

Restrictions

After upgrading Desigo project data for a Desigo software product to V6.0, the data can only be accessed or processed with the appropriate software/LibSets for Desigo V6.0.

24.3.10 Forward Compatibility

As of Desigo V6.0, Desigo Insight management stations V5.1 SP2 can be used with Desigo Room Automation / PX automation stations V6.0 (upward compatible) as long as no new V6.0 Desigo Room Automation / PX automation station functionality is used. In this case, a forwards compatibility patch must be installed for Desigo Insight V5.1 SP2.

Restrictions

This is beneficial in simple project situations, for example, for extending an existing plant by just a few automation stations without any additional functionality or new hardware device types. A firmware downgrade to the automation station or an upgrade to the management is no longer necessary in this case.

See also chapters *Management Level Desigo Insight*, *Upgrade to PX / Desigo Room Automation Automation Level* and *VVS Desigo V6.0*.

24.3.11 Engineering Compatibility

All project data on all system levels (automation level with room automation and management level) must have the same LibSet with the same LibSet version number (for example, V6.xxxx-xx) for unlimited engineering of tested Desigo solutions (libraries).

Restrictions

Library extensions for V6.0 cannot be used during engineering if the upgrade of a Desigo runtime system > V2.3x occurs on only a portion of the project data to V6.0 (for example, only Desigo Xworks Plus (XWP), but not Desigo Insight).

The library extensions cannot be used in the other project data (system levels) if during engineering only part of the Desigo project data uses a higher LibSet (higher version number) with extended application scope (for example, in RX, but not Desigo Xworks Plus and Desigo Insight).

24.3.12 Compatibility with Desigo Configuration Module (DCM)

The Desigo Configuration Module (DCM) version supplied with the relevant Desigo system covers the available Desigo product scope.

When importing DCM projects from earlier DCM versions, the project is converted to the status and options of the current DCM version. After conversion, the project data can only be revised in the current DCM version.

DCM projects from DCM version 5.0 support import.

DCM requires Microsoft Office.

24.3.13 Compatibility with InfoCenter

InfoCenter V1.7 is compatible with the following Desigo Insight versions:

- Desigo Insight V4.1 SP1 (only if you don't use the *trendlog interrupted* function)
- Desigo Insight V5.1 SP2
- Desigo Insight V6.0

24.4 When to Upgrade to Desigo V6.0

PX and PXC

If you want to use an automation station or a system controller (PXC…) with Desigo V6.0 firmware, you must upgrade all operating clients to Desigo V6.0, if you intend to use the new functions.

PXC3x

The following requirements must be met to upgrade firmware on PXC3 room automation stations (Desigo Room Automation) from Desigo V5.x to Desigo V6.0:

- ABT Pro project data is available.
- ABT project is converted to V6.0.
- Room automation station in ABT still has version V5.x.
- DNT is installed.
- V6.0 firmware is available.
- The administrator password V5.x for the room automation station is known (it is visible in ABT Pro under project settings).

Do the following to upgrade firmware on a PXC3x room automation station from Desigo V5.x to V6.0:

1. Room automation station: Restore Desigo V5.x parameters with ABT Pro.
2. Management station: Save trend data (if available).
3. ABT Pro: Delete (clear) room automation station application (but not the entire device).
4. DNT: Load firmware.
5. ABT Pro: Upgrade room automation station to Desigo V6.0. Requirement: ABT Pro Library V6.0 is installed.
6. Room automation station: Run a full compile.
7. Room automation station: Load program.
8. ABT-SSA: Check if the room automation station changes to *operational* after loading.
9. ABT-SSA: Check if the TX, KNX PL-Link and DALI (if available) buses are *operational*.

If a PXC3 already has the Desigo V6.0 firmware, newer V6.x firmware versions must be loaded with ABT Startup.

If the load of a PXC3 in V5.x approaches the upper load limit, the program may not be able to be loaded after a firmware upgrade. In this case, the PXC3 must be replaced by a PXC3x-100 of the new series.

Stricter guidelines for passwords apply after a firmware upgrade to V6.0. The user profile is loaded by ABT Site after the program is loaded by ABT Pro. The V5.x password is no longer valid at this point.

24.4.1 Management Level Desigo CC

For information about the system compatibility of the Desigo CC management station, see *Desigo CC System Description* (A6V10415500).

24.4.2 Management Level Desigo Insight

Upgrade required

An upgrade from Desigo Insight V1 or V2.2 - V5.1 to Desigo Insight V6.0 may be necessary under the following circumstances:

- As soon as at least one automation station or one system controller is used with Desigo V6.0 firmware in the runtime system (project) (see also chapter *VVS Desigo V6.0*).
- When at least one Desigo Room Automation / PX automation station is used with Desigo V6.0 firmware in the runtime environment (project), that is, and a new function introduced as part of Desigo V6.0 (see also chapter *VVS Desigo V6.0*).
- When a BACnet third-party device is used in the runtime environment using BACnet protocol revision > 1.5.
- When a certified management station is required in the runtime system as per BACnet B-AWS.
- When a certified management station is required in the runtime system as per AMEV MBE-A or MBE-B.
- To allow the use of an additional application scope for Desigo V6.0.

