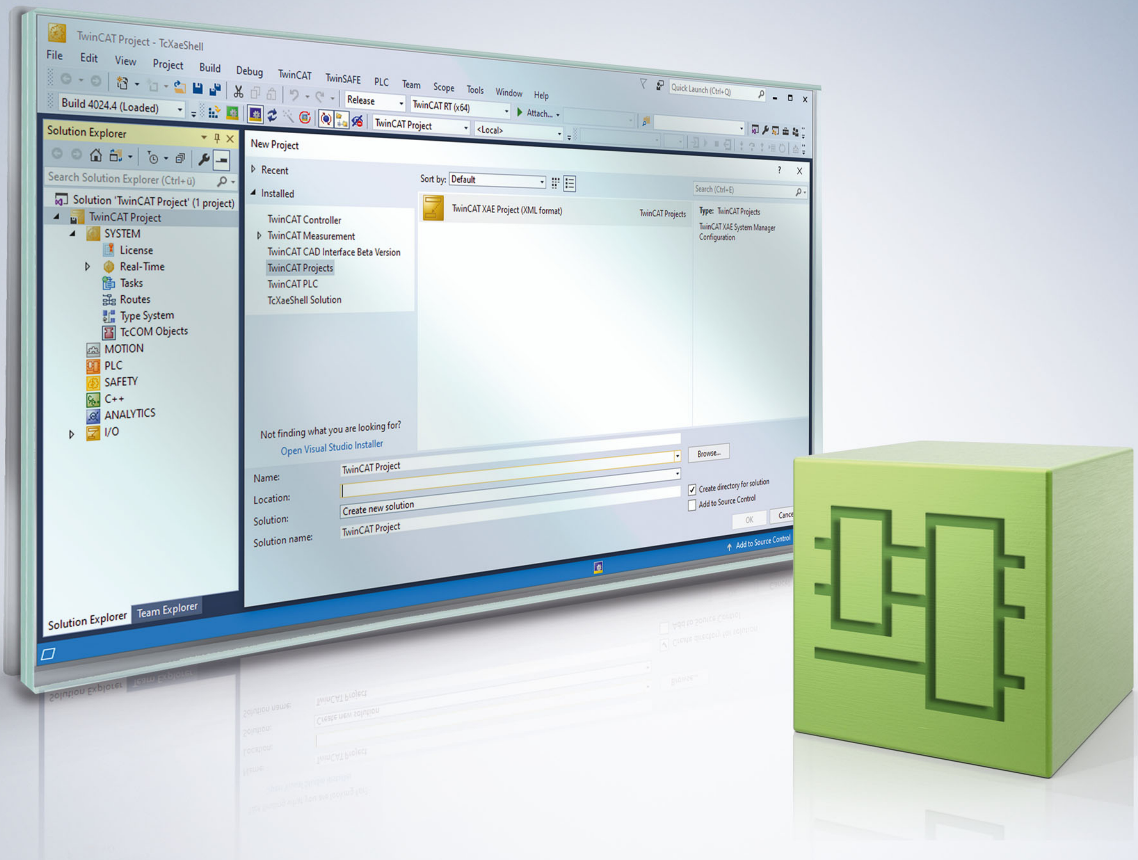
BECKHOFF New Automation Technology

Manual | EN

TE1000

TwinCAT 3 | PLC Library: Tc2_GENIbus



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1 Foreword

1.1 Notes on the documentation

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning the components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

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.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation at any time and without prior announcement.
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.

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1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Description of symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!

⚠ 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.

NOTICE

Damage to the environment or devices

Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

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2 Introduction

The user of this library requires basic knowledge of the following:

- TwinCAT XAE
- PC and network knowledge
- Structure and properties of the Beckhoff Embedded PC and its Bus Terminal system
- Serial communication (RS485) and GENIbus protocol
- Relevant safety regulations for building technical equipment

This software library is intended for building automation system partners of Beckhoff Automation GmbH & Co. KG. The system partners operate in the field of building automation and are concerned with the installation, commissioning, expansion, maintenance and service of measurement, control and regulating systems for the technical equipment of buildings.

The Tc2_GENIbus library is usable on all hardware platforms that support TwinCAT 3.1 or higher.

Hardware documentation KL6021, KL6031_KL6041 and EL6021 in the Beckhoff Information System.

3 GENIbus

The TwinCAT PLC library contains communication function blocks for the GENIbus master/slave communication from the TwinCAT PLC. GENIbus (Grundfos Electronic Network Intercommunications bus) is a protocol specially developed by the Grundfos company for the exchange of data with its devices. Several Grundfos devices can be connected via GENIbus to form a network and integrated into an automation system.

GENIbus is based on the RS485 hardware interface. Data exchange takes place at 9600 baud. In most cases a GENIbus network consists of a master and up to 200 slaves.

Further documentation

- GENIbus Protocol Specification
- Grundfos: Operating the MAGNA3 and MGE model H/I via the GENIpro interface

3.1 Device addressing

In principle, the GENIbus protocol knows only two types of addressing: Individual addressing and broadcast or group commands. The addresses are to be assigned as follows:

- 0 - 31 : master addresses, i.e. the TwinCAT controllers
- 32 - 231 : slave addresses, e.g. pumps
- 255 : broadcast addressing to all slaves

At function-block level in the library the address range of the slaves is set to 1 – 200, i.e. 31 fewer than in the serial network. The reason for this is that the Grundfos parameterization devices also operate with an address range of 1 - 200. 31 is internally added to the slave address again for the serial communication.

3.2 Wiring

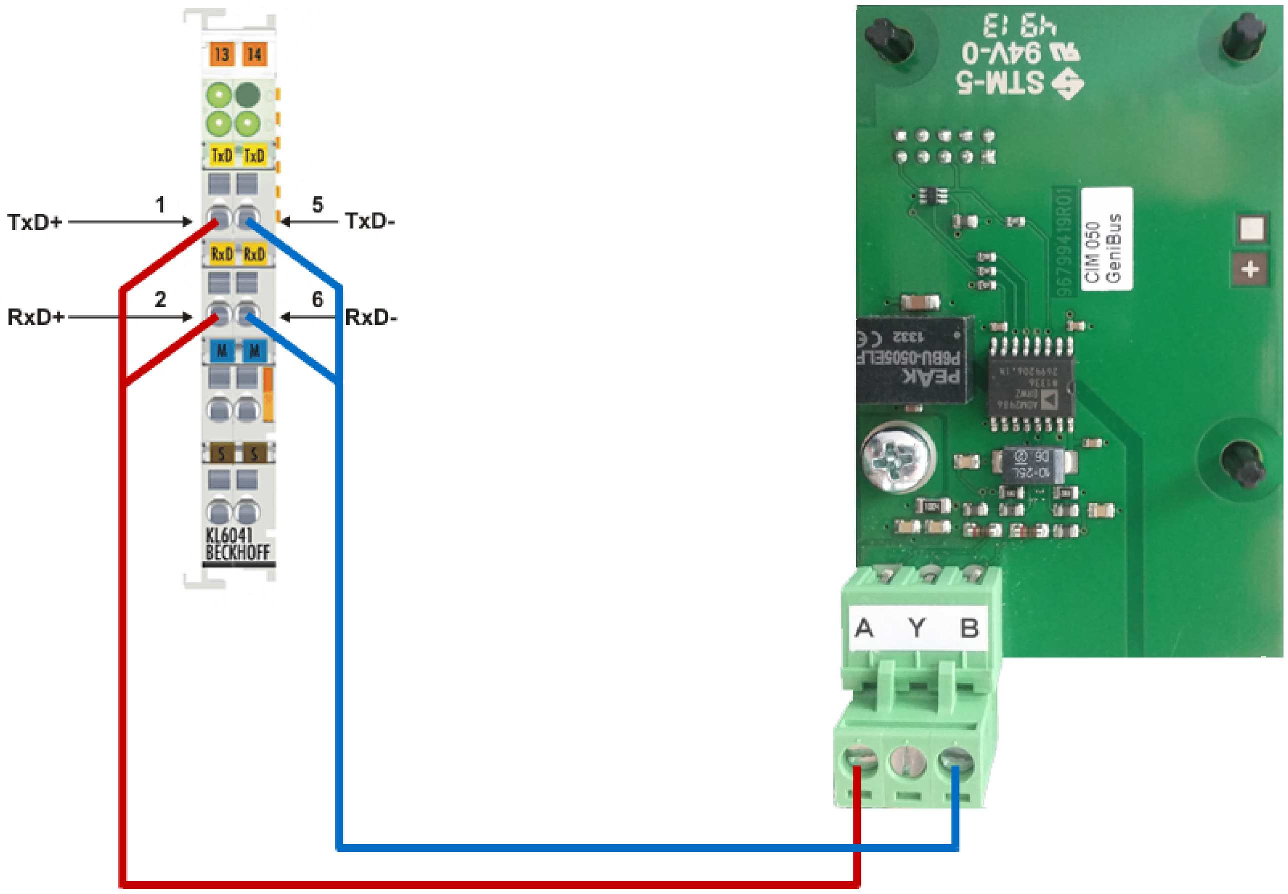
The GENIbus-communication is based on the RS485-standard running in half duplex-mode. Therefore a 2-wire-communication with a plus (A) and a minus (B) cable must be set up.
The serial-communication-terminals KL6021, KL6041 and EL6021 and the serial bus of the CX9020 can handle the half duplex-, but also and the fullduplex-mode. In this mode the plus and the minus channel exists both for the sending (Transmit-Data, TxD) and receiving-channel (Receive-Data, RxD). To use the half duplex-mode correctly, you must connect Rx- to Tx- as well as Rx+ to Tx+.
The serial bus of the CX8080 can only handle the half duplex-mode, so no direct connection between any bus-inputs is neccessary.

NOTICE

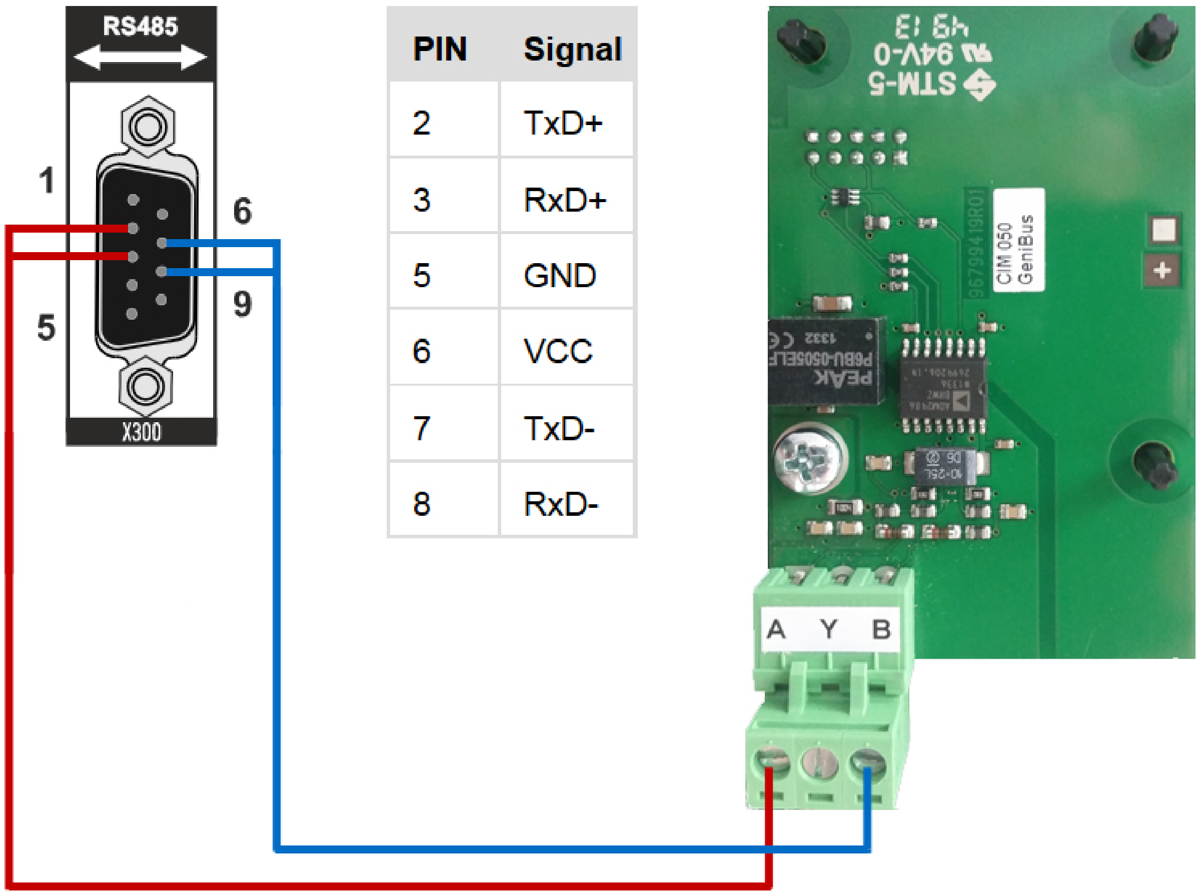
The described plus- and minus-connection to the GENIbus-module (port A for plus and port B for minus) only applies for the CIM 050, which was used for the tests. Before connecting the Beckhoff-terminals to the Grundfos-hardware, please read the documentation of the Grundfos-module, which terminals are the right ones. Furthermore, this chapter only describes the serial-bus-connections. For long wirings a shielding of the cable will be unenviable.

