

TwinCAT - Overview

This protocol enables the Supervisor to communicate with TwinCAT PLCs over an Ethernet TCP/IP network.

Architecture

The Beckhoff software for the TwinCAT (The Windows Control and Automation Technology) system turns any compatible PC into a real-time controller with a multi-PLC system, Numerical Control (NC) axis control, programming environment and operating station. TwinCAT replaces conventional PLC and NC/CNC controllers as well as operating devices.

The TwinCAT software devices can be distributed since TwinCAT PLC programs can run on PCs or on Beckhoff Bus Terminal Controllers. The TwinCAT protocol enables connection to any TwinCAT system whether local or distributed over a TCP/IP network. It uses the AMS Router (message router) provided by Beckhoff to manage and distribute all of the messages, both within the system and via TCP/IP connections.

In a distributed architecture, all communication is run over the standard Ethernet network interface of a PC.

Beckhoff AMS Router

The message router has to be installed on the system that is running the Supervisor. It comes free of charge with any TwinCAT software pack. The earliest version to use is 2.9.

If you do not need a TwinCAT system, install TwinCAT-CP instead. Once the installation is done you should see the following icon on your Windows Toolbar: .

AMS router configuration

In a distributed configuration, each PC on the network has to have a unique AMS Net Id. To allow two PCs to communicate you need to add the AMS router definition on the remote PC as follows.

1. Right-click on the TwinCAT icon and select Properties to open the TwinCAT System Properties dialog. [Show picture](#)
2. Select the AMS Router tab. [Show picture](#)
3. Enter the AMS Net Id of your PC in the Local computer field.
4. Select Add to open the Add Remote Connection dialog and then enter the parameter for the remote computer. [Show picture](#)
5. Repeat the previous step for each PC that will be communicating.
6. Apply the same steps on the remote computer.

AMS Router start-up

The message router needs to be started for the communication to work. You can do so either manually or automatically.

- Manually: in the TwinCAT icon's context menu, select System.Start. [Show picture](#)
- Automatically: in the System Properties dialog, select Properties, select the System Tab and then select Enable. [Show picture](#)

Configuration files

You may need to edit these configuration files manually as specified in the other topics of this Help book.

- COMM.DAT
- TwinCAT Variable Definition file
- VAREXP.DAT,

TwinCAT - Network Configuration

1. Open the Select Communication Objects dialog.
2. In the Network column, double-click on an existing network name or on *CREATION* to open the dialog Network Board and Protocol Selection.
3. Select the following values.
Network board - MULTI-PROTOCOL
Protocol - TWINCAT.
4. Click on OK to open the Network Parameter dialog. In the drop-down field for Network Name, enter the name by which the network will be known within the Supervisor's configuration.
5. Apply or confirm the following settings. [Show picture](#)

Property	Settings
Comment	A description of the network. Optional.
Time out	The time-out period for response.
Activate on start-up	Tick to enable the network to start when the Communication Manager starts.
	The network can also be started by SCADA BASIC program using the CIMWAY verb.

6. Click on the Validate button to register the settings, then close the dialogs.

TwinCAT - Node Configuration

1. Select the menu Configure.Communication.Equipment to open the Select Communication Objects dialog.
2. In the Network column, select the TwinCAT network previously configured.
3. In the Node column, double-click on *CREATION* to open the Node Parameters dialog.
4. Apply or confirm the following settings. [Show picture](#)

Property	Meaning
Equipment	Enter a name for the node within the Supervisor.
Characteristics	
Equipment Type	Not used - leave the default value
Message timeout	Always set to 0.
Node	
AMS Net Id	See below.
Port number	See below.
Operating mode	
Node timeout	Maximum waiting time between a request and the reply from the equipment.
Activate on start-up	Tick to enable starting of the equipment when the network is started.
	The equipment can also be started by SCADA BASIC program using the CIMWAY verb.

4. Click on the Validate button to register the settings, then close the dialogs.

AMS Net Id

Enter the six digit AMS ID for the remote PC. For example:

192 168 0 12 1 1

Port

By default, the driver will access the PLC port of the remote PC. If you wish to specify another port you change the port property as follows.

Port	Value
Port for PLC	801
Port for PLC (Runtime system 2)	811
Port for PLC (Runtime system 3)	821
Port for PLC (Runtime system 4)	831
Port for logger	100
Port for IO	300
Port for SPS	400
Port for NC	500
Port for ISG	550
Port for PCS	600

TwinCAT - Frame Configuration

1. In the menu, select Configure.Communication.Equipment to open the Select Communication Objects dialog.
2. Select the Network and Node names for TwinCAT.
3. In the Frame column, double-click on *CREATION* to open the Frame Parameters dialog.
4. Apply or confirm the following settings. [Show picture](#)

Property	Meaning
Frame	Name for the frame within the Supervisor.
Frame format	The frame format is not used other than being taken into account in the frame size calculation. See the topic on Address Selection .
Access grant	Specify whether the frame is read only, write only or read/write.
Address	Used to determine the frame size in conjunction with the <u>Frame Format</u> property. See the topic on Address Selection .
Operating mode	Meaning
Priority mode	In a queue of write requests, the priority frame is processed first.
Cyclic access	Tick this to enable a frame to be periodically scanned. For a Write Only frame this MUST be unselected.
Scan rate	The rate at which the frame is to be polled.