Upgrade not required

An upgrade to Desigo Insight V6.0 ist not required:

- If Desigo Insight V5.1 SP2 is installed and Desigo Room Automation / PX automation stations with Desigo V6.0 firmware are used in the runtime environment (project), but no functions are used that were introduced with Desigo V6.0 (see also chapter *Upgrade to PX / Desigo Room Automation Automation Level* and *VVS Desigo V6.0*).

In this case, a forward compatibility patch must be installed for Desigo Insight V5.1 SP.

Upgrade recommended

For Desigo Room Automation Desigo Insight can stay on version 5.1 under the following circumstances, an upgrade is however still recommended:

- Keep Desigo Room Automation V5.1 functionality:
  – Upgrade the firmware of Desigo PXC3 room automation station from Desigo V5.1 to V6.0 in order to profit from error corrections to Desigo Room Automation PXC3 FW V6.0.
  – Exchange a defective PXC3 with a PXC3 with firmware V5.1.
- If only the QMX3 room operator units for wall mounting[1] are used in an existing PXC3 V5.0 room automation station:
  – Visualization in Desigo Insight with QMX3.P36 functionality only.
  – Upgrade of the PXC3 FW from V5.0 needed.

In all cases observe the Desigo Room Automation system compatibility.

Key:

1 Valid only for QMX3.P34, QMX3.P74, QMX3.P37, QMX3.P02 (V5.0 function as in QMX3.P36).

Restrictions

All Desigo Insight management stations (project) must have the same version.

Minimum hardware requirements of Desigo Insight

For more information, read the up-to-date Release Notes.

24.4.3 Automation Level Desigo PX / Desigo Room Automation

Desigo Xworks Plus (XWP) and Automation Building Tool (ABT)

Upgrading projects (while simultaneously converting and upgrading the project data of a tool project as well as the libraries used) to XWP/ABT V6.0 may be required under the following circumstances:

- When at least one automation station or system controller is used with Desigo V6.0 firmware in the runtime system to allow the use of an additional application scope for Desigo V6.0.
- When automation stations are used in the runtime system as per AMEV profiles AS-A or AS-B are required (as of Desigo V5.1 firmware on the automation stations).
- To be able to use the Desigo V6.0 tool environment.

The existing engineering and commissioning tool ABT V6.0 for Desigo Room Automation supports all existing runtime systems from Desigo V5.0. It contains all required firmware versions and application libraries from V5.0.

For Desigo Room Automation the firmware of the PXC3 room automation stations can be upgraded from Desigo V5.0 to V5.1, without updating the rest of the runtime system.

For details, see chapter *Upgrade PX / Desigo Room Automation automation level*.

Touch and Web is already supported from Desigo V5.0 (from XWP V5.00.282 including patches).

What does conversion and upgrade mean?

Conversion means to upgrade the saved project data from the current XWP tool version to a higher tool version (for example, from XWP V4.x, or XWP/ABT V5.0 to XWP/ABT V5.1).

This conversion does not change the automation level system version of the project (that is, an automation station with system version V4 remains as is in the project).

A conversion of the XWP/ABT data structure always impacts all project data of a tool project.

Upgrade means to upgrade the automation level system version to a higher version (for example, system version V5.0 to automation station system version V5.1).

With XWP V6.0 after upgrading, first check the CFC log file (CFC > Options > Log file) for connection losses between the function objects in the CFC caused by different pin assignments and designations in Desigo V5.1. Upgrade errors must be corrected manually in the CFC.

Conversion and/or upgrade of the former Desigo LibSet V5.1 to Desigo LibSet V6.0 has been carried out already and is provided on the Desigo LibSet installation CD. Conversion and/or upgrade is necessary for RC and local libraries. To do this, use the Library Maintenance Utility (LMU).

For details, see chapter *Upgrade PX (CAS) Libraries*.

Room automation stations or automation stations and system controllers with firmware V2.x - V5.1 and V6.0 may be operated in the same runtime system.

An upgrade to firmware V6.0 of existing PXC3 room automation stations or PXC automation stations and system controllers (V2.2 – V5.1) is only required when one of the conditions mentioned above must be met.

Restrictions

When engineering a tool project, all tool installations must have the same version as the project.

Branch Office Server (BOS)

XWP/ABT V6.0 can be used only in Branch Office Server (BOS) version V6.0 (BOS versions < V6.0 are not compatible).

Desigo PX / Desigo Room Automation

An upgrade of previously programmed and commissioned Desigo Room Automation room automation stations or PXC automation stations / system controllers (PXC...) <= V6.0 to Desigo V6.0 SP firmware is required:

- Generally:
  – To permit the use of additional Desigo V6.0 products and application scope on the Desigo Room Automation / PX device in question.
- For V5.0 on V5.1:
  – To use additional V5.1 product and application scope and for Desigo V5.1 on the PXC3/PXC in question.
  – When the use of certified devices as per AMEV AS-A or AS-B is demanded by the runtime system.
  – To integrate BACnet/IPv6 devices into the Desigo system (a router PXG3.M/.L with V5.1 firmware is required).
- For V2.2-V4.1:
  – If the automation station / system controllers are to be used as Desigo Room Automation system function controllers for the PXC3 room automation stations (Desigo Room Automation) for alarm and schedule system functions.
  – When the runtime system requires the use of certified devices with BACnet revision 1.10.
- For V2.2 to V2.37:
  – To allow storage of project data (engineering data storage on the plant) to all automation stations / system controllers PXC…D, and PXC52 (from Index D), and PXC-NRUF.