Wiring diagrams:

KL6021, KL6041 and EL6021

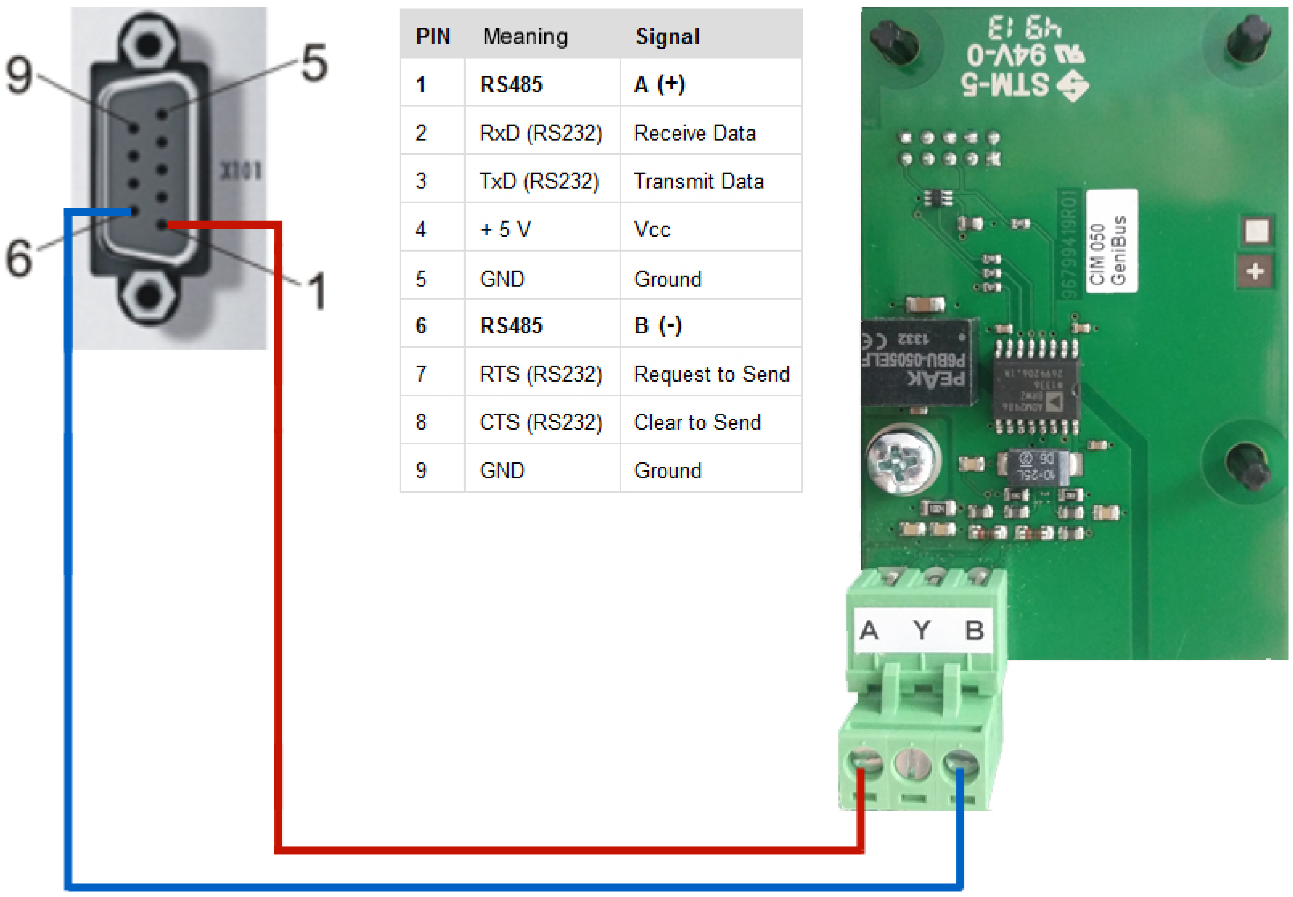


CX9020 (this configuration is not available as a program-example)



PIN	Signal
2	TxD+
3	RxD+
5	GND
6	VCC
7	TxD-
8	RxD-

CX8080



PIN	Meaning	Signal
1	**RS485**	**A (+)**
2	RxD (RS232)	Receive Data
3	TxD (RS232)	Transmit Data
4	+ 5 V	Vcc
5	GND	Ground
6	**RS485**	**B (-)**
7	RTS (RS232)	Request to Send
8	CTS (RS232)	Clear to Send
9	GND	Ground

4 Programming

4.1 Integration into TwinCAT

4.1.1 KL6041 with CX5120

The program illustrates the application of the individual function blocks, based on 5 examples.

The communication runs via a K-bus terminal.

Example: https://infosys.beckhoff.com/content/1033/tcplclib_tc2_genibus/Resources/6190631563/.zip

Hardware

Setting up the components

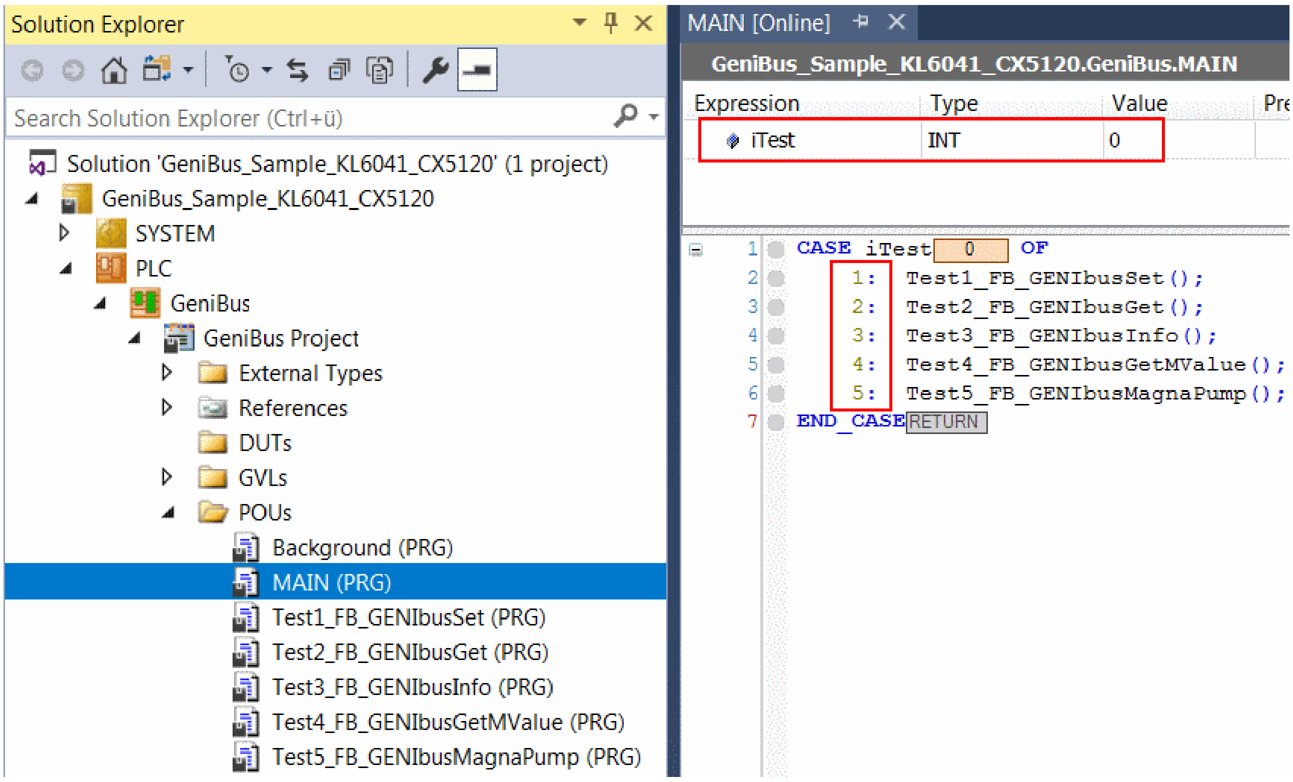
- 1x CX5120 Embedded PC
- 1x KL1408 four-channel digital input terminal for the execution of the individual tests.
- 1x KL6041 serial RS485 terminal
- 1x KL9010 end terminal

Configure the hardware as described in the corresponding documentation.

Software

Creation of the PLC program

The respective test program section can be selected by setting the *iTest* variable in the MAIN program to values from 1 to 5.



Solution 'GeniBus_Sample_KL6041_CX5120' (1 project)
- GeniBus_Sample_KL6041_CX5120
  - SYSTEM
  - PLC
    - GeniBus
      - GeniBus Project
        - External Types
        - References
        - DUTs
        - GVLs
        - POUs
          - Background (PRG)
          - MAIN (PRG)
          - Test1_FB_GENIbusSet (PRG)
          - Test2_FB_GENIbusGet (PRG)
          - Test3_FB_GENIbusInfo (PRG)
          - Test4_FB_GENIbusGetMValue (PRG)
          - Test5_FB_GENIbusMagnaPump (PRG)

GeniBus_Sample_KL6041_CX5120.GeniBus.MAIN

Expression	Type	Value	Pre
iTest	INT	0	

```
CASE iTest 0 OF
    1:  Test1_FB_GENIbusSet();
    2:  Test2_FB_GENIbusGet();
    3:  Test3_FB_GENIbusInfo();
    4:  Test4_FB_GENIbusGetMValue();
    5:  Test5_FB_GENIbusMagnaPump();
END_CASE RETURN
```

The respective program parts contain pre-configured function blocks, which you can address through the test inputs *b1* to *b8*:

```
VAR_GLOBAL
    b1              AT %I* : BOOL;
    b2              AT %I* : BOOL;
    b3              AT %I* : BOOL;
    b4              AT %I* : BOOL;
    b5              AT %I* : BOOL;
    b6              AT %I* : BOOL;
    b7              AT %I* : BOOL;
    b8              AT %I* : BOOL;

    stInData        AT %I* : ST_GENIbusInData;
    stOutData       AT %Q* : ST_GENIbusOutData;
    stCommandBuffer        : ST_GENIbusCommandBuffer;
END_VAR
```

b1..b8: Switching inputs for the test programs.

stInData: Structure with the input variables (see ST_GENIbusInData [▸ 37]) for various terminal types.

stOutData: Structure with the output variables (see ST_GENIbusOutData [▸ 40]) for various terminal types.

stCommandBuffer: Reference to the structure for communication (see ST_GENIbusCommandBuffer [▸ 35]) with the function block FB_GENIbusCommunication [▸ 17]

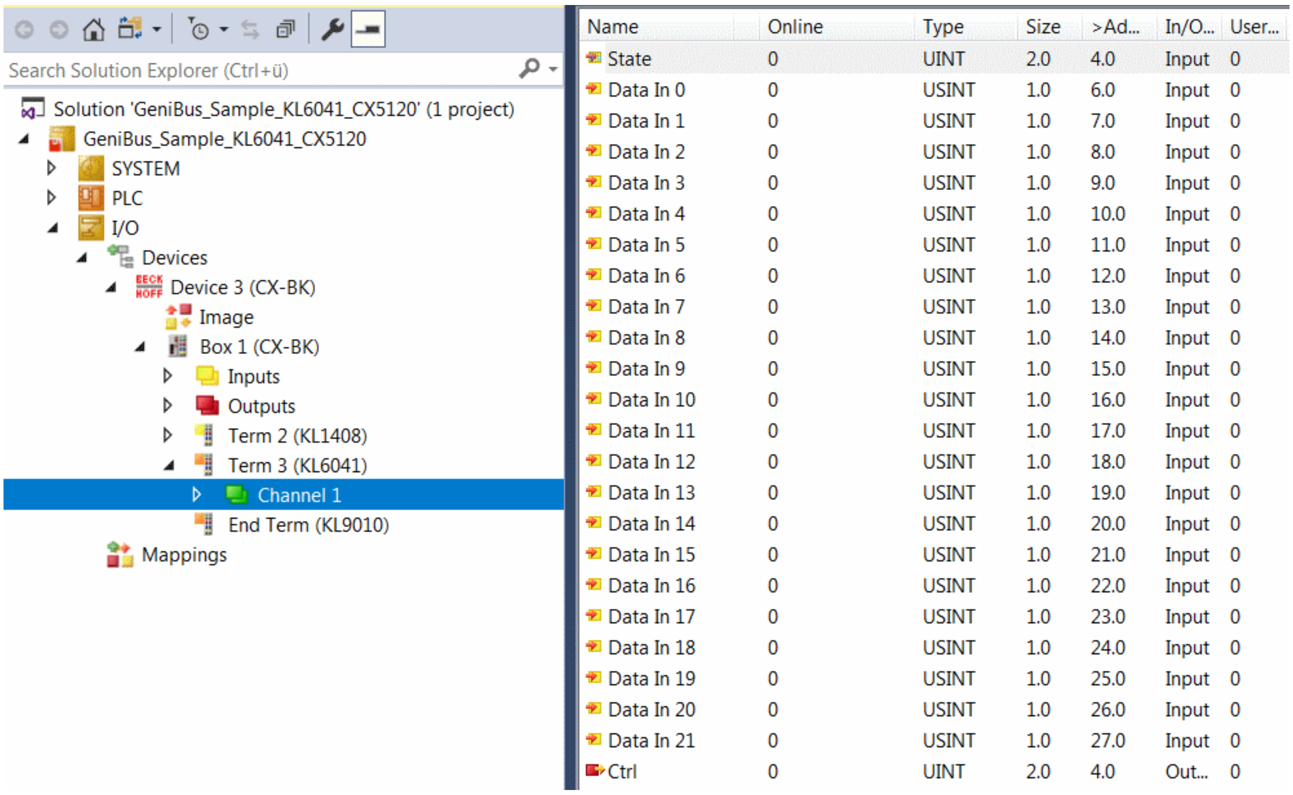
I/O configuration

The requirement for the linking of the process image is that the terminal is preset to 22 bytes in advance. In contrast to the PC interface, this cannot be configured in the I/O section, but only via the KS2000 software. The communication parameters

