Building Controller with BACnet Interface

TwinCAT 3
Quick Start Guide

BACnet/IP

BACnet MS/TP

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1 Foreword

1.1 Notes on the documentation

1.1.1 Liability conditions

This documentation has been prepared with care. The products described are, however, constantly under development. For this reason, the documentation may not always have been fully checked for consistency with the performance data, standards or other characteristics described. If it should contain technical or editorial errors, we reserve the right to make changes at any time and without notice. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

1.1.2 Delivery conditions

In addition, the general delivery conditions of the company Beckhoff Automation GmbH & Co. KG apply.

1.1.3 Brands

Beckhoff®, TwinCAT®, EtherCAT®, Safety over EtherCAT®, TwinSAFE® and XFC® are registered and licensed brand names of Beckhoff Automation GmbH. The use by third parties of other brand names or trademarks contained in this documentation may lead to an infringement of the rights of the respective trademark owner.

BACnet® is a registered trademark of ASHRAE.

1.1.4 Patents

The EtherCAT technology is patent protected, in particular by the following patent applications and patents: DE10304637, DE102004044764, DE102005009224, and DE102007017835 with the corresponding applications and registrations in various other countries.

1.1.5 Copyright

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1.2 Safety instructions

This description is only intended for the use of trained specialists in control and automation technology who are familiar with the applicable national standards. It is essential that the following notes and explanations are followed when installing and commissioning these components. The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

1.2.1 Description of safety symbols

The following safety symbols are used in this documentation. They are intended to alert the reader to the associated safety instructions.

- **DANGER**
  - **Serious risk of injury!**
  - **Failure** to follow the safety instructions associated with this symbol directly endangers the life and health of persons.

- **WARNING**
  - **Risk of injury!**
  - **Failure** to follow the safety instructions associated with this symbol endangers the life and health of persons.

- **CAUTION**
  - **Personal injuries!**
  - **Failure** to follow the safety instructions associated with this symbol can lead to injuries to persons.

- **Warning**
  - **Damage to the environment or devices**
  - **Failure** to follow the instructions associated with this symbol can lead to damage to the environment or equipment.

- **Note**
  - **Tip or pointer**
  - This symbol indicates information that contributes to better understanding.
2 Migrating projects from TwinCAT2 to TwinCAT3

The document “TwinCAT3 Getting started” provides a good overview about first steps using TwinCAT3 as well as a guideline how to migrate existing TwinCAT 2 projects into TwinCAT 3. The document can be downloaded here:

3 BACnet revision history

TwinCAT 2:

There have been two BACnet supplement versions, the first one supporting BACnet revision 6, the second supporting BACnet revision 12. Both drivers are no longer certified but are still available for backward compatibility. Note: The supplement revision 6 is not recommended to be used for new projects.

TwinCAT 3:

Since TwinCAT 3 4022.25 the BACnet supplement is released for BACnet revision 12. Note: BACnet revision 6 is not supported in TwinCAT 3.

TwinCAT 3 4024.0 introduces the up-to-date BACnet supplement revision 14, which was certified in January 2019 for a period of 5 years.
4 Documents and certificates

4.1 BTL-Listing, PICS and Certificate

The current documents for the BACnet supplement revision 14 can be downloaded from the official certification listing at BACnet International.org:

https://www.bacnetinternational.net/btl/index.php?m=100

4.2 AMEV Attestation

According to the requirements of German public authorities our BACnet controllers are listed in the attestation for the higher functional profile AS-B.

The listing overview can be downloaded here:

5 Scope of certification

Certified Controllers:
CX8191, CX9020, CX51xx, CX52xx, C60xx

Certified Control-panels:
CP66xx, CP67xx, CP22xx, CP27xx

See PICS document for further details and available combinations.
6 What’s new in BACnet revision 14?

After three alarm summits the BACnet alarming was massively enhanced in revision 13.

Limit_Enable now works as it was intended, the limits are now disabled or enabled not just the alarming.

Time_Delay_Normal works as a second hysteresis for transitions TO_NORMAL. This property complements the Time_Delay property which was applied to both OFF_NORMAL and TO_NORMAL events and thus was a bit useless.

Event_Detection_Enable now allows to dynamically enable or disable events and alarms.

Event_Message_Texts_Config now allows configuration of Event Message Texts (which contain the last event sent for OFF_NORMAL, TO_NORMAL and TO_FAULT events). This property was configurable in TwinCAT 2 and 3 in the settings dialog / Property EventMessageTexts. In TwinCAT 3 4024 this setting is provided through the Event_Message_Texts_Config property.

Event_Algorithm_Inhibit_Ref is a reference to a binary property used to suppress message showers. In case the binary property contains a value of TRUE or active, events and alarms will no longer be notified.

Event_Algorithm_Inhibit is an alternative method to suppress message showers. In this case the object contains this property and locally decides whether to distribute the alarm or suppress the message.

Reliability_Evaluation_Inhibit is used to suppress FAULT detection. This allows to set the object into the “NO_FAULT_DETECTED” state unless Out_of_Service is set to TRUE and the value may be overridden.

6.1 New properties in BACnet revision 14

Property_List: This property contains a list of all properties contained in the BACnet object. This property is automatically generated at runtime and requires no specific configuration.

6.2 New services in BACnet revision 14

BACnet revision 14 introduced two new routing layer (layer-3) messages.

WHAT_IS_NETWORK_NUMBER: This service asks for the local network number the devices resides in, mostly sent as a broadcast at startup.