For Desigo Room Automation the firmware of the PXC3 room automation stations can be upgraded from Desigo V5.0 to V5.1 / V5.1 SP, without updating the rest of the runtime system.

For details, see chapter *Upgrade PX / Desigo Room Automation Automation Level*.

Desigo Touch and Web (for PXM touch panel) has already been supported in Desigo V5.0 (from tool version XWP V5.00.260 including patches).

When converting and upgrading a plant <= Desigo Room Automation V5.1 to Desigo Room Automation V6.0, the individual address (IA) on the PL-Link subsystem must be set as per the number of data points on KNX PL-Link subsystem specifications. Failure to comply with the specifications can result in a fault on the plant.

Restrictions

Scheduler programs of the Desigo Room Automation room automation stations can be operated and their alarm functions displayed via the operator units Desigo Touch and Web (calendar objects are not supported), PXM20, PXM20-E, and PX Web using the associated Desigo Room Automation system function controllers (automation stations / Desigo PX system controller). Further Desigo Room Automation functions are not supported by these operator units.

Desigo Touch and Web (for PXM Touch Panel) is used exclusively with PXC automation stations and system controllers from firmware V4.0 (BACnet Rev. 1.5).

The modular Desigo PX automation stations / system controllers PXC00/50/100/200-E.D from firmware version V5.0 are supported as Desigo Room Automation system function controllers for the PXC3 room automation stations. For performance reasons, use PXC00-E.D where possible.

The local operator unit PXM10 cannot be used together with the following devices:

- PXC3 room automation stations (Desigo Room Automation)
- PX KNX (in PXC00-U or PXC001.D/PXC001-E.D)
- PXG3.L/PXG3.M (BACnet router)
- PXG3.W100 (web interface BACnet/IP of Desigo Touch and Web)

No I/O modules may be connected to the system controller LonWorks PXC00(-E).D.

Automation stations PXC50/100/200.D for BACnet/LonTalk communications cannot be equipped with option module PXA40-W… (no PX Web possible).

The modular series PXC…D (Desigo PX) and the PXC3 room automation stations (Desigo Room Automation) do not have a PPS2 connection.

Upgrading a BACnet primary server of a PX site to increase the system limits (for example, up to 100 PXC..D per PX site):

- Increasing the system limits by upgrading a primary server is recommended only for existing sites featuring primary servers and firmware version V4 or higher. And, only if no changes to the site's functional scope and system limits are made.
- Upgrading V2.x primary servers only to extend the system limits is not supported.
- Version-related limits continue to apply to each device of the site (for example, no limit extensions with BACnet/LonTalk, but only for BACnet/IP communication).

When replacing the primary server, the same firmware version must be used that is available in the device to be replaced (for example, replacement FW V4.x by FW V4.x, FW V5.x by FW V5.x). Within the same site, a firmware upgrade of the primary server at the same time also means changes to the communication with other PXC automation stations. This is true in particular for the replication of global objects in a PX site (for example, calendar, notification class, user profile).

The compact automation station PXC-NRUF only runs from Desigo V2.37 firmware.

Upgrading PXC-NRUF firmware to Desigo ≥ V6.0 is required if BACnet Rev. 1.12 is needed.

The Desigo V6.0 firmware exclusively runs on the following devices:

ASN	Product range
DXR2	Desigo Room Automation (from V6)
PXC00(-E).D	Desigo PX
PXC001(-E).D	Desigo PX
PXC50(-E).D	Desigo PX (from V5)
PXC100(-E).D	Desigo PX
PXC200(-E). D	Desigo PX
PXC3.7..(A)	Desigo Room Automation (from V5)
PXC3.E16A	Desigo Room Automation (from V6)
TXI1.OPEN	Desigo PX
TXI2.OPEN	Desigo PX
PXC12(-E).D	Desigo PX
PXC22(-E).D	Desigo PX
PXC36(-E).D	Desigo PX
PXG3.L/ PXG3.M	Desigo PX
PXG3. W100 (web interface for PXM touch panel)	Desigo PX
PXC-NRUF	Desigo PX
QMX7.E38	Desigo Room Automation (from V5.1 SP)
PXM20(-E)	Desigo PX
PXM40/50	Desigo PX
TXB1.P-BUS	Desigo PX
PXX-L11/12	Desigo PX
PXX-PBUS	Desigo PX

Table 173: Devices on which Desigo V6.0 firmware can run

Desigo PXR / LonWorks system controller

Migration of previously programmed and operational V2.2 - V2.37 system controllers PXR11/12 to Desigo V6.0 using PXC00(-E).D+PXX-L11/12 is required:

- To use LNS based LonWorks standard tools NL220 (Newron System) or LonMaker (Echelon) as an alternative to RXT10.3/RXT10.5 together with the RXC Link plug-in. This applies to projects based on LNS TE and OpenLNS.
- When the runtime system (project) requires the use of certified devices with BACnet rev. 1.12.

There is no need to exchange existing PXR11/12 devices. Migration to PXC00(-E).D with a PXX-L…is only required if the aforementioned conditions are required.