- Baud Rate: 9600 bits/s
- Data bits: 8
- Parity: None
- Stop bits: 1

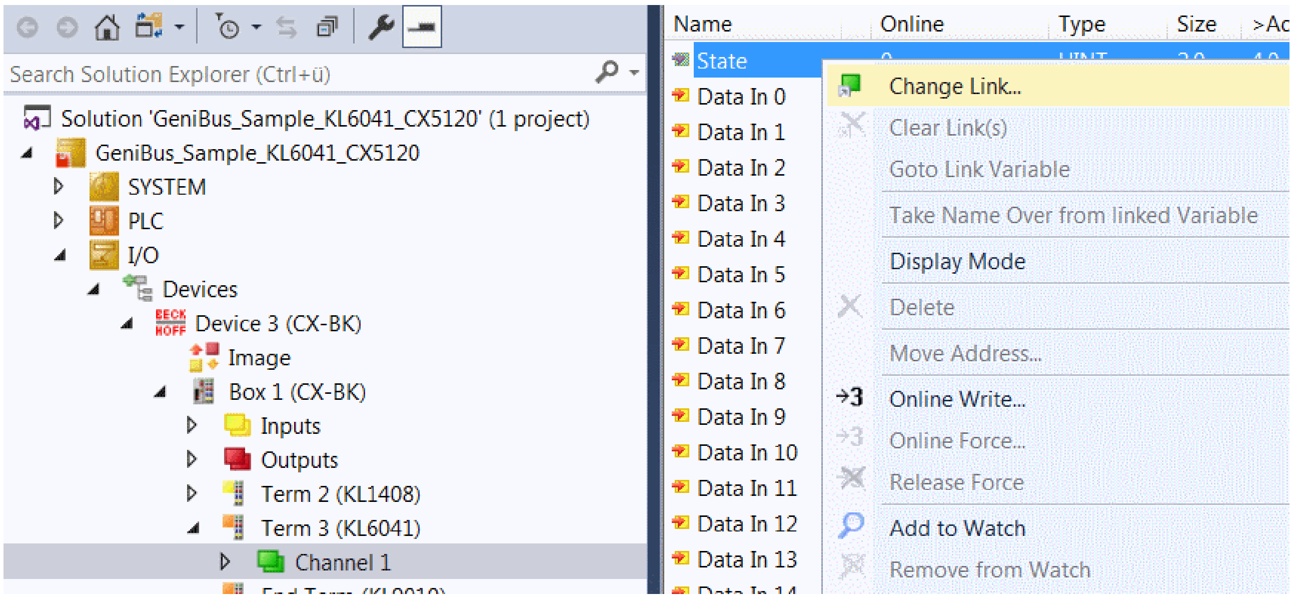
are automatically set by the PLC application, so that following the exchange of a terminal and a subsequent restart, this terminal is correctly set.

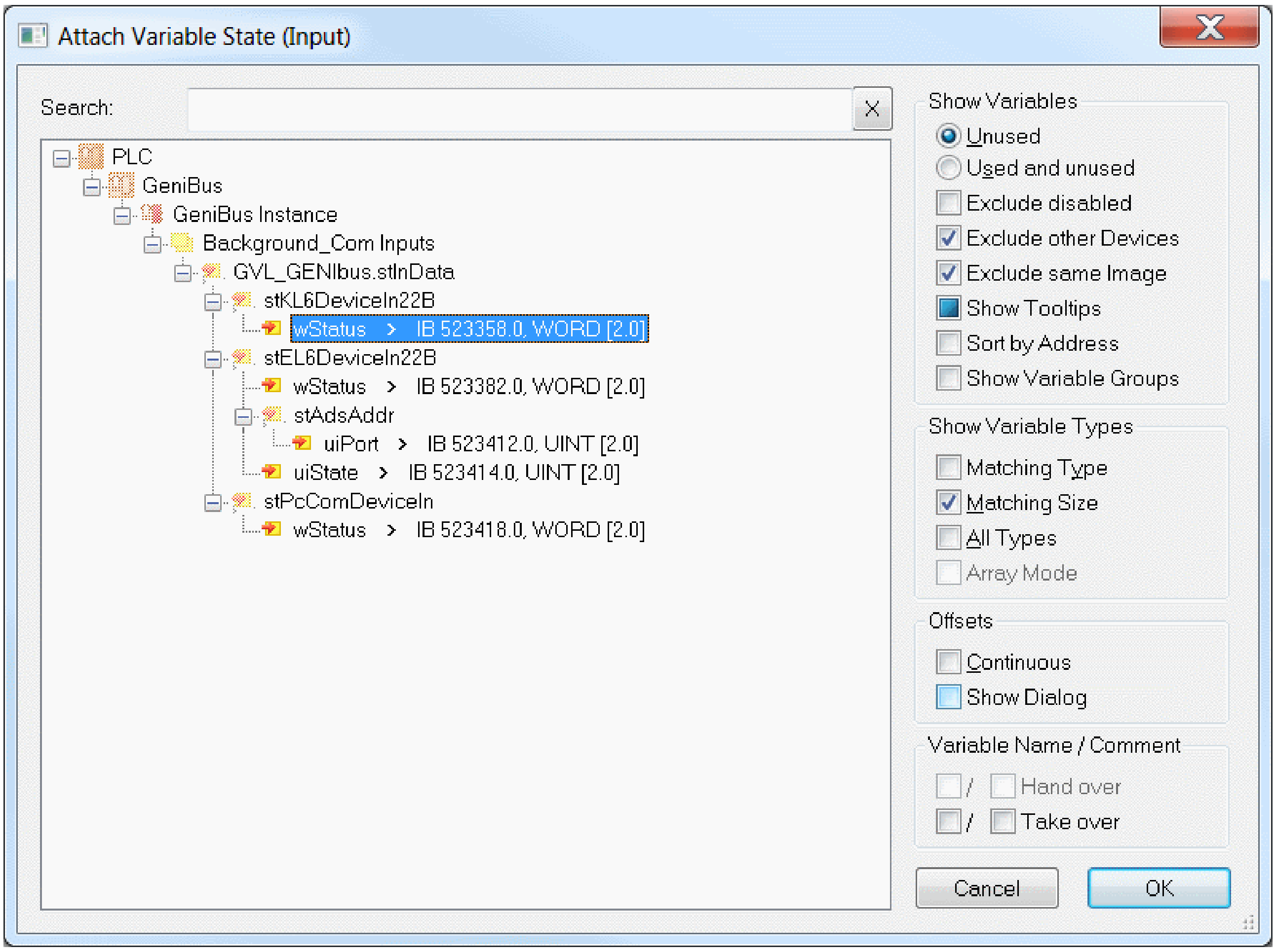
The linking of the process image to the PLC input and output variables can be accomplished most simply from the hardware side, since multi-links are possible from there. To this end, the variables must show up in the I/O section on the right:



Name	Online	Type	Size	>Ad...	In/O...	User...
State	0	UINT	2.0	4.0	Input	0
Data In 0	0	USINT	1.0	6.0	Input	0
Data In 1	0	USINT	1.0	7.0	Input	0
Data In 2	0	USINT	1.0	8.0	Input	0
Data In 3	0	USINT	1.0	9.0	Input	0
Data In 4	0	USINT	1.0	10.0	Input	0
Data In 5	0	USINT	1.0	11.0	Input	0
Data In 6	0	USINT	1.0	12.0	Input	0
Data In 7	0	USINT	1.0	13.0	Input	0
Data In 8	0	USINT	1.0	14.0	Input	0
Data In 9	0	USINT	1.0	15.0	Input	0
Data In 10	0	USINT	1.0	16.0	Input	0
Data In 11	0	USINT	1.0	17.0	Input	0
Data In 12	0	USINT	1.0	18.0	Input	0
Data In 13	0	USINT	1.0	19.0	Input	0
Data In 14	0	USINT	1.0	20.0	Input	0
Data In 15	0	USINT	1.0	21.0	Input	0
Data In 16	0	USINT	1.0	22.0	Input	0
Data In 17	0	USINT	1.0	23.0	Input	0
Data In 18	0	USINT	1.0	24.0	Input	0
Data In 19	0	USINT	1.0	25.0	Input	0
Data In 20	0	USINT	1.0	26.0	Input	0
Data In 21	0	USINT	1.0	27.0	Input	0
Ctrl	0	UINT	2.0	4.0	Out...	0

First of all, just the status is linked with the status variable of the communication input. Note that when doing so the structure for KL communication must be selected.





Attach Variable State (Input)

Search:

- PLC
  - GeniBus
    - GeniBus Instance
      - Background_Com Inputs
        - GVL_GENIbus.stInData
          - stKL6DeviceIn22B
            - wStatus > IB 523358.0, WORD [2.0]
          - stEL6DeviceIn22B
            - wStatus > IB 523382.0, WORD [2.0]
            - stAdsAddr
              - uiPort > IB 523412.0, UINT [2.0]
            - uiState > IB 523414.0, UINT [2.0]
          - stPcComDeviceIn
            - wStatus > IB 523418.0, WORD [2.0]

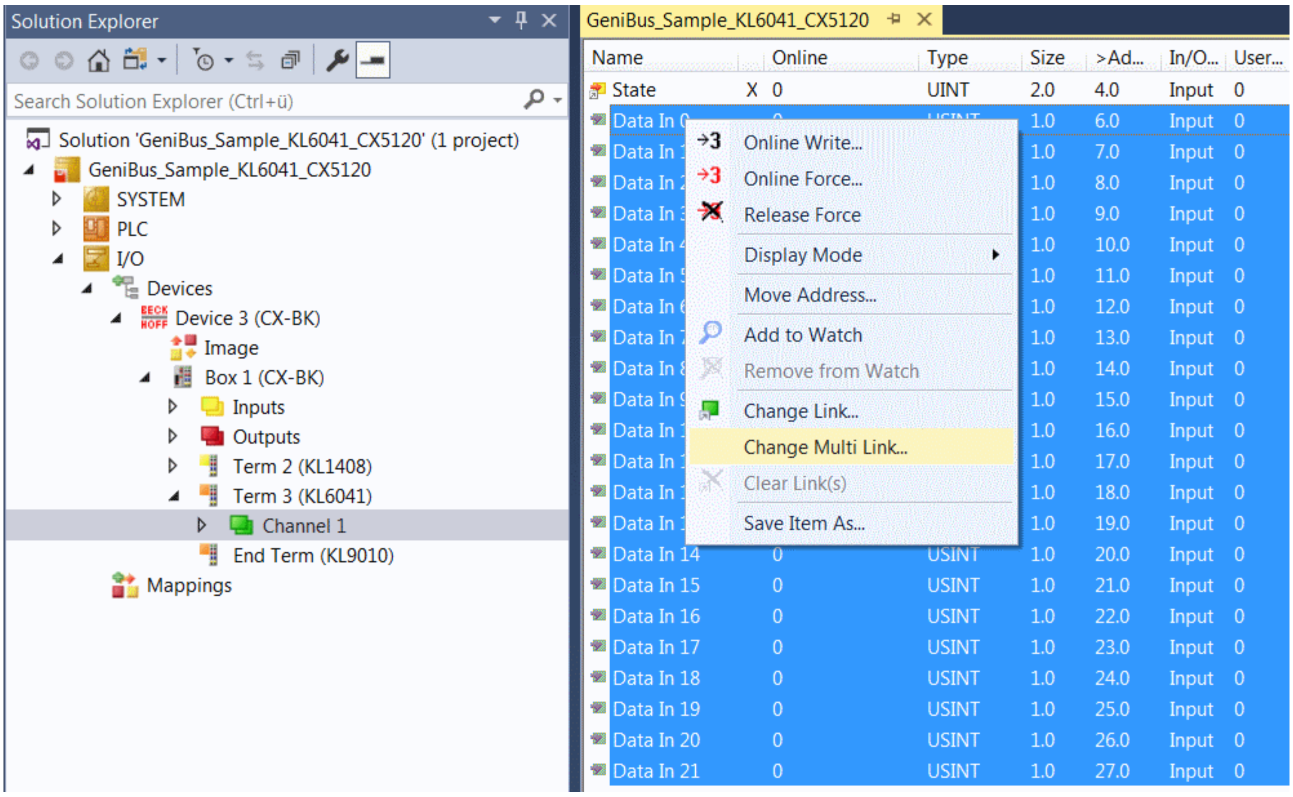
Show Variables
- [✓ Unused]
- Used and unused
- ☐ Exclude disabled
- ☑ Exclude other Devices
- ☑ Exclude same Image
- ■ Show Tooltips
- ☐ Sort by Address
- ☐ Show Variable Groups

Show Variable Types
- ☐ Matching Type
- ☑ Matching Size
- ☐ All Types
- ☐ Array Mode

Offsets
- ☐ Continuous
- ☐ Show Dialog

Variable Name / Comment
- ☐ / ☐ Hand over
- ☐ / ☐ Take over

After that the data bytes can be conveniently linked to the corresponding variables by multi-link. The selection of several variables can be achieved by clicking on “Data1” and pressing the ↓ key with the Shift key pressed.