NETWORK_NUMBER_IS: This message is sent as a response to the Network number request mentioned above and includes the network number of the local network the devices resides in.
# 6.3 New object types in TwinCAT 3 4024

The BACnet supplement revision 14 implements 12 object types to support primitive values.

<table>
<thead>
<tr>
<th>Primitive value object type</th>
<th>Meaning / Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitstring Value</td>
<td>Array of bits</td>
</tr>
<tr>
<td>CharacterString Value</td>
<td>Text information</td>
</tr>
<tr>
<td>Date Pattern Value</td>
<td>Date w/ wildcards</td>
</tr>
<tr>
<td>Date Value</td>
<td>Fully specified date</td>
</tr>
<tr>
<td>DateTime Pattern Value</td>
<td>Date/Time combination w/ wildcards</td>
</tr>
<tr>
<td>DateTime Value</td>
<td>Fully specified Date/Time combination</td>
</tr>
<tr>
<td>Integer Value</td>
<td>SIGNED INT</td>
</tr>
<tr>
<td>Large Analog Value</td>
<td>LREAL (64bit ANSI/IEEE 754 double)</td>
</tr>
<tr>
<td>OctetString Value</td>
<td>Hexadecimal information</td>
</tr>
<tr>
<td>Positive Integer Value</td>
<td>UNSIGNED INT</td>
</tr>
<tr>
<td>Time Pattern Value</td>
<td>Time w/ wildcards</td>
</tr>
<tr>
<td>Time Value</td>
<td>Fully specified time</td>
</tr>
</tbody>
</table>
7 Default revision / using the TwinCAT Remote Manager

The default revision when creating a new project is BACnet revision 14. Target systems operating TwinCAT 3 4022 (revision 12) may be configured using the TwinCAT Remote Manager. Therefore the Remote Manager for TwinCAT 4022 must be installed on the engineering PC.

Choosing a target using TwinCAT 4022 will create a BACnet revision 12 configuration. In this case all new properties for BACnet 14 are filtered and the device objects claim support for BACnet revision 12. The target can be selected in TwinCAT XAE as shown below.
8 TwinCAT 3 libraries

Currently two libraries are available for BACnet.

**TC2BACnetRev12**: This library is compatible with the TwinCAT 2 library with the same name. This library supports BACnet auto-mapping using the comment syntax described in the Infosys (https://infosys.beckhoff.com/content/1033/tcbacnet/html/tcbacnet_title.htm?id=7437683435630613408).

**TC3BACnetRev14**: This library is not yet released and currently available upon request only. It implements a new procedure to create, delete and configure BACnet objects directly from the PLC. This procedure allows changing the BACnet object configuration online and allows for a PLC ONLINE-Change.

8.1 Firmware revision number

The certified firmware revision number is 4.0.1.(0)

The first three digits represent the BACnet supplement.

The fourth digit in brackets represent changes in the firmware w/o impact to BACnet or to the supplement.
9 Using auto-mapping in revision 14

This feature requires to use the library Tc2_BACnetRev12. The auto-mapping comments are the same as in TwinCAT 2 and may be taken from the existing documentation in the Infosys.

9.1 Changes in the auto-mapping procedure

IMPORTANT: Comments in TwinCAT 3 must start in the same line or above. This significantly changed from TwinCAT 2!

9.2 Activation for tpy-file creation required

The creation of tpy-files must be enabled in TwinCAT 3 4024. This option is available in the project properties. Select Project / <project-name> properties and choose Compile.

Activate the checkbox „Generate tpy-file“.
9.3 Using revision 14 properties in the auto-mapping procedure

Properties introduced in BACnet revision 14 are not activated by default. Use “ENABLE” in the comments to activate these properties. The example below shows how to add the EventDetectionEnable property.

```plaintext
PROGRAM MAIN
VAR
fbdev : FB_BACnet_Device;
fnAI : FB_BACnet_AnalogInput: (* -

(BACnet_ObjectType  : A1  
(BACnet_ObjectName  : Potentiometer 3  
(BACnet_ObjectIdentifier : 897  
(BACnet_Description : Hello, BACnet Gurus!!!  
(BACnet_Units : 62  
(BACnet_HighLimit : 100  
(BACnet_LowLimit : -100  
(BACnet_NotificationClass : 666  
(BACnet_LimitEnable : [lowLimitEnable:highLimitEnable]  
(BACnet_EventEnable : [to_offNormal:to_normal:to_fault]  
(BACnet_ReadOnly : 0  
(BACnet_NotifyType : sAlarm  
(BACnet_ScaleOffset : 2.2331741876E-06  
(BACnet_Resolution : 0.2  
(BACnet_FineResolution : 0  
(BACnet_MinValue : -150  
(BACnet_MaxValue : 150  
(BACnet_EventMessageTexts : (ALARM;FAULT;NORMAL)  
(BACnet_EventDetectionEnable : TRUE  

END_VAR
*)
```

This creates the property EventDetectionEnable in addition to the existing properties.

9.4 Use Rebuild Solution instead of Build Solution

IMPORTANT: When using the auto-mapping in TwinCAT 3 it is essential to perform a Rebuild Solution instead of Build Solution! Comments which have changed may not be recognized when using Build Solution.
10 Appendix

10.1 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

10.2 Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!
The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: http://www.beckhoff.com
You will also find further documentation for Beckhoff components there.

10.3 Beckhoff company headquarters

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