24.4.4 Desigo TX-I/O

	TX-I/O modules											
Product range	TXM1.8D	TXM1.16D	TXM1.8U	TXM1.8U-ML	TXM1.8X	TXM1.8X-ML	TXM1.6R	TXM1.6R-M	TXM1.8P	TXM1.6RL	TXM1.8RB	TXM1.8T
Desigo Room Automation modular room automation stations PXC3 (from index D)	•	•	•	-	-	-	•	-	-	•	•	•
Desigo PX modular room automation stations PXC..D	•	•	•	•	•	•	•	•	•	•[1]	-	•

Table 174: Compatibility of TX-I/O modules with PXC..D and PXC3 automation stations

Key:

[1] Directly switched lighting applications (by the user) are not supported by the PXC..D automation stations. For this reason, the configured button function of the digital input modules is not available together with the PXC…D automation stations.

Restrictions

A firmware update or upgrade from TX-I/O modules is not possible (except for TXI1.OPEN and TXI2.OPEN).

24.4.5 TX Open

Restrictions

The TXI1.OPEN and TXI2.OPEN TX Open modules can only be used together with the PXC50/100/200(-E).D automation stations.

24.4.6 Desigo RX

	Nides.RX	PXR-xx	PXX-Lxx
Description	Phased out Q1/2010	Phased out Q4/2011	Released with Desigo V4
Desigo version	< V4	≤ V5	≥ V4
Supports RXCxx.1 devices	•	•	•
Supports RXCxx.1 devices	-	•	•

Table 175: Desigo RX

RXT10.3 (RXC project data)

RXT10.3 supports:

- Desigo V2.x projects with PXR and NIDES integration
- The new LNS database version 3.2x

RXT10.5 (RXC project data)

RXT10.5 was introduced as part of Desigo V5.1 SP and is not backwards compatible to RXT10.3. The project data can, however, be taken over after an export from RXT10.3 to RXT10.5.

RXT10.5 supports only system integration via the PXX L11/L12 Controller.

NIDES and PXR are not supported and the corresponding projects must be maintained using RXT10.3.

You can only use LON standard tools NL220 (Newron System) or LonMaker (Echelon) with project data from LonWorks PXC00(-E).D or PXC50/100/200 (-E).D system controllers (from V5.0).

24.4.7 Libraries

Converting or upgrading existing Desigo V2.x/V5.0 V4.x libraries is required:

- To be able to use XWP/ABT V5.1.
- To allow the use of an additional application scope for Desigo V5.1.
- When an automation station, a system controller or room automation station is used with Desigo V5.1 firmware in the runtime system.
- To make changes to old PX programs engineered with libraries V4.1 (or earlier) with Desigo Xworks Plus (XWP).

LibSet

Desigo LibSets have been converted and/or upgraded to Desigo LibSet V6.0 and have been provided on the Desigo LibSet installation CD.

Restrictions

All Desigo software and LibSets must be on the same PC and have the same system version.

RC and local libraries

Converting and/or upgrading is necessary for RC and local libraries at the automation level. To do this, use the Library Maintenance Utility (LMU).

For details, see chapter *Upgrade PX (CAS) Libraries*.

Restrictions

Mixing different versions of PX libraries on devices (PX...) is not allowed within the same application. This applies to CAS libraries, RC libraries, and local libraries.

24.5 Upgrade to Desigo V6.0

Restriction

Unless otherwise described, the upgrade to Desigo V6.0 must occur in stages as per the system versions.

24.5.1 Upgrade Management Level

Note the following when upgrading versions of the Desigo management stations.

Desigo CC version	Desigo system version	Unterstützte SQL server version
V2.0	V5.1	SQL Server 2008 R2 SQL Server 20012
V2.1	V6.0	SQL Server 2008 R2 SQL Server 2012 SQL Server 2014

Table 176: Desigo CC upgrade

Desigo Insight version	Desigo system version	Citect version	Supported SQL Server versions
V1.1 V2.2	V1.1 V2.2	Citect 5.5 Citect 5.5	SQL Server 2000 SQL Server 2000
V2.3 V2.35 V2.35	V2.3 V2.35 V2.36	Citect 5.5 Citect 5.5 Citect 5.5	SQL Server 2000 SQL Server 2000 SQL Server 2000
V3.0 V4.0 V5.0	V2.37 V4.0 V5.0	Citect 6.1 Citect 6.1 Citect 6.1	SQL Server 2005 SQL Server 2005 SQL Server 2005
V5.1	V5.1	Citect 7.2	SQL Server 2008 R2 SQL Server 2012
V6.0	V6.0	Citect 7.2	SQL Server 2008 R2 SQL Server 2012 SQL Server 2014
V6.0 SP2	V6.0 SP2	Citect 7.2	SQL Server 2012 SQL Server 2014 SQL Server 2016

Table 177: Desigo Insight upgrade

Citect supports upgrades only via one version at a time, that means, upgrades must be carried out from Citect V5.x to Citect V6.x, or from Citect V6.x to Citect V7.x. That’s why upgrades from Citect V5.x to Citect V7.x must always be carried out via an interim version Citect V6.x.

Microsoft does not support the direct upgrading of SQL server 2000 to SQL server 2012/2014.

Desigo Insight

Upgrade from Desigo Insight V3.0 ... V5.1 SP to Desigo Insight V6.0:

1. Back up Desigo Insight V3.0 ... V5.1 SP project data and genie libraries.
2. Keep both project and SQL installation on SQL2005 as is.
3. Install Desigo Insight V6.0.
4. Update Desigo Insight V3.0 ... V5.1. SP project data to V6.0 using the Desigo Insight V6.0 Project Utility.
5. Upgrade the trend archive with the Desigo Insight V6.0 Project Utility.
6. Install LibSet V6.0.