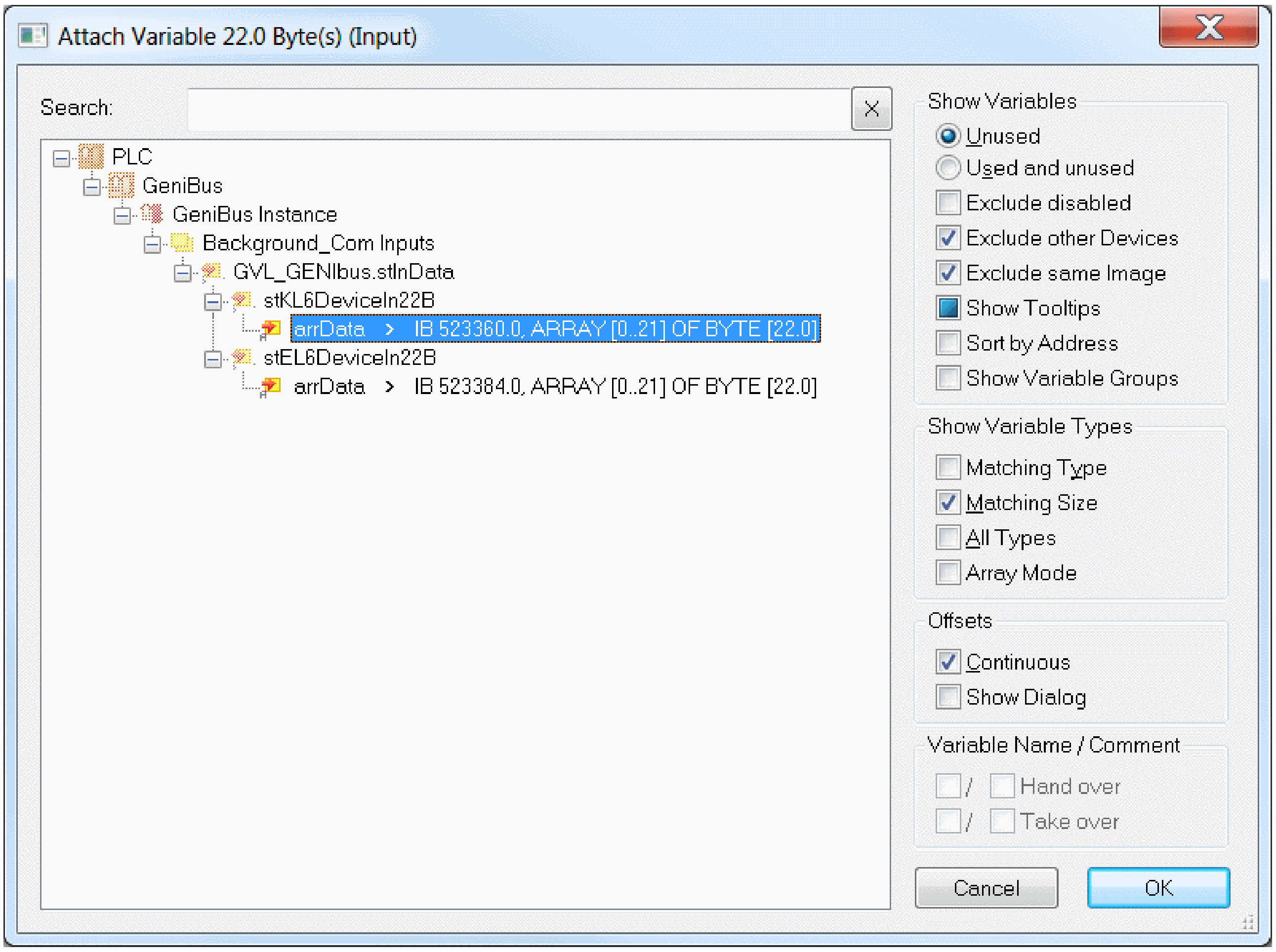
Solution Explorer

Search Solution Explorer (Ctrl+ü)

- Solution 'GeniBus_Sample_KL6041_CX5120' (1 project)
  - GeniBus_Sample_KL6041_CX5120
    - SYSTEM
    - PLC
    - I/O
      - Devices
        - Device 3 (CX-BK)
          - Image
          - Box 1 (CX-BK)
            - Inputs
            - Outputs
            - Term 2 (KL1408)
            - Term 3 (KL6041)
              - Channel 1
            - End Term (KL9010)
      - Mappings

GeniBus_Sample_KL6041_CX5120

Name	Online	Type	Size	>Ad...	In/O...	User...
State	X 0	UINT	2.0	4.0	Input	0
Data In (			1.0	6.0	Input	0
Data In 1			1.0	7.0	Input	0
Data In 2			1.0	8.0	Input	0
Data In 3			1.0	9.0	Input	0
Data In 4			1.0	10.0	Input	0
Data In 5			1.0	11.0	Input	0
Data In 6			1.0	12.0	Input	0
Data In 7			1.0	13.0	Input	0
Data In 8			1.0	14.0	Input	0
Data In 9			1.0	15.0	Input	0
Data In 1			1.0	16.0	Input	0
Data In 1			1.0	17.0	Input	0
Data In 1			1.0	18.0	Input	0
Data In 1			1.0	19.0	Input	0
Data In 14	0	USINT	1.0	20.0	Input	0
Data In 15	0	USINT	1.0	21.0	Input	0
Data In 16	0	USINT	1.0	22.0	Input	0
Data In 17	0	USINT	1.0	23.0	Input	0
Data In 18	0	USINT	1.0	24.0	Input	0
Data In 19	0	USINT	1.0	25.0	Input	0
Data In 20	0	USINT	1.0	26.0	Input	0
Data In 21	0	USINT	1.0	27.0	Input	0


Attach Variable 22.0 Byte(s) (Input)

Search:

```
PLC
  GeniBus
    GeniBus Instance
      Background_Com Inputs
        GVL_GENIbus.stInData
          stKL6DeviceIn22B
            arrData  >  IB 523360.0, ARRAY [0..21] OF BYTE [22.0]
          stEL6DeviceIn22B
            arrData  >  IB 523384.0, ARRAY [0..21] OF BYTE [22.0]
```

Show Variables
- [✓ Unused]
- Used and unused
- ☐ Exclude disabled
- ☑ Exclude other Devices
- ☑ Exclude same Image
- ■ Show Tooltips
- ☐ Sort by Address
- ☐ Show Variable Groups

Show Variable Types
- ☐ Matching Type
- ☑ Matching Size
- ☐ All Types
- ☐ Array Mode

Offsets
- ☑ Continuous
- ☐ Show Dialog

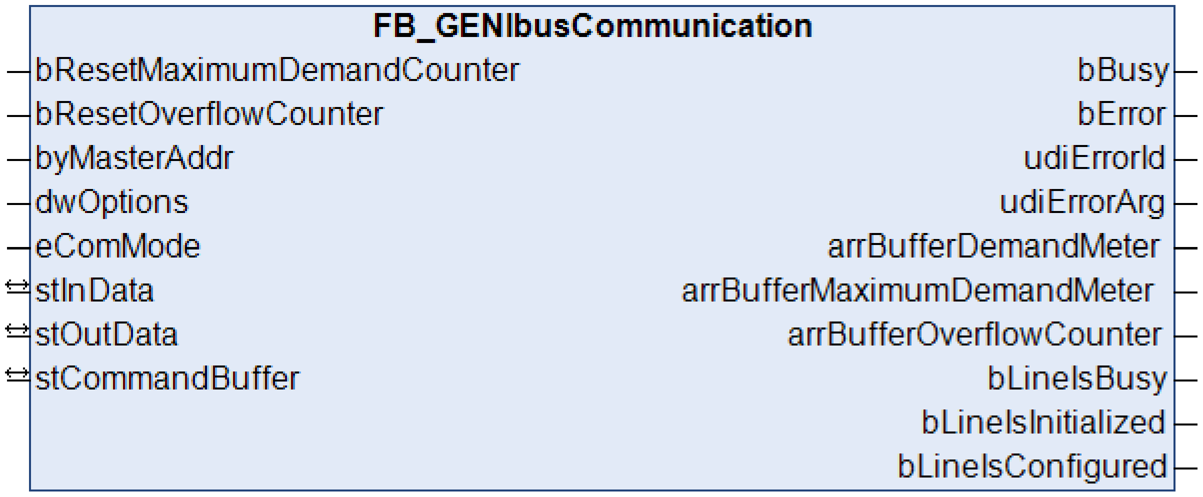
Variable Name / Comment
- ☐ / ☐ Hand over
- ☐ / ☐ Take over

The output variables must be linked in the same way.

4.2 POUs

4.2.1 Base

4.2.1.1 FB_GENIbusCommunication



The function blocks for the GENIbus commands do not directly access the process image of the selected serial interface; instead, they place the individual GENIbus commands into three different buffers. The FB_GENIbusCommunication() function block sequentially reads the GENIbus commands from these three buffers and forwards the GENIbus commands to the serial interface. This prevents multiple function blocks accessing the process image of the serial interface at the same time. Each of these three buffers is processed with a different priority (high, medium or low). The parameter eCommandPriority [▶ 32], which is available for most function blocks, can be used to specify the priority with which the respective GENIbus command is processed by the function block FB_GENIbusCommunication().

The buffers in which the GENIbus commands are placed are all contained in a variable of the type ST_GENIbusCommandBuffer [▶ 35]. There is one instance of the FB_GENIbusCommunication() function block and one variable of the type ST_GENIbusCommandBuffer per serial interface. If possible, the FB_GENIbusCommunication() function block should be called in a separate, faster task.

The extent to which the buffers are utilized can be determined from the outputs of the block. Three arrays are output for this in which each element (0, 1 or 2) represents one of the three buffers (high, middle or low). If you detect regular overflow for one of the three buffers, you should consider the following:

- How heavily are the individual PLC tasks utilized? TwinCAT XAE provides suitable analysis tools.
- Try reducing the cycle time of the task in which the FB_GENIbusCommunication() function block is called. The value should not exceed 6 ms. Ideally it should be 2 ms.
- Check the cycle time of the PLC task in which the blocks for the individual GENIbus commands are called. This value should be between 10 ms and 60 ms.
- If possible avoid polling (regular reading) of values. Only read values when they are actually required.

VAR_INPUT

```
bResetMaximumDemandCounter     : BOOL;
bResetOverflowCounter          : BOOL;
byMasterAddr                   : BYTE;
dwOptions                      : DWORD := 0;
eComMode                       : E_GENIbusComMode;
```

bResetMaximumDemandCounter: a rising edge resets the stored value of the maximum command buffer utilization, *arrBufferMaximumDemandMeter* (0 - 100%, see VAR_OUTPUT).

bResetOverflowCounter: a rising edge resets the stored value of the number of command buffer overflows, *arrBufferOverflowCounter* (see VAR_OUTPUT).

byMasterAddr: specifies the address that the TwinCAT controller should have within the GENIbus line. Possible input range: 0 - 31.

dwOptions: reserved for future applications.

eComMode: the selection of the serial communication interface must be entered at this parameter (see E_GENIbusComMode [▶ 33]). If a KL terminal or an EtherCAT Terminal is in use, then a configuration of the connection parameters is internally and automatically started:

- Baud Rate: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1

Unfortunately this is not possible for PC-based interfaces; in this case the parameters must be directly entered in the TwinCAT XAE.