4. Click on the Validate button to register the settings, then close the dialog.

TwinCAT - Address Selection and Variable Mapping

Defining the variables

The TwinCAT variable definition for a frame is specified in an ASCII formatted file. The file must be located in the C folder of the project. Its name is made up of the network name, node (equipment) name and frame name.

For example if you have a network called NET, a node called EQT and a frame called T1, the file name is NET_EQT_T1.DAT.

The format of the file's content is

Variable Name,Size

where

- *Variable Name* is the name of the variable in the TwinCAT program.
- *Size* is the size of the variable in bytes.

For example, the content of a file named NET_EQT_T1.DAT is:

MAIN.MYWORD1,2

MAIN.MYWORD2,2

MAIN.MYBIT1,1

MAIN.MYBIT2,1

MAIN.MYBIT3,1

MAIN.MYBIT4,1

MAIN.MYFLOAT,4

MAIN.MYDOUBLE,4

The order in which the TwinCAT variables are listed is significant as that is the sequence used for mapping the Supervisor's variable onto the frame.

Address selection

The start address of the frames and the data type are not used by the drive; only the size is important. The quantity of data must correspond to the total size of all of the variables you wish to access. For the example above the total size is 16 (2+2+1+1+1+1+4+4), so the size of T1 must be 16 bytes = 8 words.

Variable link

Since the variables you wish to access in the TwinCAT program may be of various kinds, the variable mapping needs to be done manually in the configuration file VAREXP.DAT which is stored in the C folder of the Supervisor's project. [Show table](#)

For example the file NET_EQT_T1.DAT might contain the following.

CTV,57,PLC1,FLOW1,,,,, "" , "" ,,,,,,E,...,1,NET,EQT,T1,U,0,0,16,...

CTV,58,PLC1,FLOW2,,,,, "" , "" ,,,,,,E,...,1,NET,EQT,T1,U,2,0,16,...

CMD,53,PLC1,CMD1,,,,, "" , "" ,,,,,,E,...,1,NET,EQT,T1,B,4,0,1,...

CMD,54,PLC1,OPEN1,,,,, "" , "" ,,,,,,E,...,1,NET,EQT,T1,B,5,0,1,...

CMD,55,PLC1,CMD2,,,,, "" , "" ,,,,,,E,...,1,NET,EQT,T1,B,6,0,1,...

CMD,56,PLC1,OPEN2,,,,, "" , "" ,,,,,,E,...,1,NET,EQT,T1,B,7,0,1,...

CTV,60,PLC1,SP1,,,,, "" , "" ,,,,,,E,...,1,NET,EQT,T1,F,8,0,32,...

CTV,59,PLC1,CPT,,,,, "" , "" ,,,,,,E,...,1,NET,EQT,T1,L,12,0,32,...



The name of the Variables Tree variable does not need to match the name given in the TwinCAT Variable Definition file. It is the byte offset that identifies each variable.

In the example above:

PLC1.FLOW1 corresponds to the TwinCAT variable MAIN.MYWORD1

PLC1.FLOW2 corresponds to the TwinCAT variable MAIN.MYWORD2

PLC1.CMD1 corresponds to the TwinCAT variable MAIN.MYBIT1 etc.



The Word variable byte offset MUST be a multiple of 2.



Double and Float variable byte offsets MUST be a multiple of 4.

There is no restriction for Bit and Text variables.

TwinCAT Limits

Version of the target ADS device

In the communication, ADS is the transport layer but the requested TwinCAT device has to support the ADS commands. These are supported by TwinCAT PLCs with version numbers from 2.7 B511, from 2.8 B718 and 2.9 ff all)

Number of TwinCAT variables per frame

The PLC processes each request before it starts the next PLC cycle. For example a request with 200,000 TwinCAT variables would cause the PLC to collect and copy 200,000 variables into a single ADS response before starting with next PLC. Such a large number of ADS sub-commands would disrupt the running of the PLCs.



We highly recommend that you do not specify more than 500 TwinCAT variables per frame.

Frame size

The size of the WORD frame defined in the Supervisor must be greater than or equal to twice the total size of all of the variables defined in the Variable Definition file.



Failure to do so will prevent you linking all the variable you wish to access.

TwinCAT - Protocol Error Codes

The TwinCAT protocol's error codes are as follows.

Common error codes

Code	Description
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0x0007	Equipment (Remote computer) not configured in the AMS Router.
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0x0012	AMS Router not started.
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0x1000	Cannot open the Variable Definition file. Please check that its name is that of a valid frame name
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0x1001	Error in allocating the driver's buffer memory
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0x1002	No variable found in the Write request.
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0x1003 The total size of the TwinCAT variable definition exceeds 2,097,152 bytes.



Each variable has an additional 4 bytes for error handling.

0x2751 TCP/IP cable disconnected

0x3yyy Variable not found in the equipment.

xxx is the index (in hexadecimal) of the variable in TwinCAT Variable Definition file.

0x6yyy Size of variable mismatched.

yyy is the index (in hexadecimal) of the variable in the TwinCAT Variable Definition file.

0x6000 Write request error

The size of one of the variables written via the variable link differs from the size specified in the TwinCAT Variable Definition file.



Write each variable in turn to find out which one is faulty.

Less usual error codes

[▣ Show table](#)