Upgrade from Desigo Insight < V3.0 to Desigo Insight V6.0:

1. Save Desigo Insight < V3.0 project data and genie libraries.
2. Start Desigo Insight V4.1 SP on a separate PC or virtual machine.
3. Update Desigo Insight < V3.0 project data V4.1 SP with the aid of the Desigo Insight V4.1 SP Project Utility.
4. Upgrade the trend archive with the Desigo Insight V4.1 SP Project Utility.
5. Save Desigo Insight V4.1 SP project data and genie libraries.
6. Install Desigo Insight V6.0.
7. Update Desigo Insight V4.1 SP project data to V6.0 with the aid of the Insight V6.0 Project Utility.
8. Upgrade the trend archive with the Desigo Insight V6.0 Project Utility.
9. Install LibSet V5.1.

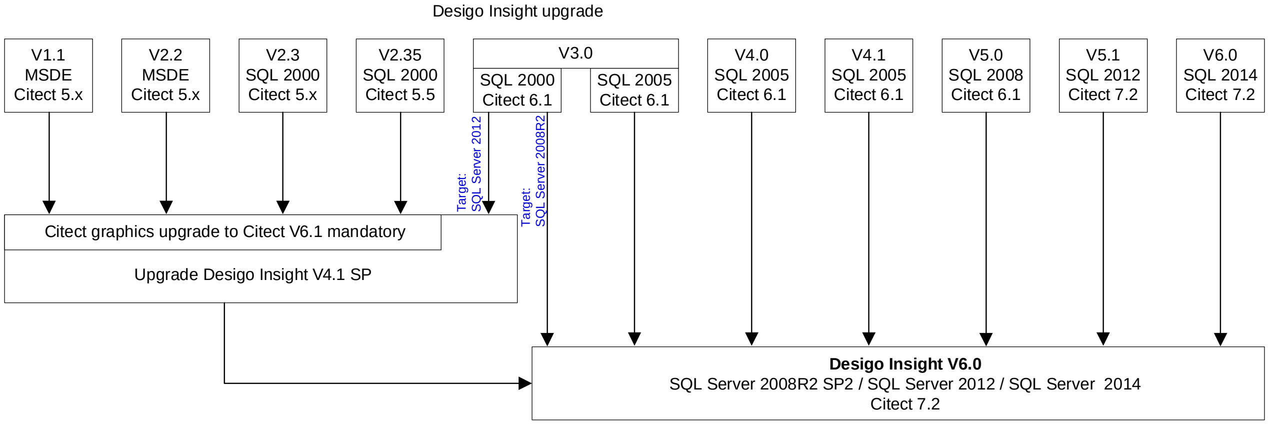


Figure 272: Desigo Insight Upgrade

Restrictions

All Desigo Insight management stations for a runtime system must have the same version.

All Desigo software and LibSets for a project must have the same system version.

Versions < ADP/CC V6.0 are not compatible with Desigo V6.0, if ADP and Desigo V6.0 are installed on the same PC.

For details about upgrading the management level, see *Desigo Insight - Installation & Configuration* (CM110591).

ADP/CC

Upgrade from ADP/CC version >= 3.1-x to ADP/CC V6.0:

1. Upgrade software to ADP/CC V6.0.
2. Migrate database from MSEE (SQL Server 2005) to MSEE (SQL Server 2012).
3. Migrate IV1/IV2 to IV3 plug-in with ToolboxNET.

Upgrade from ADP/CC version = 3.0 to ADP/CC V6.0:

1. Upgrade software to ADP/CC V4.1-2.
2. Migrate database and archive files (Sybase, QRACLE or MSDE (SQL server 2000 to MSEE or SQL server 2005)).
3. Upgrade software to ADP/CC V6.0.
4. Migrate database from MSEE (SQL Server 2005) to MSEE (SQL Server 2012).
5. Migrate IV1/IV2 to IV3 plug-in with ToolboxNET.

Upgrade from ADP/CC version < 3.0 to ADP/CC V6.0:

1. Upgrade software to ADP/CC 3.0.
2. Install Sybase Central 6.0.3, if the database version is still Sybase 5.
3. Upgrade database to Sybase 6.0.3 if the database version is still Sybase 5.
4. Upgrade database to Version 1.8 if the database version is still < 1.8.
5. Upgrade database to version 3.0.
6. Upgrade software to ADP/CC V4.1-2.
7. Migrate database and archive file (Sybase, QRACLE or MSDE (SQL server 2000 to MSEE or SQL server 2005).
8. Upgrade software to ADP/CC V6.0.
9. Migrate the database from MSEE (SQL server 2005) to MSEE (SQL server 2012).
10. Migrate IV1/IV2 to IV3 plug-in with ToolboxNET.

24.5.2 Upgrade PX / Desigo Room Automation Automation Level

Desigo Xworks Plus

The Desigo Xworks Plus (XWP) V6.0 engineering and commissioning tool supports all existing runtime systems, beginning from Desigo V2.2 to V5.x, which were created in the Desigo Toolset (DTS) or Desigo Xworks ≤ V5.1.