VAR_OUTPUT

```
bBusy                         : BOOL;
bError                        : BOOL;
udiErrorId                    : UDINT;
udiErrorArg                   : UDINT;
arrBufferDemandMeter          : ARRAY[0..2] OF BYTE;
arrBufferMaximumDemandMeter   : ARRAY[0..2] OF BYTE;
arrBufferOverflowCounter      : ARRAY[0..2] OF UINT;
bLineIsBusy                   : BOOL;
bLineIsInitialized            : BOOL;
bLineIsConfigured             : BOOL;
```

bBusy: a GENIbus command is converted into a serial telegram and transmitted. This flag is reset again following a successful response or following an abort after an error.

bError: This output is switched to TRUE as soon as an error occurs during the execution of a command. The command-specific error code is contained in *udiErrorId*.

udiErrorId: Contains the command-specific error code of the most recently executed command (see error codes [▶ 29]). It is set back to 0 by the reactivation of the function block via the *bStart* input.

udiErrorArg: if applicable, contains an extended description of the error code.

arrBufferDemandMeter: Occupancy of the respective buffer (0 - 100%).

arrBufferMaximumDemandMeter: previous maximum occupancy of the respective buffer (0 - 100%).

arrBufferOverflowCounter: Number of buffer overflows to date.

bLineIsBusy: this output is set as long as the serial communication is active.

bLineIsInitialized: if the block is being called for the first time (e.g. when the controller is starting up) an initialization process is executed. No GENIbus commands can be processed during this time.

bLineIsConfigured: this output indicates with TRUE that the terminal has been successfully configured with the above serial parameters. This output is automatically set if the interface is a PC interface, since the user has to enter the parameters himself in the TwinCAT XAE.

since an error may not interrupt the execution of the function block, bError, udiErrorId and udiErrorArg are initially reset in every PLC cycle and then re-evaluated.

VAR_IN_OUT

```
stInData              : ST_GENIbusInData;
stOutData             : ST_GENIbusOutData;
stCommandBuffer       : ST_GENIbusCommandBuffer;
```

stInData : reference to the structure which contains the input process image for communication with the serial interface (see ST_GENIbusInData [▶ 37]).

stOutData : reference to the structure which contains the output process image for communication with the serial interface (see ST_GENIbusOutData [▶ 40]).

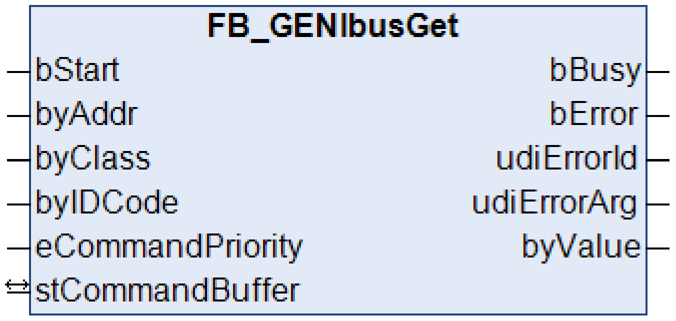
stCommandBuffer: reference to the structure for communication (buffer) with the GENIbus function blocks (see ST_GENIbusCommandBuffer [▶ 35]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.2.2 Basic commands

4.2.2.1 FB_GENIbusGet



This function block reads a value from a GENIbus device.

VAR_INPUT

```
bStart             : BOOL;
byAddr             : BYTE := 0;
byClass            : BYTE := 2;
byIDCode           : BYTE := 0;
eCommandPriority   : E_GENIbusCommandPriority := eGENIbusCommandPriorityMiddle;
```

bStart: The reading process is initiated by a rising edge at this input.

byAdress: address of the GENIbus device to be addressed: valid entries: 1 - 200. This corresponds to the setting as is made directly on the GENIbus device. Conversion to the actual address range 32 - 231 takes place within the block (see GENIbus standard). A broadcast command via address 255 is naturally not permitted.

byClass/byIDCode: Class and ID code of the memory location to be read. GET commands are permissible only for classes 2, 4, 5 and 7 – an error is output for all other entries. Conversely, there is no restriction of the ID code entry, since these ranges are not without gaps and may possibly be extended.

eCommandPriority: priority (high, medium or low) with which the command is processed by the PLC library (see E_GENIbusCommandPriority [▸ 32]).

VAR_OUTPUT

```
bBusy          : BOOL;
bError         : BOOL;
udiErrorId     : UDINT;
udiErrorArg    : UDINT;
byValue        : BYTE;
```

bBusy: starting with the edge at *bStart*, this output remains TRUE until the command has been processed.

bError: This output is switched to TRUE as soon as an error occurs during the execution of a command. The command-specific error code is contained in *udiErrorId*.

udiErrorId: Contains the command-specific error code of the most recently executed command. It is set back to 0 by the reactivation of the function block via the *bStart* input (see error codes [▸ 29]).

udiErrorArg: if applicable, contains an extended description of the error code.

byValue: output of the read value.

VAR_IN_OUT

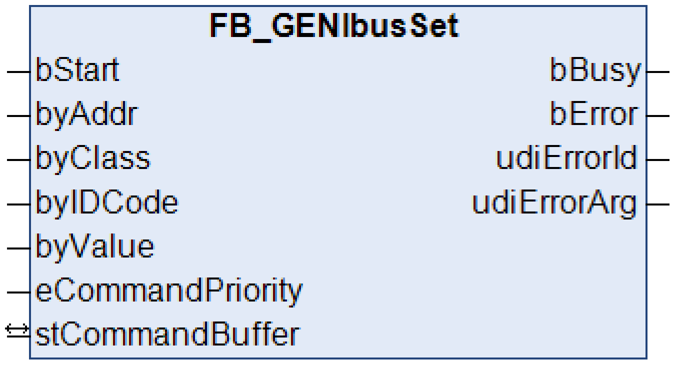
```
stCommandBuffer    : ST_GENIbusCommandBuffer;
```

stCommandBuffer: reference to the structure for communication (buffer) with the FB_GENIbusCommunication() [▸ 17] function block (see ST_GENIbusCommandBuffer [▸ 35]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.2.2.2 FB_GENIbusSet



This function block writes a value in a GENIbus device or executes a command (Class-3 Ids).

VAR_INPUT

```
bStart           : BOOL;
byAddr           : BYTE := 0;
byClass          : BYTE := 2;
byIDCode         : BYTE := 0;
byValue          : BYTE;
eCommandPriority : E_GENIbusCommandPriority := eGENIbusCommandPriorityMiddle;
```

bStart: A rising edge at this input starts the setting process.

byAdress: address of the GENIbus device to be addressed: valid entries: 1 - 200. This corresponds to the setting as is made directly on the GENIbus device. Conversion to the actual address range 32 - 231 takes place within the block (see GENIbus standard).

byClass/byIDCode: Class and ID code of the memory location to be written. SET commands are permissible only for classes 3, 4 and 5 – an error is output for all other entries. Conversely, there is no restriction of the ID code entry, since these ranges are not without gaps and may possibly be extended.

byValue: Value to be written. In the case of Class-3 IDs this entry is ignored.

eCommandPriority: priority (high, medium or low) with which the command is processed by the PLC library (see E_GENIbusCommandPriority [▶ 32]).

VAR_OUTPUT

```
bBusy             : BOOL;
bError            : BOOL;
udiErrorId        : UDINT;
udiErrorArg       : UDINT;
```

bBusy: starting with the edge at *bStart*, this output remains TRUE until the command has been processed.

bError: this output is switched to TRUE as soon as an error occurs during the execution of a command. The command-specific error code is contained in *udiErrorId*.

udiErrorId: Contains the command-specific error code of the most recently executed command (see error codes [▶ 29]). It is set back to 0 by the reactivation of the function block via the *bStart* input.

udiErrorArg: if applicable, contains an extended description of the error code.

VAR_IN_OUT

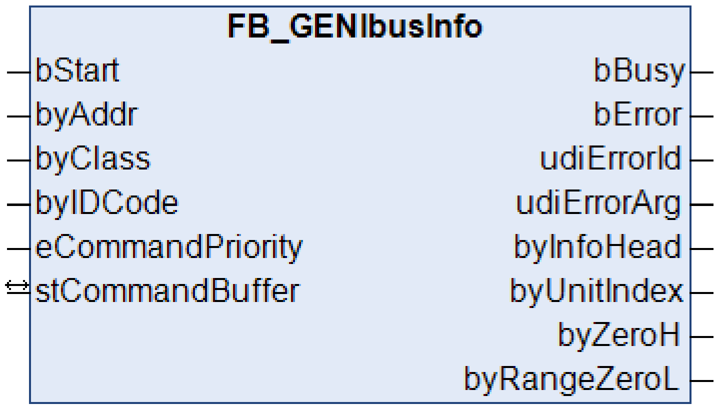
```
stCommandBuffer   : ST_GENIbusCommandBuffer;
```

stCommandBuffer: reference to the structure for communication (buffer) with the FB_GENIbusCommunication() [▶ 17] function block (see ST_GENIbusCommandBuffer [▶ 35]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.2.2.3 FB_GENIbusInfo



This function reads out the notification area of an ID.

VAR_INPUT

```
bStart             : BOOL;
byAddr             : BYTE := 0;
byClass            : BYTE := 2;
byIDCode           : BYTE := 0;
eCommandPriority   : E_GENIbusCommandPriority := eGENIbusCommandPriorityMiddle;
```

bStart: The reading process is initiated by a rising edge at this input.

byAdress: address of the GENIbus device to be addressed: valid entries: 1 - 200. This corresponds to the setting as is made directly on the GENIbus device. Conversion to the actual address range 32 - 231 takes place within the block (see GENIbus standard). A broadcast command via address 255 is naturally not permitted.

byClass/byIDCode: Class and ID code of the memory location to be read. INFO commands are permissible only for classes 2, 3, 4 and 5 - an error is output for all other entries. Conversely, there is no restriction of the ID code entry, since these ranges are not without gaps and may possibly be extended.

eCommandPriority: priority (high, medium or low) with which the command is processed by the PLC library (see E_GENIbusCommandPriority [▶ 32]).

VAR_OUTPUT

```
bBusy          : BOOL;
bError         : BOOL;
udiErrorId     : UDINT;
udiErrorArg    : UDINT;
byInfoHead     : BYTE;
byUnitIndex    : BYTE;
byZeroH        : BYTE;
byRangeZeroL   : BYTE;
```

bBusy: starting with the edge at *bStart*, this output remains TRUE until the command has been processed.

bError: This output is switched to TRUE as soon as an error occurs during the execution of a command. The command-specific error code is contained in *udiErrorId*.

udiErrorId: Contains the command-specific error code of the most recently executed command (see error codes [▶ 29]). It is set back to 0 by the reactivation of the function block via the *bStart* input.

udiErrorArg: if applicable, contains an extended description of the error code.

byInfoHead: scaling information

byUnitIndex: sign and unit – coded.

byZeroH: zero point in the case of normal range zero-point scaling OR high-byte zero point in the case of extended scaling.

byRangeZeroL: range in the case of normal range zero-point scaling OR low-byte zero point in the case of extended scaling.

VAR_IN_OUT

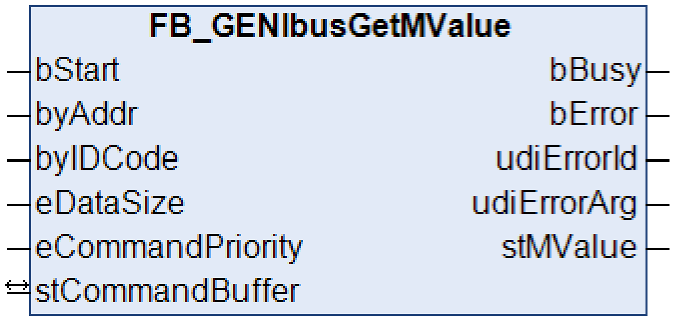
```
stCommandBuffer   : ST_GENIbusCommandBuffer;
```

stCommandBuffer: reference to the structure for communication (buffer) with the FB_GENIbusCommunication() [▸ 17] function block (see ST_GENIbusCommandBuffer [▸ 35]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.2.2.4 FB_GENIbusGetMValue



This function block reads a measured value from a GENIbus device. The operation is thereby exclusively restricted to values of class 2. Only the ID code of the high byte and the length of the measured value need to be specified; the type of scaling and the unit of the measured value are determined by an internal INFO query. A structure at the *stMValue* output provides all important information about the value.

VAR_INPUT

```
bStart             : BOOL;
byAddr             : BYTE := 0;
byIDCode           : BYTE := 0;
eDataSize          : E_GENIBusMDataSize;
eCommandPriority   : E_GENIbusCommandPriority := eGENIbusCommandPriorityMiddle;
```

bStart: The reading process is initiated by a rising edge at this input.

byAddr: address of the GENIbus device to be addressed: valid entries: 1 - 200. This corresponds to the setting as is made directly on the GENIbus device. Conversion to the actual address range 32 - 231 takes place within the block (see GENIbus standard). A broadcast command via address 255 is naturally not permitted.