Desigo PX

All required firmware versions and application libraries are included. Converting and/or upgrading with the Library Maintenance Utility (LMU) is necessary for RC and local libraries at the automation level.

When you decide to use XWP V6.0 proceed as follows:

Case 1

Extend an existing Desigo project < V5.1. The existing runtime system will not be upgraded to firmware Desigo V6.0.

1. Open the existing project in Desigo XWP V6.0. XWP data storage is converted automatically to XWP V6.0.
2. Read back the parameters.
3. Edit your project as needed.
4. The firmware on the automation station or system controller does not need to be changed.

Result:

The Desigo PX project data was not upgraded (conversion only) to Desigo V6.0.

The entire project can only be processed with XWP V6.0.

Case 2

Extend an existing Desigo project ≤ V5.1. The firmware Desigo V6.0 is to be used in the existing runtime system to be able to use the new V6.0 features.

1. Open the existing project in Desigo XWP V6.0. XWP data storage is converted automatically to XWP V6.0.
2. Read back the parameters.
3. Upgrade the project data from PX automation stations or system controllers to Desigo V6.0 where the firmware needs to be upgraded to Desigo V6.0.
4. Edit your project as needed.
5. The firmware V6.0 must be loaded on the impacted automation stations/system controllers.

Result:

The Desigo PX devices were upgraded to Desigo system version V6.0.

The entire project can only be processed with XWP V6.0.

Restrictions

Not all Desigo PX devices in the field can be upgraded to firmware Desigo V6.0.

Automation Building Tool (ABT)

The engineering and commissioning tool ABT V6.0 for Desigo TRA supports all existing runtime systems starting from Desigo V5.0. It contains all required firmware versions and application libraries from V5.0.

Desigo TRA

For existing Desigo TRA V5.x projects the following steps are recommended for the change to Desigo TRA V6.0:

1. Upgrade all XWP/ABT V5.x PC installations to XWP/ABT V6.0.
2. Convert all Desigo TRA V5.x projects to Desigo TRA V6.0 projects with XWP/ABT V6.0 (Offline).
3. Work with XWP/ABT V6.0 taking into account the TRA system compatibility with:
   – Existing PXC3 V5.x room automation stations where the TRA V5.x functionality in existing or additional rooms still meets the requirements.
   – Existing PXC3 V5.x room automation stations where on demand the new V5.1 / V5.1 SP functionality (QMX3 room operator units for wall mounting or QMX7) is needed in existing or additional rooms.
   – Existing or new PXC3 where the complete V6.0 functionality is needed in additional or new rooms.

TRA application		Desigo TRA PXC3 firmware	XWP/ABT	Desigo TRA HQ application library	Desigo Insight	Desigo PX…D/U (including TRA system functions group controller)
Extension with V5.1 functionality	Continuation or maintenance:	V5.1	V5.1	TRA03_V5.0_HQ _ABT1.1	V5.1	≥V5.0
	- If only V5.1 functionality is required.	V5.1 SP	V5.1 SP	TRA03_V6.0_HQ _ABT1.1	V5.1 SP	
	- To benefit from error corrections of TRA PXC3 firmware. And application of QMX7. - To exchange a defective PXC3 with a new PXC3 with the current firmware. No downgrade required.	V6.0	V6.0	TRA03_V6.0_HQ _ABT1.2	V5.1 SP[1]	
Upgrade for complete V6.0 functionality	If new TRA functionality is required by V6.0	V6.0	V6.0	TRA03_V6.0_HQ _ABT1.2	V6.0	

Table 178: Desigo TRA system compatibility

Key:

[1] In this case, a forward compatibility patch must be installed for Desigo Insight V5.1 SP2.

Restrictions

Restricted readback of minor Command and Device objects properties which were changed in the runtime system after the last read back with ABT V5.1 or ABT V6.0.

Affects upgrades of PXC3 room automation stations from Desigo 5.1 to V6.0 with XWP/ABT V6.0 without readback done previously.

Affected BA Object Properties	Description
ActnTbl	Action table
ActnTxt	Action text
EnMem	Enable memorize
Des	Description
ObjNam	Object name

Table 179: Command object

Affected BA Object Properties	Description
Locat	Location
RstNfRcp	Restart notific. recipients
TioBck	Timeout for backup
Des	Description

Table 180: Device object

QMX7

QMX7 is provided from Desigo V5.1 SP. This requires the following versions:

- ABT V5.1 SP
- Application library V5.1 SP
- PXC3 FW V5.1 SP

Restrictions

Projects under older versions, such as V5.0, must be upgraded to ≥V5.1 SP (System Version Set).

Branch Office Server (BOS)

Procedure for upgrading XWP and BOS from the previous version to the latest version:

1. Check in previous version of XWP using the presious version of BOS.
2. Install new BOS version.
3. Continue with new XWP version only.

You do not need to upgrade all tool project data of all automation stations, system controllers or room automation stations to V6.0.

In a Desigo runtime system, existing PX automation stations, system controllers or room automation stations may remain unchanged on Desigo ≤ V5.x even after a conversion to the V6.0 tool environment.

Restrictions

When engineering a tool project, all tool installations must have the same version as the project.

All Desigo software and LibSets must be on the same PC and have the same version.