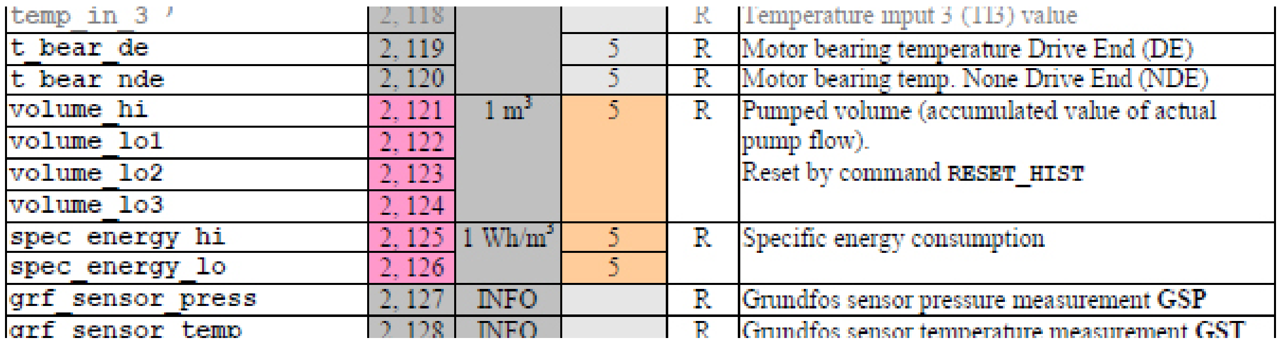
byIDCode: ID code of the value to be read. In the case of 16, 24 and 32-bit values, the ID of the high byte must be specified here and the following order is always assumed: ID = hi, ID+1 = lo1, ID+2 = lo2, ID+3 = lo3.

eDataSize: data size of the measured value: 8, 16, 24 or 32 bytes (see E_GENIBusMDataSize [▸ 33]).

eCommandPriority: priority (high, medium or low) with which the command is processed by the PLC library (see E_GENIbusCommandPriority [▸ 32]).

Sample: Read-out of the total pumped volume of water. For this case is:

- byIdCode = 121
- eDataSize = eGENIbusMSize32Bit



temp_in_3	2, 118			R	Temperature input 3 (113) value
t_bear_de	2, 119		5	R	Motor bearing temperature Drive End (DE)
t_bear_nde	2, 120		5	R	Motor bearing temp. None Drive End (NDE)
volume_hi	2, 121	1 m^3	5	R	Pumped volume (accumulated value of actual pump flow). Reset by command **RESET_HIST**
volume_lo1	2, 122				
volume_lo2	2, 123				
volume_lo3	2, 124				
spec_energy_hi	2, 125	1 Wh/m^3	5	R	Specific energy consumption
spec_energy_lo	2, 126		5		
grf_sensor_press	2, 127	INFO		R	Grundfos sensor pressure measurement GSP
grf_sensor_temp	2, 128	INFO		R	Grundfos sensor temperature measurement GST

Source: Grundfos documentation "Operating the MAGNA3 and MGE model H/I via the GENIpro interface - Edition 01.00.35 - April 2015".

VAR_OUTPUT

```
bBusy          : BOOL;
bError         : BOOL;
udiErrorId     : UDINT;
udiErrorArg    : UDINT;
stMValue       : ST_GENIbusMValue;
```

bBusy: starting with the edge at *bStart*, this output remains TRUE until the command has been processed.

bError: This output is switched to TRUE as soon as an error occurs during the execution of a command. The command-specific error code is contained in *udiErrorId*.

udiErrorId: Contains the command-specific error code of the most recently executed command (see error codes [▸ 29]). It is set back to 0 by the reactivation of the function block via the *bStart* input.

udiErrorArg: if applicable, contains an extended description of the error code.

stMValue: output of the read value (see ST_GENIbusMValue [▸ 39]).

VAR_IN_OUT

```
stCommandBuffer    : ST_GENIbusCommandBuffer;
```

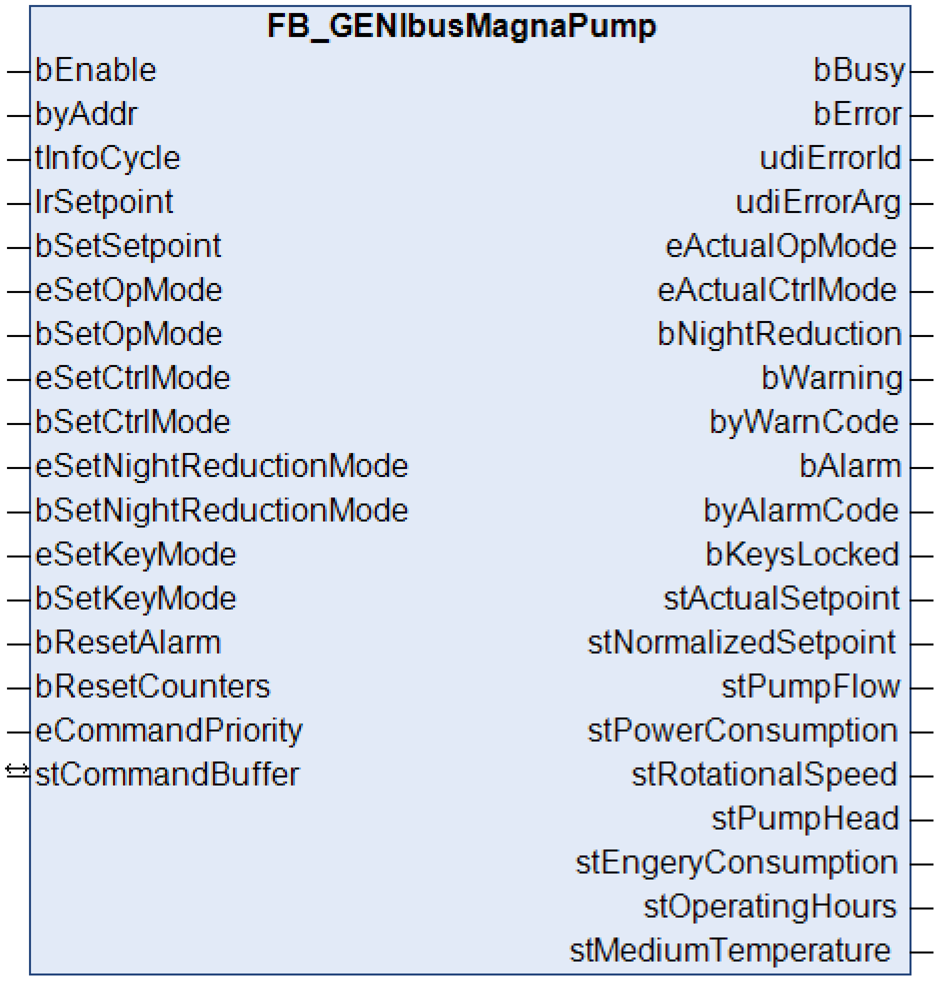
stCommandBuffer: reference to the structure for communication (buffer) with the FB_GENIbusCommunication() [▸ 17] function block (see ST_GENIbusCommandBuffer [▸ 35]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.2.3 Pumps

4.2.3.1 FB_GENIbusMagnaPump



This function block represents a universal application for a Grundfos Magna pump. The fundamental operating modes can be set and important parameters read out.

The values shown in bold lettering inside square brackets represent the class and ID with which the commands are executed or the information acquired. These values are listed in the Grundfos documentation "Operating the MAGNA3 and MGE model H/I via the GENIpro interface - Edition 01.00.35 - April 2015".

VAR_INPUT

```
bEnable                : BOOL;
byAddr                 : BYTE;
tInfoCycle             : TIME;
lrSetpoint             : LREAL;
bSetSetpoint           : BOOL;
eSetOpMode             : E_GENIbusOpMode := eGENIbusOpModeStop;
bSetOpMode             : BOOL;
eSetCtrlMode           : E_GENIbusCtrlMode := eGENIbusCtrlModeConstFreq;
bSetCtrlMode           : BOOL;
eSetNightReductionMode : E_GENIbusNightReductionMode := eGENIbusNightReductionModeOff;
bSetNightReductionMode : BOOL;
eSetKeyMode            : E_GENIbusKeyMode := eGENIbusKeyModeUnlocked;
bSetKeyMode            : BOOL;
bResetAlarm            : BOOL;
bResetCounters         : BOOL;
eCommandPriority       : E_GENIbusCommandPriority := eGENIbusCommandPriorityMiddle;
```

bEnable: the function block is activated by setting this input.

byAdress: address of the GENIbus device to be addressed: valid entries: 1 - 200. This corresponds to the setting as is made directly on the GENIbus device. Conversion to the actual address range 32 – 231 (see GENIbus standard), takes place internally in the function block.

A broadcast or collective command to several pumps is also possible. The value at this input must then be 255. The value queries are deactivated in the case of the broadcast command.

tInfoCycle: specifies the interval at which the value-query commands are to be output. This entry is limited to a minimum of 1 s. Conversely, the entry "0s" is permitted and means that no query takes place.

lrSetpoint: setpoint entry **[5, 1]**. The entry is in percent and refers to the specified limits, depending on the method of control. A more precise description is given in the respective documentation from the Grundfos company.

bSetSetpoint: a rising edge at this input transmits the set setpoint.

eSetOpMode: this input is used to set one of the following operating modes (see E_GENIbusOpMode [▶ 34]):

- Stop **[3, 5]**
- Start **[3, 6]**
- Minimum curve **[3, 25]**
- Maximum curve **[3, 26]**

bSetOpMode: a rising edge at this input transmits the set operating mode.

eSetCtrlMode: this input is used to set one of the following control modes (see E_GENIbusCtrlMode [▶ 33]):

- Constant frequency **[3, 22]**
- Proportional pressure **[3, 23]**
- Constant pressure **[3, 24]**
- Auto-adapting **[3, 52]**

bSetCtrlMode: a rising edge at this input transmits the set control mode.

eSetNightReductionMode: this input is used to select or deselect the night setback mode (see E_GENIbusNightReductionMode [▶ 34]). **[4, 170]**

bSetNightReductionMode: a rising edge at this input transmits the set selection.

eSetKeyMode: locking of the manual operation on the pump can be selected with the aid of this input (see E_GENIbusKeyMode [▶ 33]). The lock only blocks the parameterization menu, not the keys themselves. **[3, 30/31]**

bSetKeyMode: a rising edge at this input transmits the set selection.

bResetAlarm: a rising edge at this input resets the currently pending alarm on the device. **[3, 2]**

bResetCounters: a rising edge at this input resets counters, such as operating hours or energy. **[3, 36]**

eCommandPriority: priority (high, medium or low) with which the command is processed by the PLC library (see E_GENIbusCommandPriority [▶ 32]).

VAR_OUTPUT

```
bBusy                  : BOOL;
bError                 : BOOL;
udiErrorId             : UDINT;
udiErrorArg            : UDINT;
eActualOpMode          : E_GENIbusActOpMode;
eActualCtrlMode        : E_GENIbusActCtrlMode;
bNightReduction        : BOOL;
bWarning               : BOOL;
byWarnCode             : BYTE;
bAlarm                 : BOOL;
byAlarmCode            : BYTE;
bKeysLocked            : BOOL;
stActualSetpoint       : ST_GENIbusMValue;
```

```
stNormalizedSetpoint   : ST_GENIbusMValue;
stPumpFlow             : ST_GENIbusMValue;
stPowerConsumption     : ST_GENIbusMValue;
stRotationalSpeed      : ST_GENIbusMValue;
stPumpHead             : ST_GENIbusMValue;
stEngeryConsumption    : ST_GENIbusMValue;
stOperatingHours       : ST_GENIbusMValue;
stMediumTemperature    : ST_GENIbusMValue;
```

bBusy: this output is always TRUE when a command or query is being processed.

bError: This output is switched to TRUE as soon as an error occurs during the execution of a command. The command-specific error code is contained in *udiErrorId*.

udiErrorId: Contains the command-specific error code of the most recently executed command (see error codes [▶ 29]). It is set back to 0 by the reactivation of the function block via the *bStart* input.

udiErrorArg: if applicable, contains an extended description of the error code.

eActualOpMode: currently valid operating mode (see E_GENIbusActOpMode [▶ 32]). **[2, 81]**

eActualCtrlMode: currently valid control mode (see E_GENIbusActCtrlMode [▶ 32]). **[2, 81]**

bNightReduction: night setback is selected. **[2, 84]**

bWarning : a warning message is pending.

byWarnCode: code of the current warning message. **[2, 156]**

bAlarm: an alarm is pending.

byAlarmCode: code of the current alarm. **[2, 158]**

bKeysLocked: locking of manual operation on the pump is activated. **[4, 170]**

stActualSetpoint: currently set setpoint; the unit displayed depends on the control mode (see ST_GENIbusMValue [▶ 39]). **[2, 48]**

stNormalizedSetpoint: currently normalized setpoint (see ST_GENIbusMValue [▶ 39]). **[2, 49]**

stPumpFlow: flow rate (see ST_GENIbusMValue [▶ 39]). **[2, 39]**

stPowerConsumption: power consumption (see ST_GENIbusMValue [▶ 39]). **[2, 34]**

stRotationalSpeed: speed (see ST_GENIbusMValue [▶ 39]). **[2, 35/36]**

stPumpHead: pump head (see ST_GENIbusMValue [▶ 39]). **[2, 37]**

stEngeryConsumption: energy consumption (see ST_GENIbusMValue [▶ 39]). **[2, 152/153]**

stOperatingHours: operating hour counter (see ST_GENIbusMValue [▶ 39]). **[2, 24/25]**

stMediumTemperature: water (medium) temperature (see ST_GENIbusMValue [▶ 39]). **[2, 58]**

since an error may not interrupt the execution of the function block, bError, udiErrorId and udiErrorArg are initially reset in every PLC cycle and then re-evaluated. for the determination of sporadically occurring errors, an error memory must therefore be programmed external to the function block.