24.5.3 Upgrade RX Room Automation

RXT10.x project data

All Desigo software and LibSets must be on the same PC and have the same system version.

RXC HW and applications V2 to V4.1 to V5.x

Existing RXC (to V4.1) and RXC V5.x devices can be commissioned with RXT10.3/RXT10.5. A tool workflow supports exchanging RXC (to V4.1) for RXC V5.x devices.

24.5.4 Upgrade PX (CAS) Libraries

Libraries at the automation level must be converted and upgraded.

LibSet

Former Desigo LibSets have been converted and/or upgraded to Desigo LibSet V6.0 and provided on the Desigo LibSet installation CD.

RC and local libraries

Use the Library Maintenance Utility (LMU) to upgrade existing Desigo V2.x/V4.x/V5.x RC or local libraries to Desigo V6.0. If the LMU is not available, contact your local RC representative for upgrading.

First back up the library folder *…\All Users\Application data\Siemens\Desigo\Toolset\XwpData* so that you do not lose existing RC or local PX libraries.

Conversion or upgrading always applies to the entire library for RC or local libraries.

Restrictions

Do not mix different versions of PX libraries (CAS libraries, local libraries and RC libraries) on one Desigo PX.

All Desigo software and LibSets must be on the same PC and have the same system version.

In a Desigo V2.x/V4.x/V5.x runtime system, existing PX automation stations or system controllers may remain on Desigo V2.x/V4.x/V5.x, even after data conversion to V6.0:

- The automation station or system controller remains on V2.x. The data was not upgraded.
- You must use Xworks Plus (XWP) from V4.0 forward.
- The automation station or system controller are no longer compatible with DTS or Xworks Plus (XWP) V2.x.

24.5.5 Upgrade TRA Libraries

The Automation Building Tool (ABT) scope of delivery contains libraries with conversion and/or upgrades.

The ABT V6.0 engineering and commissioning tool for Desigo TRA supports all existing runtime systems from Desigo V5.0. It contains all required firmware versions and application libraries from V5.0.

If only QMX3 room operator units for wall mounting are used, you can upgrade the firmware of the PXC3 room automation stations (Desigo TRA) from Desigo V5.x to V6.0 without upgrading the entire runtime system. Use the special TRA library.

24.6 Siemens WEoF Clients

This information is only for Siemens employees who use a WEoF client PC.

24.6.1 Desigo Software

All Desigo V6.0 software programs and LibSets (LED) operate on the Siemens WEoF client.

Minimum user level required	Version	Desigo product compatibility
Standard User	V6.0	Desigo Configuration Module (DCM)
Standard User	V6.0	Desigo Insight (including DIGG)
Permanent Open User	V6.0	Desigo Xworks Plus (XWP) including PX firmware library (FW), Automation Building Tool (ABT) and additional tools
Permanent Open User	V6.0	Branch Office Server (BOS)
Permanent Open User	V6.0	RXT10 (including RX library)
Permanent Open User	ADP/CC V6.0	ADP/CC
Permanent Open User	V6.0	HQ and RC libraries

Table 181: Desigo Software with WEoF

Desigo Insight ≥ V5.1 requires an HTML 5.0-capable browser with native SVG format.

24.6.2 Third-Party Engineering Software

The ETS standard tool from the Konnex Association (www.konnex.org) is used to engineer and commission KNX S-Mode / EIB segments (for RXB and KNX/EIB third-party devices) at the field level.

The following standard Lon tools can be used from Desigo V4 instead of RXT10.3/RXT10.5:

- NL220 (Newron System) www.newron-system.com
- LonMaker (Echelon) www.echelon.com

	NL220	LonMaker	ETS 3.0 Professional
Operating System	Windows XP Professional	Windows XP Professional	Windows XP Professional
WEoF client	WEoF	WEoF	WEoF
Minimum user level required	Standard User	Standard User	Standard User

Table 182: Third-party software with CAT2

24.7 Migration Compatibility

Migration of Xworks Plus (XWP):

Described in	Requirements
CM110776	Automation Level Engineering Manual
CM110563	Replacement of legacy I/O modules by TX-I/O modules or workarounds

Table 183: Migration of Xworks Plus (XWP) for all subsystems

Migration of Unigyr:

Described in	Requirements
CM110496	Unigyr tools V7.61 with Unigyr automation level V7.64
CM110491	Unigyr with Desigo Insight V1.1
CM110496	Unigyr with Unigyr Insight

Table 184: Migration of Unigyr

Migration of Integral:

Described in	Requirements
CM110499	NCRS from V3.1 (only automation level)
CM110498	NITEL from V1.31 (only automation level)
CM110497	Integral with Desigo Insight V1.1

Table 185: Migration of Integral

For replacing Integral RS modules (NRUA, NRUB, NRUC, and NRUD) with PXC AS and PXC-NRUD modules, Desigo supports the use of PXC-NRUD modules with PXC100/200(-E).D (from Desigo ≥ V4.1) and PXC50(-E).D (from V5.0).

Migration of Visonik:

Described in	Requirements
CM110497	DCS from V22.16 Patch 195 or V24.16 Patch 195 (server with automation level)
CM110491	Visonik with Desigo Insight V1.1
CM110497	DCS with Visonik Insight

Table 186: Migration of Visonik

24.8 Hardware Requirements of Desigo Software Products

The following table shows the minimum hardware and software requirements of Desigo software products.

Product	Version	CPU	Frequency	Storage	Hard disk	Other
Desigo Configuration Module (DCM)	V6.0	Compatible with Intel and AMD technology	1.6 GHz	1 GB RAM	40 GB HD	
Desigo Xworks Plus (including ABT/SSA and other additional tools) or ABT Site (stand-alone)	V6.0	Compatible with Intel and AMD technology	> 1.6 GHz (> 3 GHz)	6 GB RAM (> 16 GB RAM)	50 GB HDD* with good performance (HDD at very fast access times)	Monitor: 1366x768 Recommended for ABT 1680x1050 DVD (SSD drive) (USB port for SSA-DNT as alternative to ethernet connection) Multiple core processors, for example, for VMware
Branch Office Server (BOS)	V6.0	Compatible with Intel and AMD technology	> 1.6 GHz (2.5 GHz)	4 GB RAM (8 GB RAM)	HDD size depending on project data volume	PCI slot or PC card (Typ II) or USB2
RXT10.3 / RXT10.5	-	Compatible with Intel and AMD technology	> 1.6 GHz	4 GB RAM	HDD size depending on project data volume	
ADP/CC	V6.0	Compatible with Intel and AMD technology	> 1.6 GHz	4 GB RAM	HDD size depending on project data volume	

Table 187: Minimum hadware requirements of Desigo software products

Key:

* Desigo Xworks Plus (XWP) requires ca. 1.4 GB memory. Automation Building Tool (ABT) requires ca. 1-2 GB memory. Uncompressed project data requires an additional 0.5 MB memory per data point (reference value). The performance depends on available memory.

The indicated values apply to a host installation. For stable and reliable operation of VMware, CPU and RAM requirements are higher.

Values in (…) are recommended, especially if Automation Building Tool (ABT) is installed on a 64-bit operating system, to allow for larger projects (up to 12 PXC3 with 8 rooms each per ABT project). For details, see chapter *Compatibility with Operating Systems*.

16 GB RAM are recommended if two Automation Building Tool (ABT) satellite projects are opened at the same time, and if in ABT two PXC3 are to be online at the same time.

Configure SSDs for a long life. See Microsoft documentation (Windows 7 & SSD).

ABT projects require ca. 2.5 times more memory per PXC3 room automation station compared to PXC automation stations.

Parallel port or USB port for license dongle.

For online functions you need:

- LonWorks interface card or LonWorks dongle
- Ethernet interface
- Connection cable for automation stations
- USB port for P-bus BIM connection

The following software is required:

- Windows 7 Professional/Ultimate/Enterprise 64- or 32-bit edition (XWP only XP Mode) or Microsoft Windows XP Professional with Service Pack 3
- Microsoft Office 2003/2007/2010

- Acrobat Reader 6.0 or higher (optional installation with tool installation)
- WinZIP
- .NET Framework >= V3.5 (version 3.5 is available on the tool DVD)

For the minimum hardware and operating system requirements for Desigo Insight, see chapter *Management Level Desigo Insight*.

24.9 VVS Desigo V6.0

The following table shows the firmware versions delivered with Desigo V6.0 resulting in the valid VVS V6.0.xxx. For firmware compatibility, see also chapter *Automation Level Desigo PX/TRA*.

Desigo hardware products	Firmware version	Required firmware loader
PXM20	V6.00.184	V5.00.000
PXM20-E	V6.00.184	V5.00.000
PXC compact (PXC...D)	V6.00.184	V5.00.000 V6.00.000
PXC modular (PXC...D)	V6.00.184	V6.00.000
PXX-L11/12 and PXX-PBus	V6.00.184	V5.00.001
PXC modular (PXC...-U)	V6.00.184	V5.00.000
TXI1.OPEN (TX Open module)	IOOPEN 4.00.224 MODBUS_HQ_ V4.00.242 MBUS_HQ_ V4.00.234 SED2_HQ_ V4.00.226 GENIBUS_HQ_ V4.00.232	-
TXB1.P-BUS	V1.1.34	-
PXC3.xxx-100A (Desigo TRA) PXC3.7.. (Desigo TRA)	V01.20.yy.xxx V01.20.yy.xxx	-
DXR2 (-variants)	V01.20.yy.xxx	-
PX KNX (in PXC00-U)	V6.00.184	V5.00.000
PX M-Bus (in PXC00-U)	V6.00.184	V5.00.000
PX Modbus (in PXC00-U)	V6.00.184	V5.00.000
PX SCL (in PXC00-U)	V6.00.184	V5.00.000
PX KNX (in PXC001..D)	V6.00.184	V6.00.000
PX M-Bus (in PXC001..D)	V6.00.184	V6.00.000
PX Modbus (in PXC001..D)	V6.00.184	V6.00.000
PX SCL (in PXC001..D)	V6.00.184	V6.00.000
PXG3.M/.L (BACnet router)	V01.15.15.xxx	-
PXG3.W100 (web interface for PXM touch panel)	V01.15.35.xxx	-
PXC-NRUF AS Integral Migration	V6.00.184	V5.00.000

Table 188: VVS Desigo V6.0 firmware

The versions listed correspond to the latest state upon delivery release of Desigo V6.0. As part of continuous product improvements, more current firmware versions (with higher numbers) may be delivered.

For the current state, see the current release notes of the product.

Issued by
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