VAR_IN_OUT

```
stCommandBuffer    : ST_GENIbusCommandBuffer;
```

stCommandBuffer: reference to the structure for communication (buffer) with the FB_GENIbusCommunication() [▶ 17] function block (see ST_GENIbusCommandBuffer [▶ 35]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.2.4 Error codes

ErrId (hex)	ErrId (dec)	ErrArg	Description
0x0000	0	n/a	No error.
0x8001	32769	n/a	Internal error: no AMS-Net ID is read out. The process image is possibly not correctly linked.
0x8002	32770	n/a	Incorrect baud rate entry.
0x8003	32771	Sub-function-block error number	Internal error while writing the configuration data. *udiErrorArg* contains the error number of the write function block FB_EcCoESdoWrite() of the internally used library TcEtherCAT.lib.
0x8004	32772	n/a	Internal error: Incorrect pointer assignment *pRegComIn*/ *pRegComOut*. One of the two pointers points to the address 0.
0x8005	32773	n/a	Timeout error during the register communication.
0x8019	32793	n/a	Invalid master address. Valid range: 0 - 31.
0x8020	32800	Sub-function-block error number	Error while configuring a KL6xxx (5 bytes of data). *udiErrorArg* contains the error number of the internal configuration function block.
0x8021	32801	Sub-function-block error number	Error while configuring a KL6xxx (22 bytes of data). *udiErrorArg* contains the error number of the internal configuration function block.
0x8022	32802	Sub-function-block error number	Error while configuring a KL6xxx (22 bytes of data). *udiErrorArg* contains the error number of the internal configuration function block.
0x8023	32803	1	Incorrect communication type (*eGENIbusComMode* input).
		2	Incorrect pointer assignment. One of the two addresses of the selected input/output variable (*stGENIbusInData*/ *stGENIbusOutData*) points to the address 0.
		3	Communication via an EtherCAT Terminal is selected. However, the EL6xxx terminal is not in the “OP state”.
		4	The EL6xxx terminal contains incorrect data. This is signaled by the fact that the input variable “WC State” is set to 1.
0x8024	32804	Sub-function-block error number	Error during the creation of the serial telegram. *udiErrorArg* contains the error number of the internal function block.
0x8025	32805	Sub-function-block error number	Error during the serial data transmission. *udiErrorArg* contains the error number of the internal function block.
0x8026	32806	Sub-function-block error number	Error during the evaluation of the serial telegram. *udiErrorArg* contains the error number of the internal function block.
0x8027	32807	n/a	Timeout error during the transmit-receive cycle.
0x8030	32816	n/a	Index error while transmitting the telegram.
0x8031	32817	n/a	Index error while receiving the telegram.
0x8032	32818	n/a	Incorrect data length while receiving the telegram.
0x8033	32819	n/a	Timeout error while receiving the telegram.
0x8040	32832	Incorrect OS	The response telegram contains an unknown “Operation Specifier” (OS), see *GENIbus Protocol Specification.*
0x8041	32833	n/a	Telegram length error.
0x8042	32834	n/a	Telegram CRC check error.
0x8045	32837	Maximum number of APDUs	Error during the conversion to a telegram: too many APDU entries. *udiErrorArg* shows the maximum possible number of APDU entries.
0x8049	32841	n/a	Invalid device (slave) address. Valid range: 1 - 200.
0x8050	32848	n/a	Incorrect class entry *byClass.*

ErrId (hex)	ErrId (dec)	ErrArg	Description
0x8051	32849	n/a	Incorrect entry *eCommandPriority.*
0x8052	32850	n/a	Incorrect entry *eSetOpMode.*
0x8053	32851	n/a	Incorrect entry *eSetCtrlMode.*
0x8054	32852	n/a	Incorrect entry *eSetNightReductionMode.*
0x8055	32853	n/a	Incorrect entry *eSetKeyMode.*
0x8056	32854	n/a	Command buffer overflow (*stCommandBuffer*): Not all previously transmitted commands have been processed.
0x8057	32855	n/a	Timeout error (runtime monitoring) with the response telegram.
0x8058	32856	n/a	The response telegram of the GENIbus device reports “Data Class Unknown”, see *GENIbus Protocol Specification*, feedback entry “*ACK*”.
0x8059	32857	n/a	The response telegram of the GENIbus device reports “Data Item ID Unknown”, see *GENIbus Protocol Specification*, feedback entry “*ACK*”.
0x805A	32858	n/a	The response telegram of the GENIbus device reports “Invalid command or Data Class write buffer is full”, see *GENIbus Protocol Specification*, feedback entry “*ACK*”.
0x805B	32859	n/a	Unknown ACK entry in response telegram.
0x805C	32860	transferred error number	The FB_GENIbusCommunication() function block has already detected an error and entered it in the response structure *stResponseTableItem*. *udiErrorArg* contains the error number of the FB_GENIbusCommunication() function block.
0x805D	32861	transferred error number	An internal error has occurred during the scaling. *udiErrorArg* contains the internal error number.
0x8060	32864	n/a	Data size (*eDataSize*) invalid.
0x8061	32865	n/a	Invalid Scale-Info parameter in the telegram (*eSIF*), see *GENIbus Protocol Specification*, feedback entry “SIF”.
0x8062	32866	n/a	Invalid combination of data size and Scale-Info.
0x8063	32867	n/a	No info data available.
0x8064	32868	n/a	The read-out unit index is not assigned to any unit, i.e. it doesn’t exist in the internal tables.

4.3 DUTs

4.3.1 Enums

4.3.1.1 E_GENIbusACK

ACK (Acknowledge-Code) from the response telegram.

```
TYPE E_GENIbusACK :
(
  eGENIbusACKOk            := 0,
  eGENIbusACKUnknownClass := 1,
  eGENIbusACKUnknownId    := 2,
  eGENIbusACKIllegalOp    := 3
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.2 E_GENIbusActCtrlMode

The read-out current control mode.

```
TYPE E_GENIbusActCtrlMode :
(
  eGENIbusActCtrlModeUnknown    := 0,
  eGENIbusActCtrlModeConstFreq  := 1,
  eGENIbusActCtrlModeConstPress := 2,
  eGENIbusActCtrlModePropPress  := 3,
  eGENIbusActCtrlModeAutoAdapt  := 4
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.3 E_GENIbusActOpMode

The read-out current operating mode.

```
TYPE E_GENIbusActOpMode :
(
  eGENIbusActOpModeUnknown := 0,
  eGENIbusActOpModeStop    := 1,
  eGENIbusActOpModeStart   := 2,
  eGENIbusActOpModeMin     := 3,
  eGENIbusActOpModeMax     := 4,
  eGENIbusActOpModeHand    := 5,
  eGENIbusActOpUserDef     := 6
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.4 E_GENIbusAddrType

Addressing type.

```
TYPE E_GENIbusAddrType :
(
  eGENIbusAddrTypeSingle    := 0,
  eGENIbusAddrTypeMulti     := 1,
  eGENIbusAddrTypeBroadcast := 2
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.5 E_GENIbusCommandPriority

Command priority.

```
TYPE E_GENIbusCommandPriority :
(
  eGENIbusCommandPriorityHigh   := 0,
  eGENIbusCommandPriorityMiddle := 1,
  eGENIbusCommandPriorityLow    := 2
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.6 E_GENIbusComMode

Selection of the serial communication interface.

```
TYPE E_GENIbusComMode :
(
  eGENIbusComMode_Unknown := 0,
  eGENIbusComMode_KL6_5B  := 1,
  eGENIbusComMode_KL6_22B := 2,
  eGENIbusComMode_EL6_22B := 3,
  eGENIbusComMode_PC_64B  := 4
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.7 E_GENIbusCtrlMode

Adjustable control modes.

```
TYPE E_GENIbusCtrlMode :
(
  eGENIbusCtrlModeUnknown    := 0,
  eGENIbusCtrlModeConstFreq  := 1,
  eGENIbusCtrlModeConstPress := 2,
  eGENIbusCtrlModePropPress  := 3,
  eGENIbusCtrlModeAutoAdapt  := 4
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.8 E_GENIbusKeyMode

Disablement of the parameterization option on the GENIbus device.

```
TYPE E_GENIbusKeyMode :
(
  eGENIbusKeyModeLocked   := 0,
  eGENIbusKeyModeUnlocked := 1
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.9 E_GENIBusMDataSize

Bit size of the value to be read from the GENIbus device.

```
TYPE E_GENIBusMDataSize :
(
  eGENIbusMSize8Bit  := 0,
  eGENIbusMSize16Bit := 1,
  eGENIbusMSize24Bit := 2,
  eGENIbusMSize32Bit := 3
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.10 E_GENIbusNightReductionMode

Night setback mode on/off.

```
TYPE E_GENIbusNightReductionMode :
(
  eGENIbusNightReductionModeOff := 0,
  eGENIbusNightReductionModeOn  := 1
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.11 E_GENIbusOpMode

Adjustable control modes.

```
TYPE E_GENIbusOpMode :
(
  eGENIbusOpModeUnknown := 0,
  eGENIbusOpModeStop    := 1,
  eGENIbusOpModeStart   := 2,
  eGENIbusOpModeMin     := 3,
  eGENIbusOpModeMax     := 4
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.12 E_GENIbusOS

OS (Operation-Specifier) in the command telegram.

```
TYPE E_GENIbusOS :
(
  eGENIbusGET  := 0,
  eGENIbusSET  := 1,
  eGENIbusINFO := 2
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.13 E_GENIbusSD

SD (Start Delimiter) in the command or response telegram.

```
TYPE E_GENIbusSD :
(
  eGENIbusNull         := 16#0,
  eGENIbusDatareply    := 16#24,
  eGENIbusDatamessage := 16#26,
  eGENIbusDatarequest := 16#27
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.1.14 E_GENIbusSIF

SIF (Scale Information Format) in the response telegram.

```
TYPE E_GENIbusSIF :
(
  eGENIbusNoScaleInfo    := 0,
  eGENIbusBitWiseScaled := 1,
  eGENIbusScaled816      := 2,
  eGENIbusScaledExt      := 3
);
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2 Structures

4.3.2.1 ST_GENIbusCommandBuffer

Global command buffer for commands and their responses.

```
TYPE ST_GENIbusCommandBuffer :
STRUCT
  arrMessageQueue   : ARRAY[0..2] OF ST_GENIbusMessageQueue;
  stResponseTable   : ST_GENIbusResponseTable;
  udiMessageHandle : UDINT;
END_STRUCT
END_TYPE
```

arrMessageQueue: input buffer for the commands (see ST_GENIbusMessageQueue [▸ 38]). Through the field declaration there is a choice of 3 different buffers: for high, medium and low priority.

stResponseTable: buffer for the command response (see ST_GENIbusResponseTable [▸ 42]).

udiMessageHandle: pointer to the current buffer element.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.2 ST_GENIbusComRegisterData

Register address and contents for the parameterization of terminals.

```
TYPE ST_GENIbusComRegisterData :
STRUCT
  byRegister : BYTE;
  wValue     : WORD;
END_STRUCT
END_TYPE
```

byRegister: register address.

wValue: register contents.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.3 ST_GENIbusEL6AMSAddress

Structure for linking in the input process image. The structure should be used for communication of an EL6xxx terminal.

```
TYPE ST_GENIbusEL6AMSAddress :
STRUCT
  arrNetId : ARRAY[0..5] OF USINT;
  uiPort   : UINT;
END_STRUCT
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.4 ST_GENIbusEL6DeviceIn22B

Structure for linking in the input process image. The structure must be used for communication of an EL6xxx terminal.

```
TYPE ST_GENIbusEL6DeviceIn22B :
STRUCT
  wStatus   : WORD;
  arrData   : ARRAY[0..21] OF BYTE;
  stAdsAddr : ST_GENIbusEL6AMSAddress;
  uiState   : UINT;
  bWcState  : BOOL;
END_STRUCT
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.5 ST_GENIbusEL6DeviceOut22B

Structure for linking in the output process image. The structure must be used for communication of an EL6xxx terminal.

```
TYPE ST_GENIbusEL6DeviceOut22B :
STRUCT
  wCtrl   : WORD;
  arrData : ARRAY[0..21] OF BYTE;
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.6 ST_GENIbusInData

Structure for linking the input image of the process variables. There is a choice of four different possible structures, of which finally only one is to be linked:

```
TYPE ST_GENIbusInData :
STRUCT
  stKL6DeviceIn5B   : ST_GENIbusKL6DeviceIn5B;
  stKL6DeviceIn22B  : ST_GENIbusKL6DeviceIn22B;
  stEL6DeviceIn22B  : ST_GENIbusEL6DeviceIn22B;
  stPcComDeviceIn   : ST_GENIbusPcComDeviceIn64B;
END_STRUCT
END_TYPE
```

stKL6DeviceIn5B: input process image of a 5-byte data terminal with standard communication bus, e.g. KL6021 (see ST_GENIbusKL6DeviceIn5B [▸ 37]).

stKL6DeviceIn22B: input process image of a 22-byte data terminal with standard communication bus, e.g. KL6041 (see ST_GENIbusKL6DeviceIn22B [▸ 37]).

stEL6DeviceIn22B: input process image of a 22-byte EtherCAT data terminal, e.g. EL6021 (see ST_GENIbusEL6DeviceIn22B [▸ 36]).

stPcComDeviceIn: input process image of a serial PC interface (see ST_GENIbusPcComDeviceIn64B [▸ 40]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.7 ST_GENIbusKL6DeviceIn22B

Structure for linking in the input process image. The structure must be used for communication of a KL6xxx terminal with 22-byte process image.

```
TYPE ST_GENIbusKL6DeviceIn22B :
STRUCT
  wStatus : WORD;
  arrData : ARRAY[0..21] OF BYTE;
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.8 ST_GENIbusKL6DeviceIn5B

Structure for linking in the input process image. The structure must be used for communication of a KL6xxx terminal with 5-byte process image.

```
TYPE ST_GENIbusKL6DeviceIn5B :
STRUCT
  byStatus : BYTE;
  arrData  : ARRAY[0..4] OF BYTE;
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.9 ST_GENIbusKL6DeviceOut22B

Structure for linking in the output process image. The structure must be used for communication of a KL6xxx terminal with 22-byte process image.

```
TYPE ST_GENIbusKL6DeviceOut22B :
STRUCT
  wCtrl    : WORD;
  arrData : ARRAY[0..21] OF BYTE;
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.10 ST_GENIbusKL6DeviceOut5B

Structure for linking in the output process image. The structure must be used for communication of a KL6xxx terminal with 5-byte process image.

```
TYPE ST_GENIbusKL6DeviceOut5B :
STRUCT
  byCtrl   : BYTE;
  arrData : ARRAY[0..4] OF BYTE;
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.11 ST_GENIbusMessageQueue

command buffer.

```
TYPE ST_GENIbusMessageQueue :
STRUCT
  arrBuffer                    : ARRAY[1..GENIBUS_COMMAND_BUFFER_ENTRIES] OF ST_GENIbusMessageQueueI
tem;
  byBufferReadPointer          : BYTE;
  byBufferWritePointer         : BYTE;
  byBufferDemandCounter        : BYTE;
  byBufferMaximumDemandCounter : BYTE;
  uiBufferOverflowCounter      : UINT;
  bLockSemaphore               : BOOL;
END_STRUCT
END_TYPE
```

arrBuffer: command buffer (see ST_GENIbusMessageQueueItem [▶ 39]).

byBufferReadPointer: pointer to the current buffer element of the command buffer.

byBufferWritePointer: pointer to the current buffer element of the receive memory.

byBufferDemandCounter: current buffer demand.

byBufferMaximumDemandCounter: maximum buffer demand.

uiBufferOverflowCounter: number of buffer overflows.

bLockSemaphore: write protection during the processing of a command.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.12 ST_GENIbusMessageQueueItem

Individual element in the command buffer.

```
TYPE ST_GENIbusMessageQueueItem :
STRUCT
  byAddr           : BYTE;
  eAddrType        : E_GENIbusAddrType;
  eSD              : E_GENIbusSD;
  arrAPDUs         : ARRAY[1..GENIBUS_MAX_APDU_NUMBER] OF ST_GENIbusRequestClassEntry;
  byRFS            : BYTE;
  udiMessageHandle : UDINT;
END_STRUCT
END_TYPE
```

byAddr: device destination address.

eAddrType: single, multiple or collective command (see E_GENIbusAddrType [▸ 32]).

eSD: start delimiter of the telegram (see E_GENIbusSD [▸ 34]).

arrAPDUs: collection of the APDUs (Application Program Data Units) to be transmitted (see ST_GENIbusRequestClassEntry [▸ 42]).

byRFS: not yet used: "Request from Slave".

udiMessageHandle: pointer to the current buffer element.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.13 ST_GENIbusMValue

Structure with the contents of a read device value, e.g. flow rate or speed.

```
TYPE ST_GENIbusMValue :
STRUCT
  lrValue       : LREAL;
  lrPrefix      : LREAL;
  sUnit         : STRING(8);
  eDataSize     : E_GENIBusMDataSize;
  byValueH      : BYTE;
  byValueL1     : BYTE;
  byValueL2     : BYTE;
  byValueL3     : BYTE;
  byInfoHead    : BYTE;
  byUnitIndex   : BYTE;
  byZeroH       : BYTE;
  byRangeZeroL  : BYTE;
END_STRUCT
END_TYPE
```

lrValue: final value determined from the raw data.

lrPrefix: sign and division (+/- and e.g. 0.1).

sUnit: Unit.

eDataSize: size of the measured value (8, 16, 24 or 32 bytes) (see E_GENIBusMDataSize [▸ 33]).

byValueH: high byte of the measured value.

byValueL1: low byte.

byValueL2: low byte.

byValueL3: low byte.

byInfoHead: scaling information

byUnitIndex: sign and unit – coded.

byZeroH: zero point in the case of normal range zero-point scaling OR high-byte zero point in the case of extended scaling.

byRangeZeroL: range in the case of normal range zero-point scaling OR low-byte zero point in the case of extended scaling.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.14 ST_GENIbusOutData

Structure for linking the output image of the process variables. There is a choice of four different possible structures, of which finally only one is to be linked:

```
TYPE ST_GENIbusOutData :
STRUCT
  stKL6DeviceOut5B   : ST_GENIbusKL6DeviceOut5B;
  stKL6DeviceOut22B  : ST_GENIbusKL6DeviceOut22B;
  stEL6DeviceOut22B  : ST_GENIbusEL6DeviceOut22B;
  stPcComDeviceOut   : ST_GENIbusPcComDeviceOut64B;
END_STRUCT
END_TYPE
```

stKL6DeviceOut5B: output process image of a 5-byte data terminal with standard communication bus, e.g. KL6021 (see ST_GENIbusKL6DeviceOut5B [▶ 38]).

stKL6DeviceOut22B: output process image of a 22-byte data terminal with standard communication bus, e.g. KL6041 (see ST_GENIbusKL6DeviceOut22B [▶ 38]).

stEL6DeviceOut22B: output process image of a 22-byte EtherCAT data terminal, e.g. EL6021 (see ST_GENIbusEL6DeviceOut22B [▶ 36]).

stPcComDeviceOut: output process image of a serial PC interface (see ST_GENIbusPcComDeviceOut64B [▶ 40]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.15 ST_GENIbusPcComDeviceIn64B

Structure for linking in the input process image. The structure must be used for communication of a serial PC interface.

```
TYPE ST_GENIbusPcComDeviceIn64B :
STRUCT
  wStatus : WORD;
  arrData : ARRAY[0..63] OF BYTE;
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.16 ST_GENIbusPcComDeviceOut64B

Structure for linking in the input process image. The structure must be used for communication of a serial PC interface.

```
TYPE ST_GENIbusPcComDeviceOut64B :
STRUCT
  wCtrl    : WORD;
  arrData : ARRAY[0..63] OF BYTE;
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.17 ST_GENIbusReplyClassEntry

Response structure containing the data of a response APDU for processing within the library.

```
TYPE ST_GENIbusReplyClassEntry :
STRUCT
  byClass       : BYTE;
  eACK          : E_GENIbusACK;
  eOS           : E_GENIbusOS;
  iEntryCount   : INT;
  arrEntry      : ARRAY[0..GENIBUS_MAX_APDU_LENGTH] OF ST_GENIbusReplyDataEntry;
  sASCIIString : STRING(64);
END_STRUCT
END_TYPE
```

byClass: data class.

eACK: acknowledgement of the GENIbus device (see E_GENIbusACK [▶ 31]).

eOS: operation display (GET/SET/INFO) (see E_GENIbusOS [▶ 34]).

iEntryCount: number of data points (ID codes) used within the APDU.

arrEntry: contents of the data points (ID codes) (see ST_GENIbusReplyDataEntry [▶ 41]).

sASCIIString: string evaluation for data class 7.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.18 ST_GENIbusReplyDataEntry

Contents of an element of a response APDU: value and information.

```
TYPE ST_GENIbusReplyDataEntry :
STRUCT
  byValue       : BYTE;
  byInfoHead    : BYTE;
  byUnitIndex   : BYTE;
  byZeroH       : BYTE;
  byRangeZeroL : BYTE;
END_STRUCT
END_TYPE
```

byValue: raw value.

byInfoHead: information head containing among other things the scaling information.

byUnitIndex: sign and unit code.

byZeroH: zero point in the case of normal range zero-point scaling OR high-byte zero point in the case of extended scaling.

byRangeZeroL: range in the case of normal range zero-point scaling OR low-byte zero point in the case of extended scaling.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.19 ST_GENIbusRequestClassEntry

Command or query structure containing the data of a request APDU for processing within the library.

```
TYPE ST_GENIbusRequestClassEntry :
STRUCT
  byClass      : BYTE;
  eOS          : E_GENIbusOS;
  byEntryCount : BYTE;
  arrEntry     : ARRAY[0..GENIBUS_MAX_APDU_LENGTH] OF ST_GENIbusRequestDataEntry;
END_STRUCT
END_TYPE
```

byClass: data class.

eOS: operation display (GET/SET/INFO) (see E_GENIbusOS [▸ 34]).

byEntryCount: number of data points (ID codes) used within the APDU.

arrEntry: field with addresses of the data points (ID codes) and, if applicable, the values to be written (see ST_GENIbusRequestDataEntry [▸ 42]).

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.20 ST_GENIbusRequestDataEntry

Address and, if applicable, the value to be written within a request APDU.

```
TYPE ST_GENIbusRequestDataEntry :
STRUCT
  byIDCode : BYTE;
  byValue  : BYTE;
END_STRUCT
END_TYPE
```

byIDCode: address.

byValue: value to be written.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.21 ST_GENIbusResponseTable

Response buffer.

```
TYPE ST_GENIbusResponseTable :
STRUCT
  arrResponseTableItem           : ARRAY[1..GENIBUS_COMMAND_BUFFER_ENTRIES] OF ST_GENIbusResponseTab
leItem;
  byResponseTableCounter         : BYTE;
  byResponseTableMaxCounter      : BYTE;
  uiResponseTableOverflowCounter : UINT;
  bLockSemaphore                 : BOOL;
END_STRUCT
END_TYPE
```

arrResponseTableItem: Response buffer (see ST_GENIbusResponseTableItem [▸ 43]).

byResponseTableCounter: current buffer demand.

byResponseTableMaxCounter: maximum buffer demand.

uiResponseTableOverflowCounter: number of buffer overflows.

bLockSemaphore: write protection during the processing of a command.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.22 ST_GENIbusResponseTableItem

Individual element in the response buffer.

```
TYPE ST_GENIbusResponseTableItem :
STRUCT
  byAddr           : BYTE;
  byLength         : BYTE;
  eSD              : E_GENIbusSD;
  arrAPDUs         : ARRAY[1..GENIBUS_MAX_APDU_NUMBER] OF ST_GENIbusReplyClassEntry;
  byRFS            : BYTE;
  udiMessageHandle : UDINT;
  udiErrorId       : UDINT;
END_STRUCT
END_TYPE
```

byAddr: device destination address.

eAddrType: single, multiple or collective command.

eSD: start delimiter of the telegram (see E_GENIbusSD [▸ 34]).

arrAPDUs: collection of the APDUs (Application Program Data Units) to be transmitted (see ST_GENIbusReplyClassEntry [▸ 41]).

byRFS: not yet used: "Request from Slave".

udiMessageHandle: pointer to the current buffer element.

udiErrorId: If an error has occurred in the FB_GENIbusCommunication() function block, the corresponding error code will be saved here for further evaluation.

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

4.3.2.23 ST_GENIbusSerComBuffer

Serial communication buffer – for transmission and reception alike.

```
TYPE ST_GENIbusSerComBuffer :
STRUCT
  arrBuffer     : ARRAY[0..GENIBUS_MAX_TELEGRAM_LENGTH] OF BYTE;
  uiDataLength  : UINT;
  bBlocked      : BOOL;
END_STRUCT
END_TYPE
```

Requirements

Development environment	required TC3 PLC library
TwinCAT from v3.1.4020.14	Tc2_GENIbus from v3.3.0.0

5 Appendix

5.1 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.

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: https://www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Beckhoff Support

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline:	+49 5246 963 157
Fax:	+49 5246 963 9157
e-mail:	support@beckhoff.com

Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

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